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Monitoring
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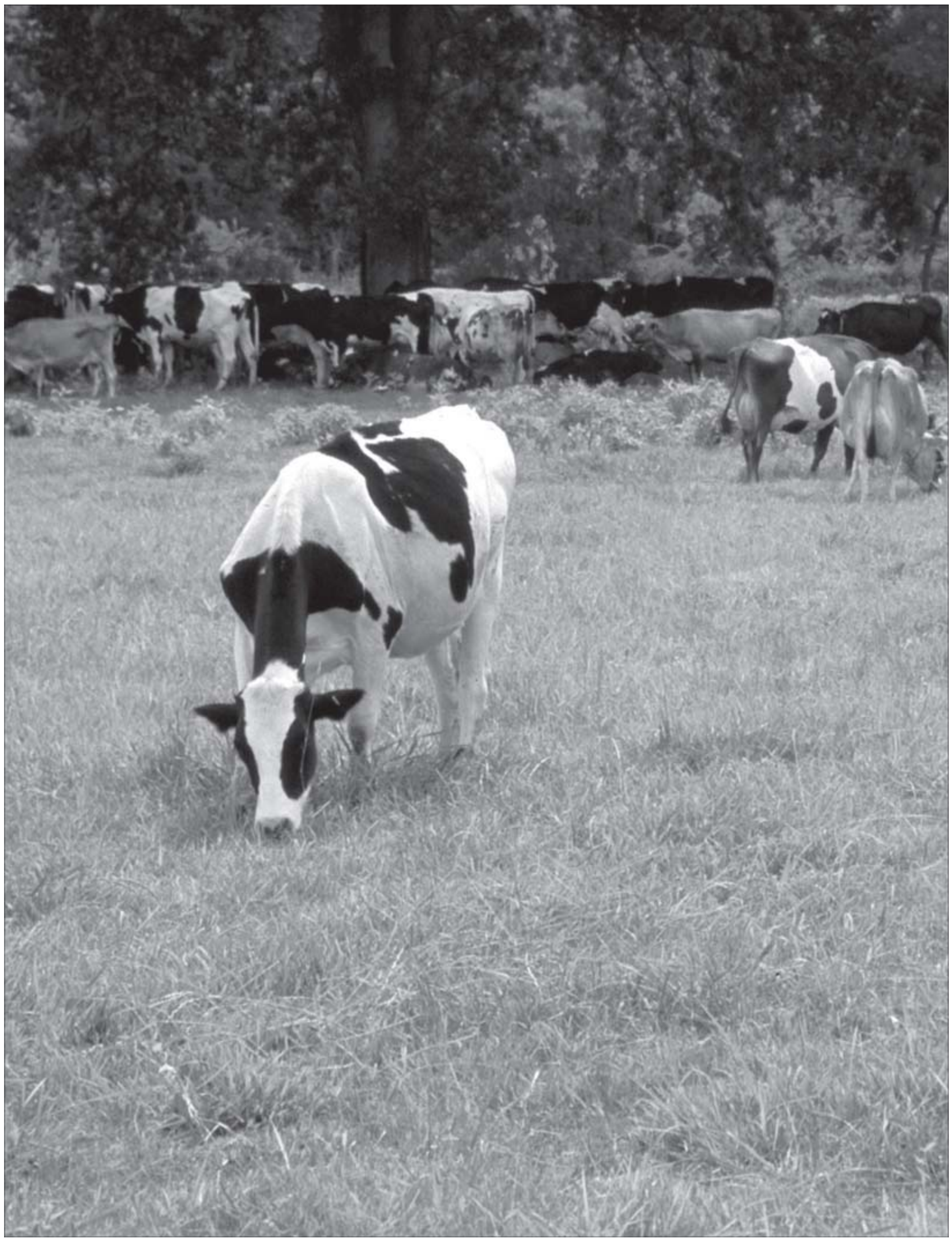
Dairy 2007

Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007



USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

#N480.1007

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- University of Wisconsin, Madison
- Wisconsin Veterinary Diagnostic Laboratory

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Larry M. Granger
Director
Centers for Epidemiology and Animal Health

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Contacts for further information:

Questions or comments on data analysis: Dr. Jason Lombard (970) 494-7000
Information on reprints or other reports: Ms. Kathy Snover (970) 494-7000
E-mail: NAHMS@aphis.usda.gov

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Terms Used In This Report

Bovine viral diarrhea–persistent infection (BVD–PI): Cattle infected with BVD in utero. These animals continuously shed large quantities of the virus via nasal discharge, saliva, semen, urine, feces, tears, and milk, thereby serving as a source of persistently–infected (PI) cattle.

Cow: Female dairy bovine that has calved at least once.

Cow average: The average value for all cows (milking and dry); the reported value for each operation multiplied by the number of cows on that operation is summed over all operations and divided by the number of cows on all operations. This way, results are adjusted for the number of cows on each operation. For instance, on p. 21, the rolling herd average milk production (lb/cow) is multiplied by the number of cows for each operation. This product is then summed over all operations and divided by the sum of cows over all operations. The result is the average milk production for all cows.

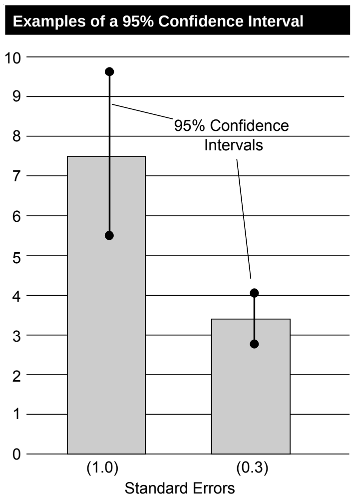
Dairy Herd Improvement Association (DHIA): An organization with programs and objectives intended to improve the production and profitability of dairy farming. DHIA also aids farmers in keeping milk production and management records.

Heifer: Female dairy bovine that has not yet calved.

Herd size: Herd size is based on January 1, 2007, cow inventory. Small herds are those with fewer than 100 cows; medium herds are those with 100 to 499 cows; and large herds are those with 500 or more cows.

Operation: Premises with at least one dairy cow on January 1, 2007.

Operation average: The average value for all operations; a single value for each operation is summed over all operations reporting divided by the number of operations reporting. For example, operation average age of heifers at first calving (shown on p. 23) is calculated by summing reported average age over all operations divided by the number of operations.



Population estimates: Estimates in this report are provided with a measure of precision called the standard error. A 95-percent confidence interval can be created with bounds equal to the estimate, plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean 95 out of 100 times. In the example to the left, an estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). The second estimate of 3.4 shows a standard error of 0.3 and results in limits of 2.8 and 4.0. Alternatively, the 90-percent confidence interval would be created by multiplying the standard error by 1.65 instead of 2. Most estimates in this report are rounded to the nearest tenth. If rounded to 0, the standard error was reported (0.0). If there were no reports of the event, no standard error was reported (—).

Sample profile: Information that describes characteristics of the operations from which Dairy 2007 data were collected.

Regions:
West: California, Idaho, New Mexico, Texas, and Washington
East: Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

Rolling Herd Average (RHA): Average milk production per cow (lb/cow) in the herd during the previous 12 months.

The West region had a higher percentage of conventional operations than the East region (72.4 and 63.2 percent, respectively). Conversely, the East region had a higher percentage of combination operations than the West region (32.4 and 15.8 percent, respectively). The percentages of grazing and organic operations were similar in the West and East regions.

c. Percentage of operations by operation type and by region:

	Percent Operations			
	Region			
	West		East	
Operation Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Conventional	72.4	(2.9)	63.2	(1.4)
Grazing	8.0	(2.4)	2.7	(0.6)
Combination	15.8	(2.0)	32.4	(1.4)
Organic	3.8	(1.3)	1.5	(0.4)
Other	0.0	(0.0)	0.2	(0.1)
Total	100.0		100.0	

Conventional operations and the cows on these operations had the highest RHA milk production (20,253 and 22,182 lb/cow, respectively). RHA milk production was similar for grazing, organic, and other operations.

d. Operation average (and cow average) RHA milk production (lb/cow), by operation type:

	RHA Milk Production			
Operation Type	**Operation Average** (lb/cow)	**Standard Error**	**Cow Average** (lb/cow)	**Standard Error**
Conventional	20,253	(135)	22,182	(126)
Grazing	15,146	(608)	15,903	(457)
Combination	17,587	(213)	18,696	(217)
Organic	15,266	(714)	16,369	(728)
All*	19,175	(112)	21,483	(115)

* “Other” operation types included in “all” operation types.

2. Record-keeping systems

Dairy record-keeping systems are commonly used to track milk production, reproduction, and the health of cows. The use of hand-written records decreased as herd size increased, while the use of on-farm computer records increased as herd size increased. The highest percentage of small and medium operations (77.9 and 67.2 percent, respectively) used hand-written records, while the highest percentage of large operations (82.7 percent) used on-farm computer records. Almost all operations (95.1 percent) had some form of record-keeping system to track individual animals. Operations could have used more than one system. The majority of operations (73.5 percent) used hand-written records to track animals, while almost half (45.9 percent) used the Dairy Herd Improvement Association (DHIA) record-keeping system. Although only 19.4 percent of operations used on-farm computer record-keeping systems, 56.9 percent of cows were on these operations.

a. Percentage of operations by type of individual animal record-keeping systems used for the operation, by herd size:

	Percent Operations							
	Herd Size (Number of Dairy Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
System	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Hand written, such as a ledger or notebook	77.9	(1.5)	67.2	(2.1)	38.1	(2.8)	73.5	(1.2)
DHIA	42.4	(1.7)	56.5	(2.3)	50.5	(2.9)	45.9	(1.4)
Off-farm computer record system other than DHIA	2.7	(0.5)	10.9	(1.4)	10.0	(1.5)	4.9	(0.5)
On-farm computer record system	9.3	(1.0)	37.8	(2.2)	82.7	(2.1)	19.4	(0.9)
Other system	4.0	(0.7)	5.9	(1.2)	3.2	(1.0)	4.4	(0.6)
Any record-keeping system	94.2	(0.9)	97.0	(0.9)	99.8	(0.1)	95.1	(0.7)

b. Percentage of cows by type of individual animal record-keeping systems used for the operation:

System	Percent Cows	Standard Error
Hand written, such as a ledger or notebook	54.0	(1.5)
DHIA	48.7	(1.5)
Off-farm computer record system other than DHIA	9.0	(0.9)
On-farm computer record system	56.9	(1.2)
Other system	4.0	(0.6)
Any record-keeping system	98.4	(0.2)

For operations using on- or off-farm computer data record systems, 34.9 percent used Dairy Comp 305 as their primary system, accounting for 60.3 percent of cows. “Other” computer programs were used on 30.8 percent of operations but accounted for only 13.6 percent of cows. Dairy Quest and Dairy Plan were the most common other computer programs.

c. For operations using on- or off-farm computer data record systems, percentage of operations (and percentage of cows on these operations) by primary computer record system used:

Primary System	Percent Operations	Standard Error	Percent Cows	Standard Error
Dairy Comp 305	34.9	(2.3)	60.3	(2.0)
PC Dart	19.3	(1.9)	10.2	(0.9)
DHI Plus	15.0	(1.7)	15.9	(1.7)
Other	30.8	(2.4)	13.6	(1.3)
Total	100.0		100.0	

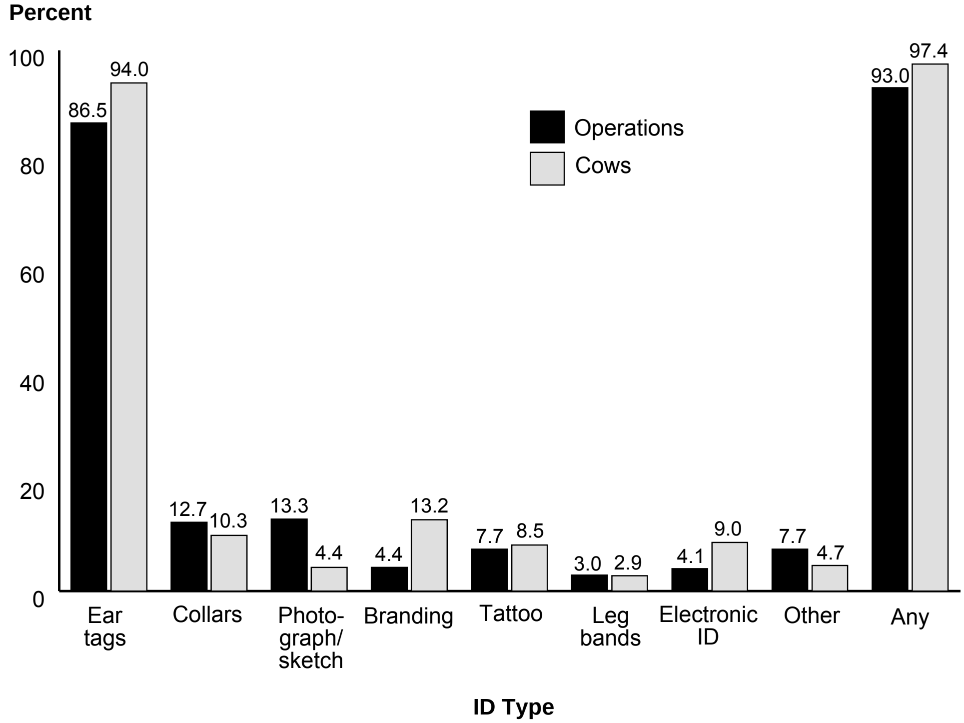
3. Individual animal identification

Individual animal identification (ID) is crucial for managing the health and performance of cattle. Approximately 9 of 10 operations (93.0 percent) used some form of individual animal ID, and almost all cows (97.4 percent) had some form of individual animal ID. Most operations (86.5 percent) used ear tags on cows as a form of individual ID, and most cows (94.0 percent) had individual ear tags. Branding as a type of individual ID was used on only 4.4 percent of operations: however, 13.2 percent of cows were branded, suggesting that branding was more common on larger operations. Various methods of electronic ID were used on 4.1 percent of operations, accounting for 9.0 percent of cows.

a. Percentage of operations (and percentage of cows), by type of individual animal ID used on at least some cows:

ID Type	Percent Operations	Standard Error	Percent Cows	Standard Error
Ear tags (all kinds)	86.5	(1.0)	94.0	(0.5)
Collars	12.7	(0.9)	10.3	(0.9)
Photograph or sketch	13.3	(1.0)	4.4	(0.4)
Branding (all methods)	4.4	(0.5)	13.2	(1.1)
Tattoo (other than tattoo for brucellosis)	7.7	(0.6)	8.5	(0.9)
Leg bands	3.0	(0.4)	2.9	(0.5)
Electronic (pedometers, bar code, RFD, etc.)	4.1	(0.5)	9.0	(0.9)
Other	7.7	(0.8)	4.7	(0.6)
Any identification	93.0	(0.8)	97.4	(0.4)

Percentage of Operations (and Percentage of Cows) by Type of Individual Animal ID Used on at Least Some Cows



On operations that used individual animal ID, evaluating milk production and evaluating genetic improvements were the two most common primary reasons for using ID (38.1 and 30.4 percent of operations, respectively). Approximately 2 of 10 operations (21.1 percent) listed “other” as a primary reason, with many of these operations noting that all choices given were primary reasons for using individual animal ID.

b. For operations that used individual animal ID, percentage of operations by primary reason ID was used:

Primary Reason	Percent Operations	Standard Error
Evaluating milk production	38.1	(1.4)
Evaluating animal health	8.8	(0.8)
Disease or residue traceback	1.6	(0.4)
Evaluating genetic improvements	30.4	(1.4)
Other	21.1	(1.2)
Total	100.0	

4. Herd identification

More than one-third of operations (36.4 percent)—representing 54.0 percent of cows—used some form of unique herd ID. The highest percentage of operations (34.5 percent) used ear tags for herd ID, and the highest percentage of cows (41.0 percent) had ear tags as a form of herd ID. Branding as a type of herd ID was used on 3.1 percent of operations and 18.7 percent of cows.

Percentage of operations (and percentage of cows) by type of ***herd*** identification used on at least some cows:

ID Type	Percent Operations	Standard Error	Percent Cows	Standard Error
Ear tags (all kinds)	34.5	(1.3)	41.0	(1.5)
Collars	2.8	(0.4)	2.9	(0.5)
Branding (all methods)	3.1	(0.3)	18.7	(1.4)
Tattoo (other than tattoo for brucellosis)	2.5	(0.4)	4.6	(0.8)
Electronic (pedometers, bar code, RFD, etc.)	1.8	(0.3)	3.9	(0.6)
Other	2.0	(0.4)	1.7	(0.4)
Any identification	36.4	(1.3)	54.0	(1.5)

5. National Animal Identification System (NAIS) and U.S. Animal Identification Number (AIN)

NAIS is a voluntary program that facilitates the collection of information about all livestock operations, regardless of livestock species. This information is stored in a database for use during animal disease events. NAIS is designed to allow animal tracking during disease outbreaks so that sick or exposed animals can be located quickly to help contain the disease. Although the program was designed by USDA, each State is responsible for its implementation. A unique premises ID is assigned by each State's Department of Agriculture to all operations enrolled in NAIS.

Almost half of operations (46.7 percent) had a unique premises ID. A lower percentage of large operations (32.8 percent) had a unique premises ID compared to medium and small operations (48.3 and 47.2 percent, respectively).

a. Percentage of operations with a unique premises ID assigned by their State Department of Agriculture as part of NAIS, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
47.2	(1.5)	48.3	(2.1)	32.8	(2.5)	46.7	(1.1)

A lower percentage of operations in the West region (16.5 percent) had a unique premises ID compared to operations in the East region (49.1 percent).

b. Percentage of operations with a unique premises ID assigned by their State Department of Agriculture as part of NAIS, by region:

Percent Operations			
Region			
West		**East**	
Percent	**Standard Error**	**Percent**	**Standard Error**
16.5	(1.8)	49.1	(1.2)

Operations enrolled in NAIS cannot obtain individual animal identification without a unique premises ID. Once a premises ID is obtained, an operation has the option of obtaining officially recognized individual animal ID, as outlined in AIN guidelines. Only 7.8 percent of all operations had implemented individual animal ID. A higher percentage of large operations (12.5 percent) implemented an individual animal ID system or technology utilizing AIN guidelines compared to small operations (7.0 percent).

c. Percentage of operations that had implemented an individual animal ID system or technology that utilizes AIN guidelines, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
7.0	(0.9)	9.6	(1.3)	12.5	(1.8)	7.8	(0.7)

Photo by Dr. Jason Lombard

For operations assigned a unique premises ID, 16.8 percent had implemented individual animal ID. A higher percentage of large operations (38.2 percent) with a unique premises ID had implemented an individual animal ID system utilizing AIN guidelines compared to small operations (14.8 percent).

d. For operations that had a unique premises ID assigned, percentage of operations that had implemented an individual animal ID system that utilizes AIN guidelines, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
14.8	(1.8)	19.8	(2.6)	38.2	(4.9)	16.8	(1.5)

6. Breed of cows

Holsteins continue to be the predominant dairy breed in the United States. Approximately 95 percent of operations housed at least one Holstein cow, and Holsteins represented 90.1 percent of all cows. Although 18.1 percent of operations reported having Jerseys on-hand, only 5.3 percent of all cows were Jerseys. “Other” breeds, which generally included cross-breed cattle, were reported on 21.4 percent of operations.

a. Percentage of operations (and percentage of cows) by breed:

Breed	Percent Operations	Standard Error	Percent Cows	Standard Error
Holstein	95.1	(0.6)	90.1	(0.7)
Jersey	18.1	(1.1)	5.3	(0.6)
Ayrshire	3.4	(0.5)	0.3	(0.1)
Brown Swiss	7.6	(0.7)	0.6	(0.1)
Guernsey	3.0	(0.5)	0.4	(0.1)
Other	21.4	(1.2)	3.3	(0.4)
Total			100.0	

Primary breed for each operation was defined as the most prevalent dairy breed reported on the January 1, 2007, cattle inventory. Holsteins were the primary dairy breed on more than 9 of 10 operations (92.2 percent) operations.

b. Percentage of operations by primary breed:

Breed	Percent Operations	Standard Error
Holstein	92.2	(0.7)
Jersey	3.5	(0.4)
Ayrshire	0.3	(0.1)
Brown Swiss	0.9	(0.3)
Guernsey	0.9	(0.3)
Other	2.2	(0.5)
Total	100.0	

7. Cow registration

A higher percentage of cows on small and medium operations (16.8 and 18.7 percent, respectively) were registered with a breed association compared to cows on large operations (8.9 percent). Overall, 13.6 percent of cows were registered.

a. Percentage of cows registered with a breed association, by herd size:

Percent Cows							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
16.8	(1.2)	18.7	(1.5)	8.9	(1.3)	13.6	(0.8)

Photo by Judy Rodriguez

All cows were registered with a breed association on 8.9 percent of operations, while 71.7 percent of operations had no cows registered. The percentages of operations with less than 10 percent of their cows registered with a breed association were similar across herd sizes. A higher percentage of small and medium operations (14.2 and 15.6 percent, respectively) had 75 percent or more of their cows registered compared to large operations (6.5 percent).

b. Percentage of operations by registration level (percentage of cows registered with a breed association) and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Percent of Dairy Cows Registered	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
0	73.6	(1.6)	65.5	(2.2)	70.9	(2.7)	71.7	(1.3)
0.1 to 9.9	5.2	(0.8)	6.4	(1.2)	7.7	(1.5)	5.6	(0.6)
10.0 to 49.9	5.2	(0.8)	9.8	(1.5)	11.5	(1.8)	6.5	(0.7)
50.0 to 74.9	1.8	(0.4)	2.7	(0.8)	3.4	(1.3)	2.1	(0.4)
75.0 to 99.9	4.8	(0.7)	7.1	(1.2)	2.9	(1.2)	5.2	(0.6)
100	9.4	(1.1)	8.5	(1.2)	3.6	(1.0)	8.9	(0.8)
Total	100.0		100.0		100.0		100.0	

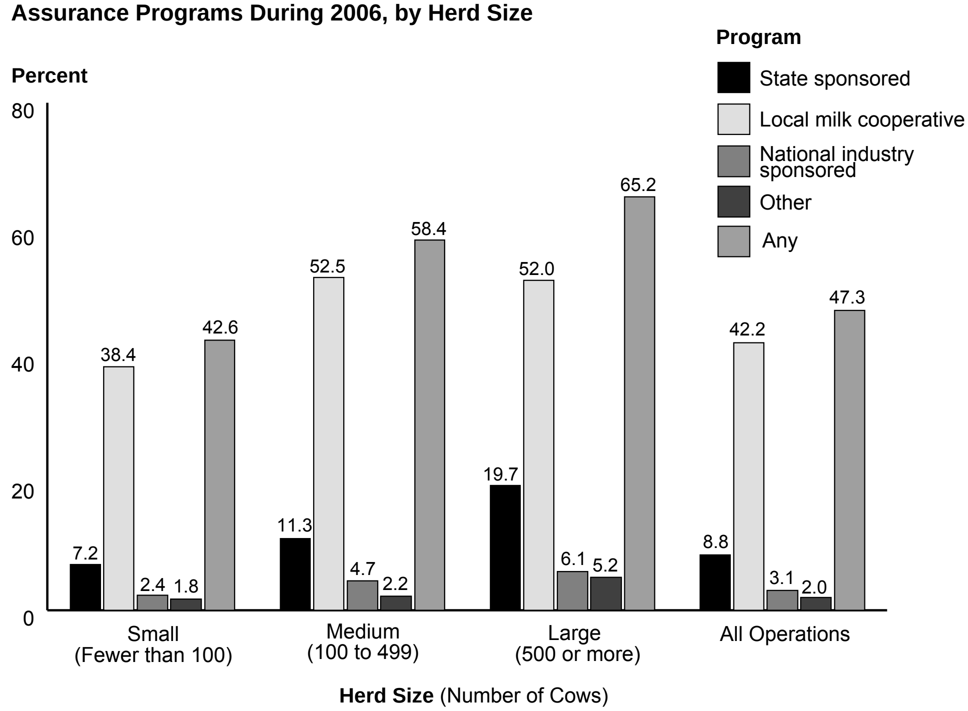
8. Quality assurance programs

Quality assurance programs are designed to educate producers and provide them with guidelines to ensure the highest quality products. Nearly half of operations (47.3 percent) participated in any quality assurance program during 2006. The highest percentage of operations (42.2 percent) participated in a local milk cooperative/processor-sponsored assurance program. A higher percentage of medium and large operations (58.4 and 65.2 percent, respectively) participated in any quality assurance program compared to small operations (42.6 percent).

a. Percentage of operations that participated in the following types of quality assurance programs during 2006, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Quality Assurance Program	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
State sponsored	7.2	(0.9)	11.3	(1.3)	19.7	(2.6)	8.8	(0.7)
Local milk cooperative/ processor sponsored	38.4	(1.8)	52.5	(2.3)	52.0	(2.9)	42.2	(1.4)
National industry sponsored	2.4	(0.5)	4.7	(1.1)	6.1	(1.2)	3.1	(0.4)
Other	1.8	(0.4)	2.2	(0.6)	5.2	(1.4)	2.0	(0.3)
Any of the above	42.6	(1.8)	58.4	(2.3)	65.2	(2.5)	47.3	(1.4)

Percentage of Operations that Participated in the Following Types of Quality Assurance Programs During 2006, by Herd Size



The percentages of operations that participated in individual programs were similar between regions, but a higher percentage of operations in the West region (59.5 percent) participated in any program compared to operations in the East region (46.3 percent).

b. Percentage of operations that participated in the following types of quality assurance programs during 2006, by region:

	Percent Operations			
	Region			
	West		**East**	
Quality Assurance Program	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
State sponsored	11.8	(1.9)	8.5	(0.8)
Local milk cooperative/ processor sponsored	50.4	(3.0)	41.6	(1.5)
National industry sponsored	6.1	(1.6)	2.8	(0.5)
Other	3.9	(1.1)	1.9	(0.4)
Any of the above	59.5	(2.9)	46.3	(1.5)

B. Productivity

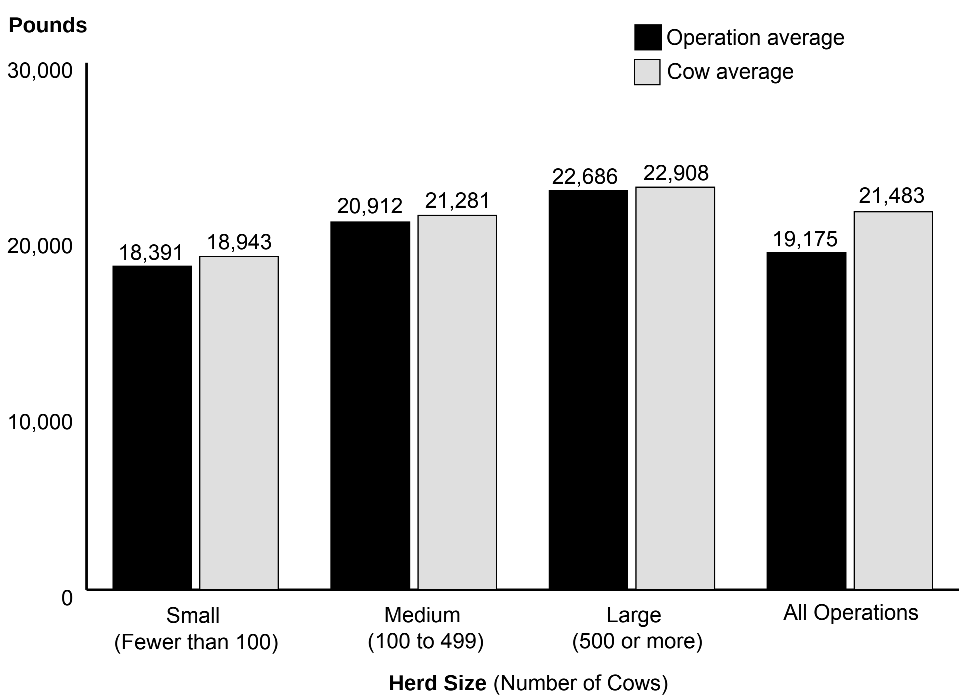
1. RHA milk production

RHA milk production is the amount of milk (lb/cow) produced by the average cow during the last 12 months. Producers were asked to report the RHA for their operation. The average of this reported number across all operations—referred to as the operation average—was 19,175 lb/cow.

a. Operation average (and cow average) RHA milk production (lb/cow), by herd size:

	Average							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Measure	Lb/Cow	Std. Error	Lb/Cow	Std. Error	Lb/Cow	Std. Error	Lb/Cow	Std. Error
Operation	18,391	(142)	20,912	(171)	22,686	(215)	19,175	(112)
Cow	18,943	(135)	21,281	(170)	22,908	(202)	21,483	(115)

Operation Average (and Cow Average) RHA Milk Production (Lb/Cow), by Herd Size



More than one-quarter of operations (26.9 percent) had an RHA milk production of 22,000 lb/cow or more.

b. Percentage of operations by RHA milk production (lb/cow):

Pounds/Cow	Percent Operations	Standard Error
Fewer than 14,000	8.3	(0.8)
14,000 to 15,999	11.7	(1.0)
16,000 to 17,999	14.8	(1.0)
18,000 to 19,999	21.0	(1.2)
20,000 to 21,999	17.3	(1.0)
22,000 or more	26.9	(1.2)
Total	100.0	

Operations that used computer record-keeping systems—either on- or off-farm—had higher RHA milk production than operations that did not use a computer system. Operations with on-farm computer systems had higher operation and cow average RHAs (21,425 and 22,785 lb/cow, respectively) compared to operations using off-farm computers or no computers.

c. Operation average (and cow average) RHA milk production (lb/cow), by computer usage:

Computer Usage	Operation Average (lb/cow)	Standard Error	Cow Average (lb/cow)	Standard Error
Off-farm	20,522	(176)	21,267	(175)
On-farm	21,425	(205)	22,785	(171)
No computer	17,094	(168)	17,992	(166)

Holsteins are known for producing the most milk per cow of all dairy breeds. Operations comprised of primarily Holsteins (more than 50 percent of dairy cows were Holsteins) had higher RHA milk production than operations with primary breeds other than Holstein. Operations with primarily Holsteins had an operation and cow average RHA milk production of approximately 4,000 lb/cow higher than operations where Holsteins were not the primary breed.

d. Operation average (and cow average) RHA milk production (lb/cow), by primary breed (over 50.0 percent of herd was Holstein):

Breed	**Operation Average** (lb/cow)	**Standard Error**	**Cow Average** (lb/cow)	**Standard Error**
Primarily Holstein	19,482	(115)	21,807	(114)
Not primarily Holstein	15,637	(381)	17,137	(418)

2. Age at first calving

Age at first calving is important in determining the lifetime productivity of heifers. In general, the earlier heifers calve after reaching the recommended height and weight, the more productive they are throughout their lifetime. The recommended age at first calving is 22 to 24 months. Overall, the average age at first calving was 25.2 months. Large operations reported the earliest average age for heifers at first calving at 24.0 months.

a. Operation average age of heifers at first calving, by herd size:

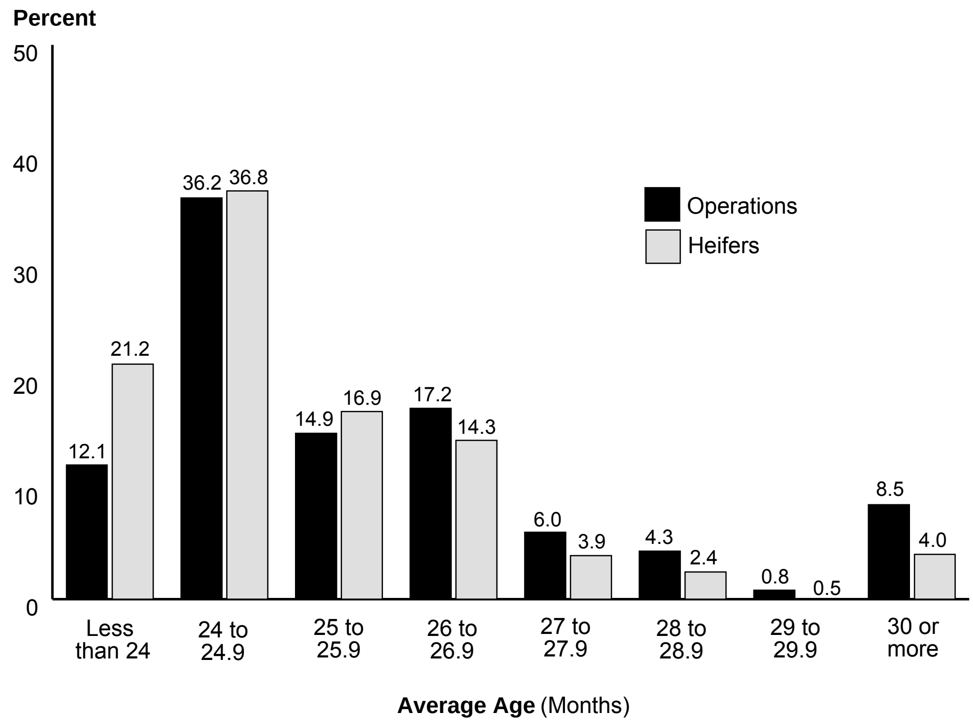
Operation Average Age (Months)							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Avg.	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
25.4	(0.1)	24.8	(0.1)	24.0	(0.1)	25.2	(0.1)

Although 48.3 percent of operations reported an average age at first calving of less than 25 months, these operations accounted for 58.0 percent of heifers. Almost 1 in 10 operations (8.5 percent) reported an average age at first calving of 30 or more months, but these operations accounted for only 4.0 percent of heifers.

b. Percentage of operations (and percentage of heifers on these operations) by average age of heifers at first calving:

Average Age (Months)	**Percent Operations**	**Standard Error**	**Percent Heifers**	**Standard Error**
Less than 24	12.1	(0.9)	21.2	(1.4)
24 to 24.9	36.2	(1.4)	36.8	(1.7)
25 to 25.9	14.9	(1.0)	16.9	(1.3)
26 to 26.9	17.2	(1.1)	14.3	(1.1)
27 to 27.9	6.0	(0.7)	3.9	(0.5)
28 to 28.9	4.3	(0.6)	2.4	(0.3)
29 to 29.9	0.8	(0.2)	0.5	(0.1)
30 or more	8.5	(0.9)	4.0	(0.4)
Total	100.0		100.0	

Percentage of Operations (and Percentage of Heifers on These Operations), by Average Age of Heifers at First Calving



3. Days dry

The dry period is a time for the cow and her mammary glands to rejuvenate and prepare for the next lactation. Traditionally, a 60-day dry period has been recommended, but recent research evaluating the optimal dry period length suggests that 40 days may improve cow health and be more profitable. An advantage of a 40-day dry period is that cows can be fed a consistent high-energy diet through the dry period, which has been shown to improve energy balance and decrease fat mobilization during the first month of the subsequent lactation.

The operation average dry period on medium operations (56.3 days) was about three days shorter than the average on large operations (59.6 days). The overall average days dry was 57.8 days.

a. Operation average days dry during 2006, by herd size:

Operation Average Days Dry

Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Avg.	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
58.2	(0.4)	56.3	(0.4)	59.6	(0.7)	57.8	(0.3)

The majority of operations (51.8 percent) reported average days dry of 60 to 69 days. A total of 2.5 percent of operations reported average days dry of fewer than 40 days, and 14.1 percent reported average days dry of 40 to 49 days.

b. Percentage of operations by average number of days dry:

Average Days Dry	Percent Operations	Standard Error
Less than 40	2.5	(0.4)
40 to 49	14.1	(1.0)
50 to 59	21.1	(1.1)
60 to 69	51.8	(1.4)
70 or more	10.5	(0.9)
Total	100.0	

4. Calving interval

Calving interval is the time from one calving to the next and is dependent on how quickly a cow conceives after calving. The longer a cow is open (not pregnant), the longer the calving interval. Ideally, with a 12-month calving interval, a cow would become pregnant approximately 90 days after calving. For all operations, the average calving interval was 13.2 months. No differences were observed in calving intervals across herd sizes.

a. Operation average calving interval for cows during 2006, by herd size:

Operation Average (Months)							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Avg.	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
13.2	(0.0)	13.3	(0.1)	13.3	(0.1)	13.2	(0.0)

Almost one-third of operations (29.4 percent) reported a calving interval of 12 months or less. A similar percentage of operations reported a calving interval of 13 or 14 months (30.1 and 28.8 percent of operations, respectively). Approximately 1 in 9 operations (11.7 percent) reported a calving interval of 15 or more months.

b. Percentage of operations by calving interval for cows:

Calving Interval (Months)	**Percent Operations**	**Standard Error**
Less than 12	5.5	(0.7)
12	23.9	(1.3)
13	30.1	(1.3)
14	28.8	(1.3)
15	8.5	(0.8)
16 or more	3.2	(0.5)
Total	100.0	

C. Heifer Management

1. Source of heifer inventory

Nearly all operations (96.5 percent) had at least some heifers that were born and raised on the operation. Almost 9 of 10 heifers (87.4 percent) were born and raised on the operation. Although 4.7 percent of operations had heifers born on the operation but raised elsewhere, these operations accounted for 11.5 percent of all heifers.

Percentage of operations and percentage of heifers, by source of heifers:

Heifer Source	**Percent Operations**	**Standard Error**	**Percent Heifers***	**Standard Error**
Born and raised on operation	96.5	(0.4)	87.4	(1.2)
Born on operation raised off operation	4.7	(0.5)	11.5	(1.2)
Born off operation	6.6	(0.8)	1.1	(0.2)
Total			100.0	

*As a percentage of January 1, 2007, heifer inventory.

2. Heifers raised off the operation

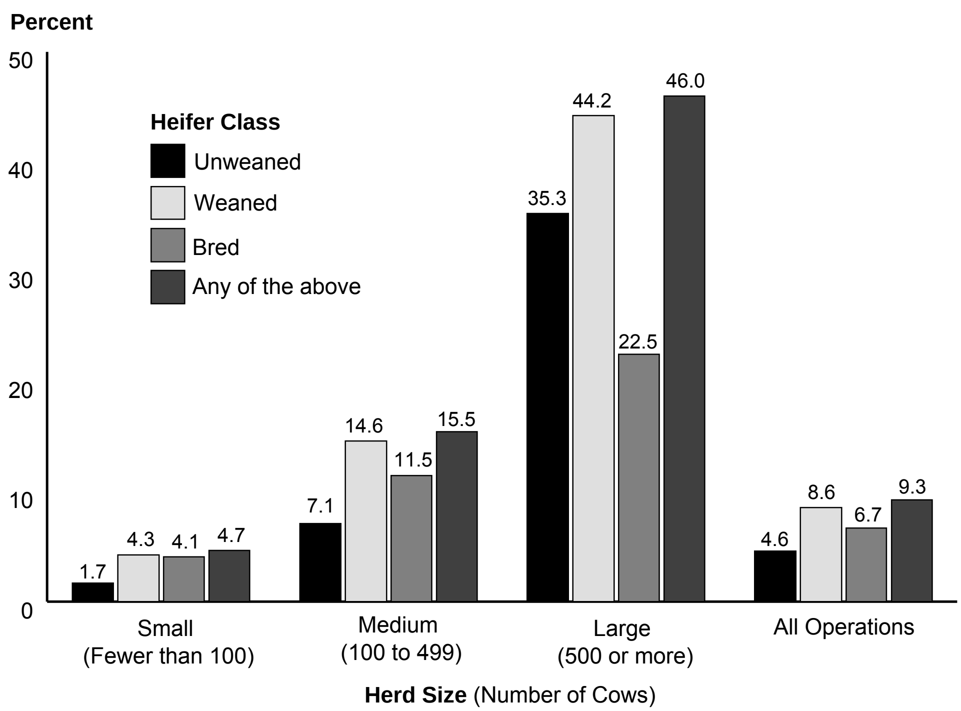
Raising heifers at a separate site (calf ranches) from the milking string has many potential advantages. Calf-ranch personnel are usually dedicated to working only with calves, which can result in increased attention to the feeding and health of calves and also decreased exposure to adult cow disease. If calves are not commingled with older animals or animals from other operations, their exposure to disease agents such as *Mycobacterium avium* subspecies *paratuberculosis*—the causative agent of Johne's disease—is reduced. Raising heifers off-site also reduces the amount of manure produced at single sites and/or may allow producers to maintain larger milking herds on the same acreage.

Fewer than 1 of 10 operations (9.3 percent) raised any heifers off the operation. The percentage of operations that raised heifers off-site increased as herd size increased for all heifer classes. Less than 5 percent of small operations raised any heifers off-site, compared to 15.5 percent of medium operations and 46.0 percent of large operations. Almost one-third of large operations (35.3 percent) raised unweaned calves off-site, compared to 7.1 percent of medium operations and 1.7 percent of small operations. Similar herd-size differences in the percentages of operations that raised heifers off-site were observed among all heifer classes.

a. Percentage of operations that raised any heifers off-site, by heifer class and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Heifer Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Unweaned	1.7	(0.5)	7.1	(1.2)	35.3	(2.9)	4.6	(0.5)
Weaned	4.3	(0.7)	14.6	(1.6)	44.2	(2.9)	8.6	(0.7)
Bred	4.1	(0.7)	11.5	(1.5)	22.5	(2.3)	6.7	(0.6)
Any of the above	4.7	(0.7)	15.5	(1.7)	46.0	(2.9)	9.3	(0.7)

Percentage of Operations That Raised Any Heifers Off-Site, by Heifer Class and by Herd Size



For operations that raised any heifers off the operation, unweaned, weaned, and bred heifers were sent off-site at an operation average age of 4.9, 189.8, and 413.8 days, respectively. The average age at which any calves left to be raised off-site was 110.3 days.

b. For operations that raised any heifers off-site, operation average age of heifers when leaving operation, by heifer class:

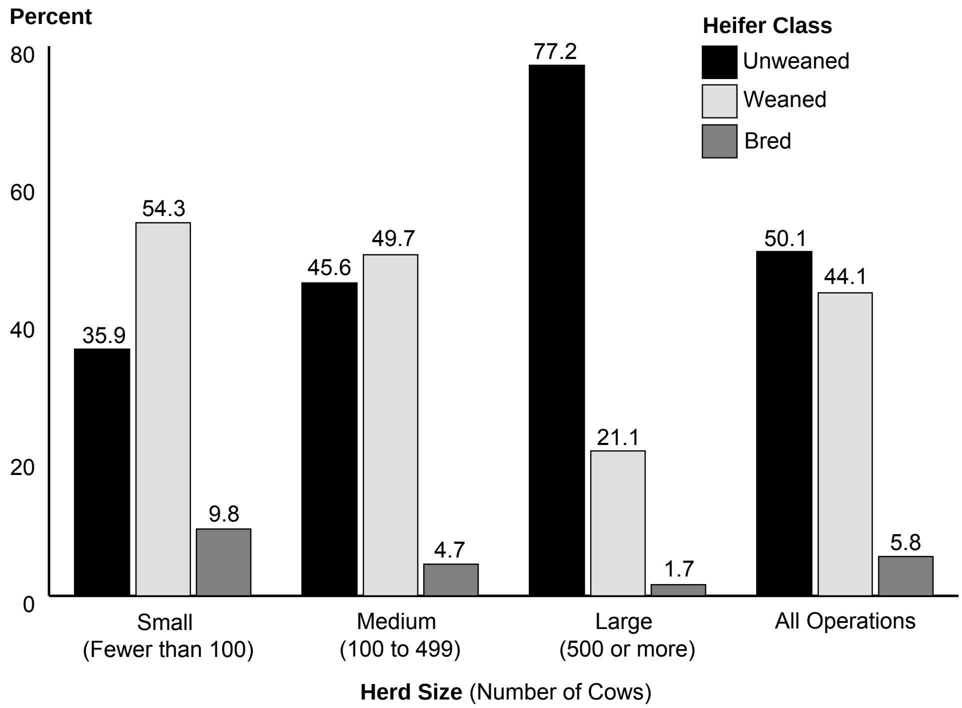
Operation Average Age (Days)							
Heifer Class							
Unweaned		**Weaned**		**Bred**		**All Operations**	
Avg.	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
4.9	(0.7)	189.8	(15.7)	413.8	(25.3)	110.3	(11.2)

Producers were asked to identify the primary class of heifers sent off-site. Almost half of all operations that sent any heifers off-site to be raised sent unweaned or weaned calves (50.1 and 44.1 percent of operations, respectively). Only 5.8 percent of operations sent bred heifers off-site to be raised. Small operations most commonly sent weaned heifers off-site (54.3 percent); medium operations sent similar percentages of unweaned and weaned calves off-site (45.6 and 49.7 percent, respectively); and large operations most frequently sent unweaned heifers off-site (77.2 percent).

c. For operations that raised any heifers off-site, percentage of operations by primary heifer class sent off-site and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Heifer Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Unweaned	35.9	(7.7)	45.6	(5.8)	77.2	(3.3)	50.1	(3.8)
Weaned	54.3	(7.9)	49.7	(5.9)	21.1	(3.2)	44.1	(3.8)
Bred	9.8	(4.0)	4.7	(2.4)	1.7	(0.6)	5.8	(1.7)
Total	100.0		100.0		100.0		100.0	

For Operations That Raised Any Heifers Off-Site, Percentage of Operations by Primary Heifer Class Sent Off-Site and by Herd Size



Approximately 8 of 10 operations (81.1 percent) that sent heifers off-site to be raised retained ownership of the heifers sent. A total of 9.4 percent of operations sold the heifers sent off-site and repurchased the same animals, and 9.5 percent of operations sold the animals sent and replaced them with different animals.

d. For operations that sent heifers off-site to be raised, percentage of operations by ownership of the majority of heifers and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Ownership	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Ownership retained	72.3	(7.5)	83.8	(4.1)	89.6	(2.1)	81.1	(3.3)
Same animals sold and then repurchased	11.1	(6.1)	10.0	(3.2)	6.0	(1.6)	9.4	(2.6)
Animals sold outright, replaced with different animals	16.6	(5.6)	6.2	(2.8)	4.4	(1.4)	9.5	(2.4)
Total	100.0		100.0		100.0		100.0	

For operations that sent heifers off-site to be raised, the highest percentage of small and medium operations transported heifers less than 20 miles to the off-site rearing facility, while the highest percentage of large operations transported heifers between 5 and 50 miles. A total of 10.6 percent of operations transported heifers 50 miles or more.

e. For operations that sent heifers off-site to be raised, percentage of operations by number of miles heifers were transported to the off-site rearing facility, and by herd size:

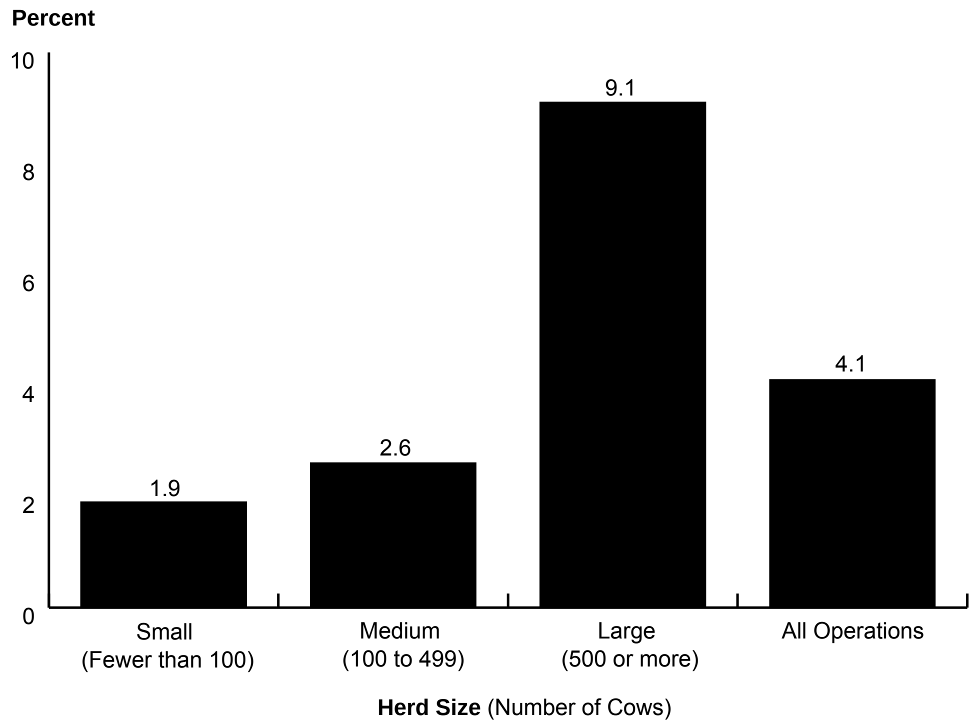
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Miles	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Fewer than 5.0	43.5	(8.4)	26.0	(5.4)	10.1	(2.8)	27.6	(3.7)
5.0 to 19.9	35.3	(8.7)	47.5	(6.1)	37.7	(4.4)	40.8	(3.9)
20.0 to 49.9	12.8	(5.2)	18.8	(4.7)	34.5	(4.7)	21.0	(3.0)
50 or more	8.4	(4.3)	7.7	(2.7)	17.7	(2.7)	10.6	(2.0)
Total	100.0		100.0		100.0		100.0	

Very few operations (4.1 percent) transported heifers out of State for rearing.

f. For operations that sent heifers off-site to be raised, percentage of operations where heifers were ever transported out of State for off-site rearing, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1.9	(1.8)	2.6	(1.5)	9.1	(1.8)	4.1	(1.0)

For Operations that Sent Heifers Off-Site to be Raised, Percentage of Operations Where Heifers were Ever Transported Out of State for Off-Site Rearing, by Herd Size



Producers were asked to choose the description that best described their primary off-site rearing facility. Ideally, heifer-raising facilities would only house animals from a single operation. More than one-quarter of operations (27.7 percent) sent heifers to a single rearing facility where heifers did not have contact with cattle from other operations, but the majority (51.3 percent) sent heifers to a single rearing facility where heifers had contact with cattle from other operations.

g. For operations that sent heifers off-site to be raised, percentage of operations by primary off-site rearing facility:

Off-Site Rearing Facility	**Percent Operations**	**Standard Error**
Heifers sent to a single rearing facility and did not have contact with cattle from other operations	27.7	(3.3)
Heifers sent to multiple rearing facilities and did not have contact with cattle from other operations	8.5	(2.1)
Heifers sent to a single rearing facility and had contact (commingled) with cattle from other operations	51.3	(4.0)
Heifers sent to multiple rearing facilities and had contact (commingled) with cattle from other operations	12.5	(3.0)
Total	100.0	

On average, weaned and bred heifers returned to the operation from the rearing facility at 7.0 and 21.6 months of age, respectively. The operation average age of any heifers returning was 17.3 months.

h. For operations that sent heifers off-site to be raised, operation average age that replacements returned to the operation, by heifer class:

Operation Average Age (Months)							
Heifer Class*							
Weaned		**Bred**		**Other****		**All Operations**	
Avg.	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
7.0	(0.6)	21.6	(0.3)	28.6	(1.0)	17.3	(0.6)

*No operations reported unweaned heifers returning from an off-site rearing facility.
**Heifers that had calved.

Producers were asked to identify the primary class of heifer replacements usually arriving or returning to the operation. Approximately two of three operations (67.6 percent) that sent any heifers off-site brought bred heifers back to the operation from the rearing facility. Approximately one in three operations (30.3 percent) brought back weaned heifers, while just 2.1 percent brought back “other” heifers (heifers that had calved). A higher percentage of large operations (53.4 percent) brought back weaned heifers compared to medium and small operations (27.3 and 15.1, respectively). A higher percentage of small and medium operations (79.1 and 72.2 percent, respectively) brought back bred heifers compared to large operations (46.6 percent).

i. For operations that sent heifers off-site to be raised, percentage of operations by primary class of heifers arriving or returning to the operation, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Heifer Class*	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Weaned	15.1	(6.0)	27.3	(5.1)	53.4	(4.7)	30.3	(3.4)
Bred	79.1	(6.7)	72.2	(5.2)	46.6	(4.7)	67.6	(3.5)
Other**	5.8	(3.4)	0.5	(0.5)	0.0	(0.0)	2.1	(1.2)
Total	100.0		100.0		100.0		100.0	

*No operations reported unweaned heifers returning from an off-site rearing facility.
**Heifers that had calved.

3. Colostrum management

Removing a newborn calf from the calving area and providing quality colostrum immediately after birth are recommended practices to maximize calf health. Isolating calves from adult cows reduces the potential for disease transmission, and providing quality colostrum within 1 hour after birth helps ensure that calves have antibodies to withstand disease challenges.

Administering colostrum to calves allows providers to determine colostrum quality and monitor when and how much calves receive. Calves that get colostrum only during nursing may not receive the proper quality or amount of colostrum in a timely manner. In addition, if the calving area is not properly maintained, calves are likely to ingest manure from the environment while searching for teats and suckling colostrum. Recommendations for colostrum feeding can be found in “A Guide to Colostrum and Colostrum Management for Dairy Calves” published by the Bovine Alliance on Management and Nutrition (BAMN). Calves should receive 3 quarts of high quality colostrum within 1 hour of birth and an additional 3 quarts in 12 hours, or 4 quarts administered by esophageal feeder within 1 hour of birth.

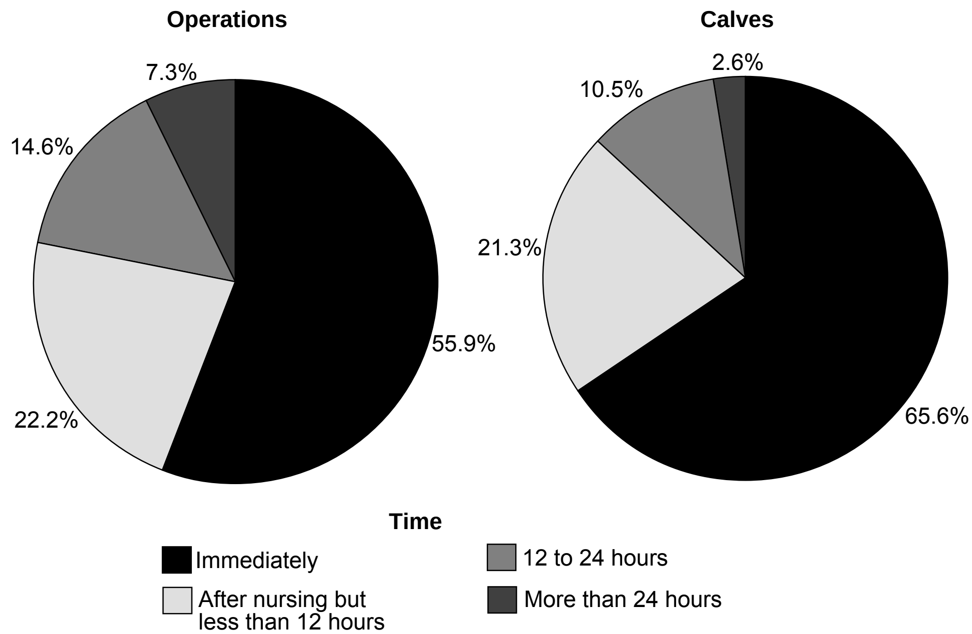
More than half the operations (55.9 percent) removed newborn heifer calves immediately after calving. These operations accounted for 65.6 percent of all heifer calves. One in five operations (22.2 percent)—accounting for 21.3 percent of newborn calves—removed calves after they nursed their dams but prior to 12 hours of age. Fewer than 1 in 10 operations (7.3 percent)—representing 2.6 percent of calves— allowed calves to stay with their dams for more than 24 hours.

a. Percentage of operations (and percentage of heifers born on these operations during 2006 and alive at 48 hours) by time following birth that calves were normally separated from their dams:

Time	Percent Operations	Standard Error	Percent Heifer Calves*	Standard Error
Immediately (no nursing)	55.9	(1.4)	65.6	(1.5)
After nursing but less than 12 hours	22.2	(1.2)	21.3	(1.3)
12 to 24 hours	14.6	(1.0)	10.5	(0.9)
More than 24 hours	7.3	(0.8)	2.6	(0.3)
Total	100.0		100.0	

*Born during 2006 and alive at 48 hours.

Percentage of Operations (and Percentage of Heifer Calves Born on These Operations During 2006 and Alive at 48 Hours) by Time Following Birth that Calves Were Normally Separated from Their Dams



On average, calves received hand-fed colostrum 3.3 hours following birth.

b. For operations that immediately removed calves from their dams and hand-fed colostrum, operation average number of hours after birth that calves got their first colostrum feeding, by herd size:

Operation Average Hours

Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Hours	**Std. Error**	**Hours**	**Std. Error**	**Hours**	**Std. Error**	**Hours**	**Std. Error**
3.4	(0.1)	3.3	(0.1)	2.8	(0.2)	3.3	(0.1)

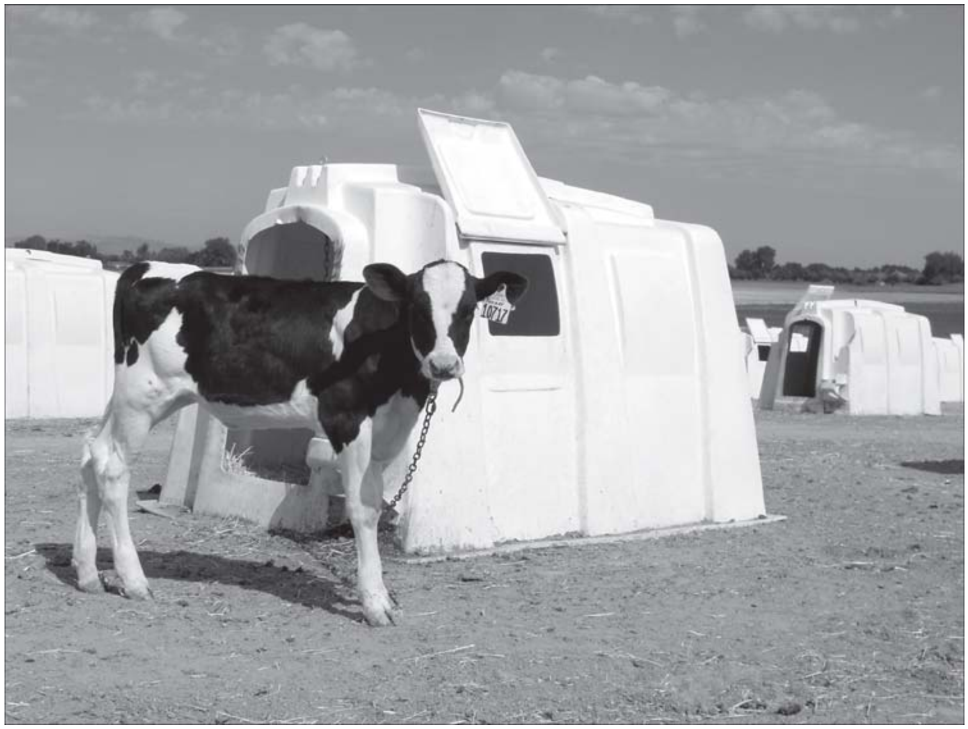


Photo by Dr. Jason Lombard

The majority of operations (59.2 percent) hand-fed colostrum to calves from a bucket or bottle. These operations accounted for 59.6 percent of heifer calves. About one-third of operations (36.3 percent) allowed calves to ingest colostrum during first nursing of the dam. A total of 4.3 percent of operations accounting for 13.7 percent of calves used an esophageal feeder to administer colostrum.

c. Percentage of operations (and percentage of heifers born on these operations during 2006 and alive at 48 hours) by method normally used for calves' first feeding of colostrum: (Table revised 2-13-2008)

Colostrum Delivery Method	Percent Operations	Standard Error	Percent Heifer Calves*	Standard Error
During first nursing of dam	36.3	(1.4)	26.5	(1.3)
Hand-fed from bucket or bottle	59.2	(1.4)	59.6	(1.6)
Hand-fed using esophageal feeder	4.3	(0.5)	13.7	(1.2)
Did not get colostrum	0.2	(0.1)	0.2	(0.1)
Total	100.0		100.0	

*Born during 2006 and alive at 48 hours.

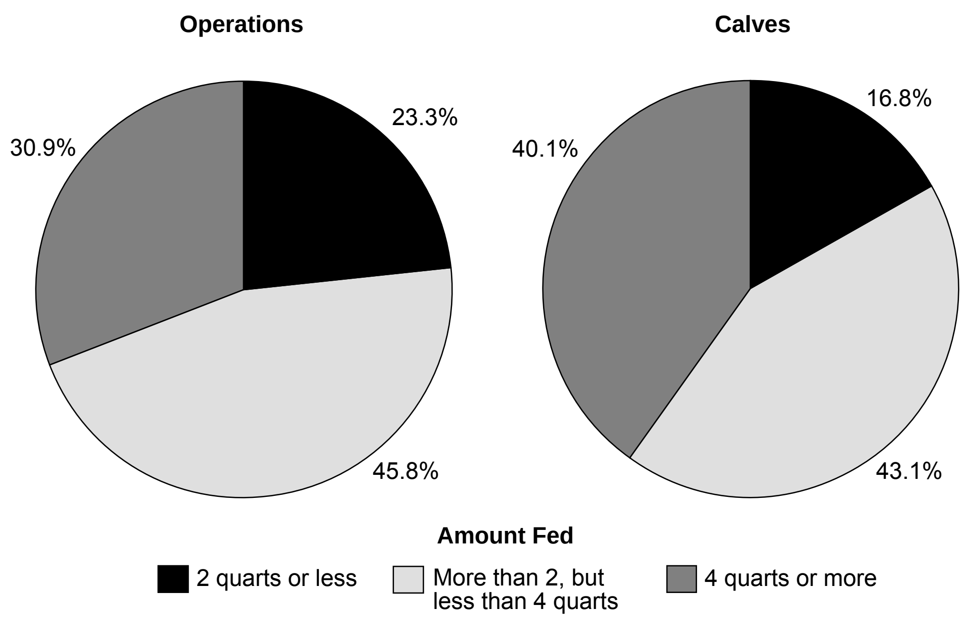
For operations that normally hand-fed colostrum, a total of 45.8 percent of operations representing 43.1 percent of heifer calves fed calves more than 2 but less than 4 quarts of colostrum during the first 24 hours of life. About 4 in 10 calves (40.1 percent) received 4 quarts or more, while 16.8 percent of calves received 2 quarts or less during the first 24 hours.

d. For operations that normally hand-fed colostrum, percentage of operations (and percentage of heifers born on these operations during 2006 and alive at 48 hours) by amount of colostrum normally fed during the first 24 hours:

Amount	Percent Operations	Standard Error	Percent Heifer Calves*	Standard Error
2 quarts or less	23.3	(1.6)	16.8	(1.4)
More than 2 but less than 4 quarts	45.8	(1.9)	43.1	(2.1)
4 quarts or more	30.9	(1.7)	40.1	(2.0)
Total	100.0		100.0	

*Born during 2006 and alive at 48 hours.

For Operations that Normally Hand-Fed Colostrum, Percentage of Operations (and Percentage of Heifer Calves Born and Alive at 48 Hours on These Operations During 2006) by Amount of Colostrum Normally Fed During the First 24 Hours



About one in eight operations that hand-fed colostrum (13.0 percent) estimated the immunoglobulin levels of the colostrum or evaluated its quality before feeding. The percentage of operations that evaluated colostrum more than doubled from one herd size to the next, ranging from 7.6 percent of small operations to 45.2 percent of large operations.

e. For operations that normally hand-fed colostrum, percentage of operations that estimated the immunoglobulin levels of the colostrum or evaluated its quality, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
7.6	(1.3)	19.8	(2.3)	45.2	(3.2)	13.0	(1.1)

The most commonly used methods of evaluating colostrum were a colostrometer and visual appearance (43.7 and 41.6 percent of operations, respectively).

f. For operations that estimated immunoglobulin levels in colostrum or evaluated its quality, percentage of operations by primary method used for measuring immunoglobulin:

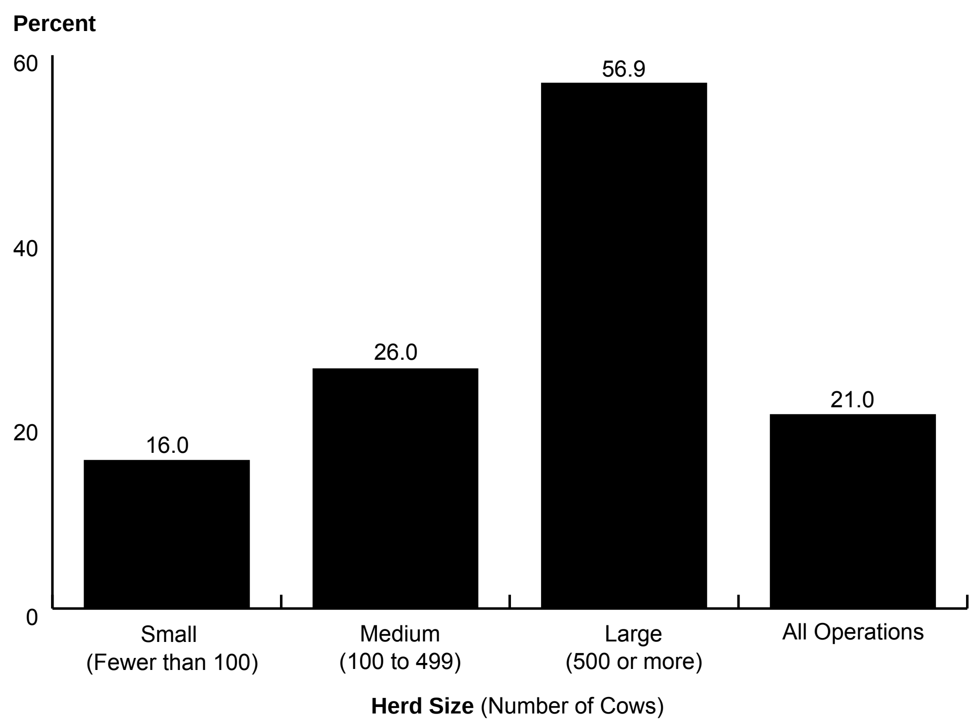
Primary Method	**Percent Operations**	**Standard Error**
Colostrometer	43.7	(4.2)
Visual appearance	41.6	(4.3)
Volume of first milking colostrum (pounds)	9.7	(2.8)
Other	5.0	(2.7)
Total	100.0	

Pooling colostrum may increase calves' exposure to pathogens. About one in five operations (21.0 percent) pooled colostrum. As herd size increased so did the percentage of operations that pooled colostrum, ranging from 16.0 percent of small operations to 56.9 percent of large operations.

g. For operations that normally hand-fed colostrum, percentage of operations that pooled colostrum from more than one cow, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
16.0	(1.7)	26.0	(2.4)	56.9	(3.1)	21.0	(1.3)

For Operations that Normally Hand-Fed Colostrum, Percentage of Operations that Pooled Colostrum from More Than One Cow, by Herd Size



Proper collection, handling, storage, and administration of colostrum are important in reducing the potential for exposing calves to pathogens. The method of storing colostrum prior to feeding can dramatically impact its quality and pathogen load. Studies have shown that storing colostrum at warm ambient temperatures results in a rapid increase of bacterial growth. Refrigerating colostrum results in intermediate rates of bacterial proliferation compared to using a preservative and refrigeration to store colostrum.

The majority of small operations (64.8 percent) did not store colostrum, while only 11.8 percent of large operations did not store colostrum. The highest percentage of large operations either stored colostrum in a refrigerator (50.5 percent) or freezer (34.7 percent).

h. For operations that normally hand-fed colostrum, percentage of operations by primary method of storing colostrum and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Primary Method*	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Stored without refrigeration	4.4	(1.0)	2.8	(0.9)	3.0	(0.9)	3.9	(0.7)
Stored in refrigerator	6.0	(1.1)	15.2	(1.9)	50.5	(3.5)	11.1	(0.9)
Stored in freezer	24.8	(2.1)	36.2	(2.8)	34.7	(3.0)	28.2	(1.6)
Not stored	64.8	(2.3)	45.8	(3.0)	11.8	(2.8)	56.8	(1.8)
Total	100.0		100.0		100.0		100.0	

*No operations reported “other” as a primary method for storing colostrum.

Pasteurizing colostrum is one method of reducing the potential for transmitting disease to calves. A high-temperature, short-time (HTST) system is one method of pasteurizing colostrum. However, HTST pasteurizers cause colostrum to gel and significantly reduce the amount of antibodies present, particularly immunoglobulin G (IgG). A batch pasteurizer uses a relatively low temperature and a longer heating time (60^{o}C for 60-120 minutes). Batch pasteurizers do not cause colostrum to gel or significantly reduce IgG concentrations. It is important to note that pasteurization decreases pathogens found in colostrum but does not improve the quality of colostrum in terms of increased maternal antibodies. Although pasteurization is commonly used for milk and can be used for colostrum, the technical issues inherent in pasteurization may be one reason that dairies have been slow to adopt this management practice.

Less than 1 percent of operations that hand-fed colostrum (0.8 percent) pasteurized the colostrum before feeding it to calves. A higher percentage of large operations (6.4 percent) pasteurized colostrum compared to medium and small operations (0.9 and 0.2 percent, respectively).

i. For operations that normally hand-fed colostrum, percentage of operations that pasteurized colostrum, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
0.2	(0.2)	0.9	(0.4)	6.4	(1.6)	0.8	(0.2)

Measuring IgG levels or total serum proteins in calves within the first 3 days of life is a relatively simple method for evaluating colostrum management programs. Overall, 2.1 percent of operations routinely measured passive transfer via serum proteins. A higher percentage of large operations (14.5 percent) routinely evaluated passive transfer compared to medium and small operations (2.4 and 1.1 percent, respectively).

j. Percentage of operations that routinely monitored serum proteins (as a measure of passive transfer) in heifers within the first 3 days of life, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1.1	(0.4)	2.4	(0.6)	14.5	(1.7)	2.1	(0.3)

4. Heifer nutrition

A variety of liquid diets are commonly offered to unweaned calves. Recent literature suggests that feeding medicated milk replacer increases weaning weights and decreases morbidity and mortality. However, the most important factor in reducing morbidity and mortality was high levels of passive transfer provided through colostrum.

Properly pasteurizing and handling waste (nonsaleable) milk or saleable milk reduces pathogen loads without affecting milk quality. However, managing a pasteurization system that consistently provides high-quality nutrition to the calf with decreased pathogens is an intensive process and requires daily monitoring of equipment and the feeding system.

A higher percentage of large operations (26.4 percent) fed nonmedicated milk replacer than medium and small operations (14.2 and 11.4 percent, respectively). Alternatively, small and medium operations (55.2 and 68.2 percent, respectively) were more likely to feed medicated milk replacer than large operations (43.6 percent). Overall, medicated milk replacer was fed on more than half of all operations (57.5 percent). A higher percentage of large operations (28.7 percent) fed pasteurized waste milk compared to medium and small operations (3.0 and 1.0 percent, respectively). Small operations (32.2 percent) were more likely to feed unpasteurized whole (saleable) milk than medium and large operations (17.4 and 12.1 percent, respectively). Similar percentages of operations fed unpasteurized waste milk and unpasteurized whole (saleable) milk (30.6 and 28.0 percent, respectively).

a. Percentage of operations that fed a liquid diet to heifers at any time prior to weaning during 2006, by type of diet and by herd size:

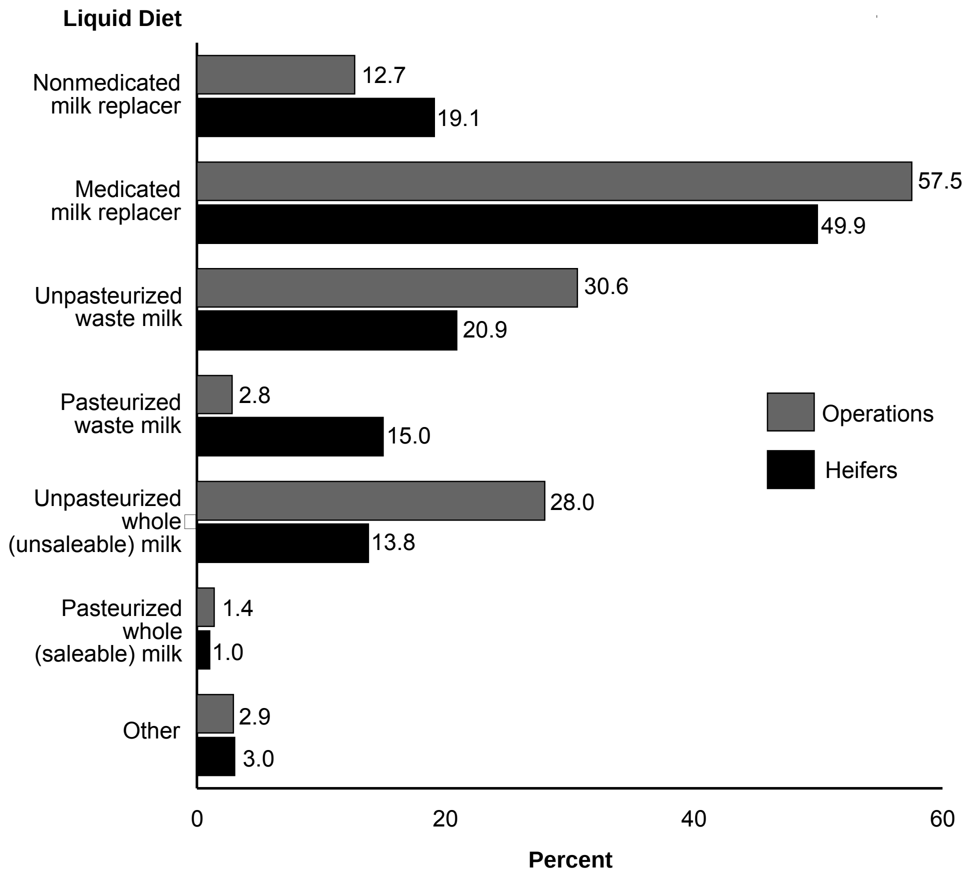
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Liquid Diet	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Nonmedicated milk replacer	11.4	(1.2)	14.2	(1.7)	26.4	(2.4)	12.7	(0.9)
Medicated milk replacer	55.2	(1.8)	68.2	(2.1)	43.6	(3.1)	57.5	(1.4)
Unpasteurized waste milk	32.2	(1.7)	25.7	(2.0)	27.6	(2.8)	30.6	(1.3)
Pasteurized waste milk	1.0	(0.3)	3.0	(0.9)	28.7	(2.7)	2.8	(0.3)
Unpasteurized whole (saleable) milk	32.2	(1.7)	17.4	(1.7)	12.1	(1.9)	28.0	(1.3)
Pasteurized whole (saleable) milk	1.3	(0.4)	1.6	(0.8)	2.0	(0.7)	1.4	(0.3)
Other	2.6	(0.6)	3.5	(0.9)	4.9	(1.8)	2.9	(0.5)

The percentage of heifers that received liquid diets was similar to the percentage of operations that fed a liquid diet. Almost half of all heifers (49.9 percent) received medicated milk replacer at some point prior to weaning.

b. Percentage of heifers that received a liquid diet any time prior to weaning during 2006, by type of diet and by herd size:

	Percent Heifers							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Liquid Diet	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Nonmedicated milk replacer	10.4	(1.1)	13.7	(1.7)	27.9	(2.6)	19.1	(1.3)
Medicated milk replacer	57.9	(1.8)	63.0	(2.2)	36.4	(3.0)	49.9	(1.5)
Unpasteurized waste milk	23.2	(1.5)	20.3	(1.8)	19.9	(2.5)	20.9	(1.3)
Pasteurized waste milk	1.2	(0.3)	2.6	(0.6)	31.5	(2.6)	15.0	(1.2)
Unpasteurized whole (saleable) milk	25.5	(1.6)	13.3	(1.5)	6.9	(1.3)	13.8	(0.8)
Pasteurized whole (saleable) milk	0.9	(0.3)	0.6	(0.3)	1.4	(0.6)	1.0	(0.3)
Other	1.6	(0.4)	3.1	(0.9)	3.7	(1.3)	3.0	(0.6)

Percentage of Operations that Fed a Liquid Diet to Heifers at Any Time Prior to Weaning During 2006, and Percentage of Heifers that Received a Liquid Diet Any Time Prior to Weaning, by Type of Liquid Diet



The most common medication in milk replacer at the operation level was oxytetracycline in combination with neomycin (49.5 percent of operations). Oxytetracycline and/or decoquinate were fed on nearly one in five operations (21.9 and 18.8 percent, respectively).

c. Percentage of operations that fed a medicated milk replacer to heifers during 2006, by medication used:

Medication	Percent Operations	Standard Error
Chlortetracycline (CTC)	12.1	(1.1)
Oxytetracycline (OTC)	21.9	(1.5)
Oxytetracycline in combination with Neomycin (Oxy NEO)	49.5	(1.9)
Decoquinate	18.8	(1.4)
Lasalocid	7.2	(0.9)
Other	5.4	(0.9)
Any medication	57.5	(1.4)

Calf-feeding equipment should be cleaned between calves to prevent the spread of disease from one calf to another. Approximately one in four operations (24.4 percent) cleaned calf-feeding equipment between calves. A higher percentage of large and medium operations (39.1 and 30.9 percent, respectively) cleaned equipment between calves compared to small operations (21.4 percent). The majority of operations (58.5 percent) cleaned equipment daily, and there was no difference in percentages across herd sizes. Small and medium operations were more likely to clean equipment weekly (7.0 and 5.2 percent, respectively) than large operations (1.3 percent). “Other” frequency accounted for 7.5 percent of operations, and a high percentage of these operations reported cleaning equipment twice daily, but not between calves.

d. Percentage of operations by frequency milk feeding equipment* was cleaned and disinfected, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Frequency	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Between calves	21.4	(1.5)	30.9	(2.2)	39.1	(2.7)	24.4	(1.2)
Daily	59.8	(1.8)	55.9	(2.3)	51.8	(2.8)	58.5	(1.4)
Weekly	7.0	(1.0)	5.2	(0.9)	1.3	(0.9)	6.4	(0.8)
Monthly	3.8	(0.7)	1.4	(0.6)	2.2	(1.0)	3.2	(0.5)
Other	8.0	(1.0)	6.6	(1.1)	5.6	(1.3)	7.5	(0.8)
Total	100.0		100.0		100.0		100.0	

*Bottles, buckets, nipples.

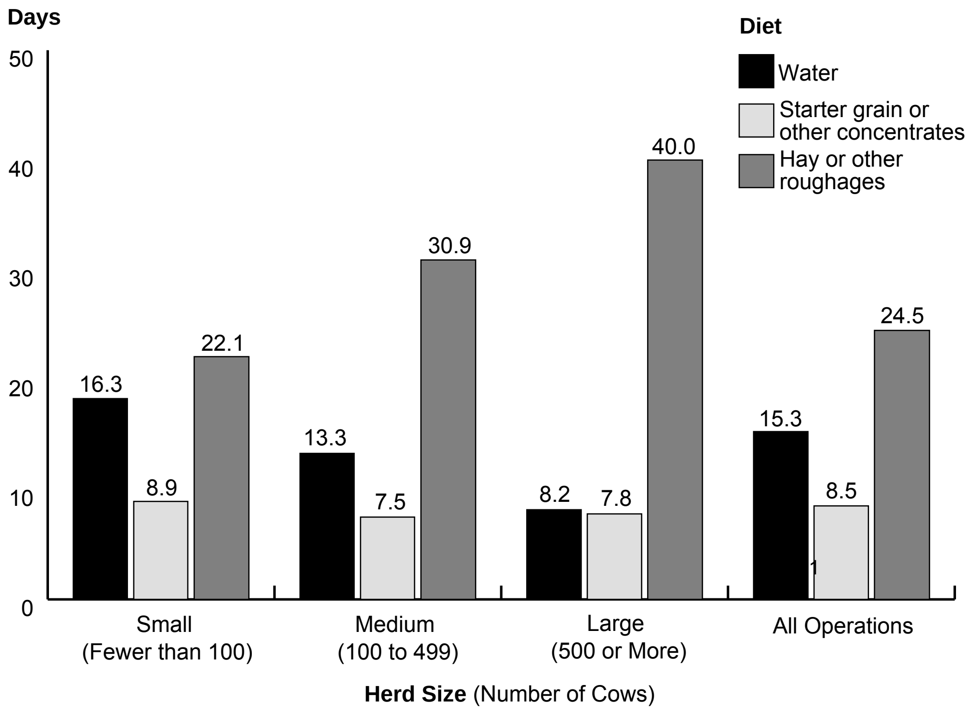
Current recommendations for providing water, starter, and hay to calves can be found in “A Guide to Dairy Calf Feeding and Management,” published by the BAMN. This publication recommends that calves have fresh water available from 1 day of age. Starter should be introduced at 4 days of age, and calves should be consuming 1.5 to 2.0 pounds per day prior to weaning. Hay should not be fed prior to weaning since—compared to calves fed a high quality, properly balanced starter— it may slow rumen development and growth.

Across all operations, water was offered to calves at 15.3 days of age. Large operations offered water earlier (8.2 days) than medium and small operations (13.3 and 16.3 days, respectively). Starter was routinely offered at 8.5 days of age, and there were no differences in average days across herd sizes. Hay was offered at increasing days of age as herd size increased, with the average age operations offered hay at 24.5 days old.

e. Operation average age (days) of unweaned heifers when heifers were routinely offered the following diets, by herd size:

	Operation Average Age (Days)							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Diet	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
Water	16.3	(0.7)	13.3	(0.8)	8.2	(0.9)	15.3	(0.6)
Starter grain or other concentrate	8.9	(0.3)	7.5	(0.4)	7.8	(0.7)	8.5	(0.3)
Hay or other roughage	22.1	(0.7)	30.9	(1.1)	40.0	(1.9)	24.5	(0.6)

Operation Average Age (Days) of Unweaned Heifers When Heifers were Routinely Offered the Following Diets, by Herd Size



5. Weaning age

The recommended weaning age for heifers is 6 to 8 weeks and should occur when calves are consuming 1.5 to 2.0 pounds of starter daily. The operation average age at weaning was 8.2 weeks, with large operations weaning calves at an older age (9.1 weeks) than medium and small operations (7.9 and 8.2 weeks, respectively).

a. Operation average age of heifers at weaning, by herd size:

Operation Average Age (Weeks)

Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Avg.	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
8.2	(0.1)	7.9	(0.1)	9.1	(0.2)	8.2	(0.1)

Approximately one-third of operations (33.2 percent) weaned heifers at 8 weeks, while another 20.5 percent weaned heifers at 6 weeks. Less than 5 percent of operations (4.8 percent) weaned heifers at 4 weeks of age.

b. Percentage of operations by operation average weaning age of heifers:

Operation Average Weaning Age (Weeks)	**Percent Operations**	**Standard Error**
4	4.8	(0.6)
5	5.6	(0.6)
6	20.5	(1.2)
7	10.3	(0.8)
8	33.2	(1.4)
9	4.5	(0.6)
10	5.9	(0.6)
11	1.1	(0.3)
12	8.9	(0.9)
13 or more	5.2	(0.7)
Total	100.0	

6. Preventive practices

Preventive practices were commonly used for heifers: 94.6 percent of operations administered at least one preventive practice to heifers, and 94.6 percent of heifers were on these operations. Nearly 7 of 10 operations (69.4 percent) dewormed heifers, and similar percentages of operations provided vitamin A-D-E or selenium in feed (74.4 and 69.3 percent, respectively).

Percentage of operations (and percentage of heifers on these operations) by preventive practices normally used for heifers:

Preventive Practice	Percent Operations	Standard Error	Percent Heifers*	Standard Error
Dewormers	69.4	(1.3)	55.2	(1.5)
Coccidiostats in feed	46.5	(1.4)	56.5	(1.6)
Vitamins A-D-E injection	10.4	(0.7)	17.4	(1.3)
Vitamins A-D-E in feed	74.4	(1.2)	71.9	(1.5)
Selenium injection	13.2	(0.9)	17.2	(1.2)
Selenium in feed	69.3	(1.3)	65.4	(1.6)
Ionophores in feed (e.g., Rumensin®, Bovatec®)	45.2	(1.4)	58.1	(1.6)
Probiotics	20.0	(1.1)	27.7	(1.6)
Anionic salts in feed	20.9	(1.1)	28.1	(1.5)
Other	4.6	(0.7)	2.5	(0.4)
Any preventive	94.6	(0.7)	94.6	(0.9)

*As a percentage of January 1, 2007, heifer inventory.

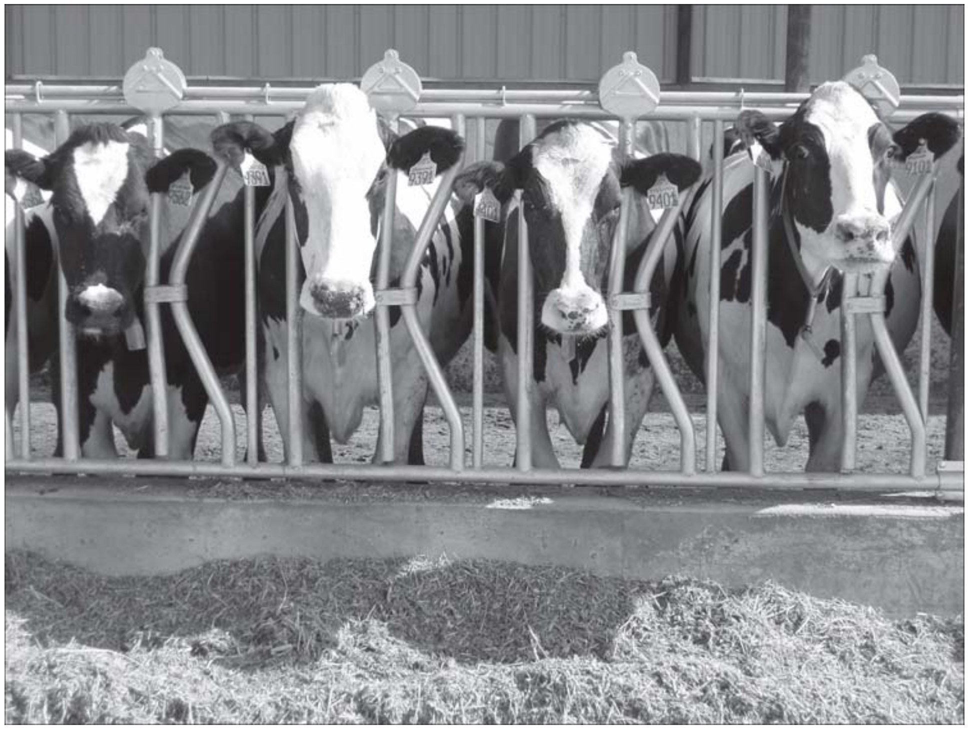


Photo by Dr. Jason Lombard

7. Vaccination practices

More than 60 percent of operations vaccinated heifers against bovine viral diarrhea (BVD), infectious bovine rhinotracheitis (IBR), parainfluenza Type 3 (PI3), bovine respiratory syncytial virus (BRSV), and leptospirosis. With the exception of IBR, PI3, BRSV, *Haemophilus somnus*, and *Mycobacterium avium* subspecies *paratuberculosis*, a higher percentage of large operations vaccinated against the listed diseases compared to medium or small operations. Less than half of operations (41.6 percent) normally vaccinated heifers against brucellosis. For heifers, a lower percentage of small operations vaccinated against each of the listed diseases than medium or large operations.

a. Percentage of operations that normally vaccinated heifers against the following diseases, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Disease	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Bovine viral diarrhea (BVD)	69.0	(1.7)	84.5	(1.7)	94.1	(1.4)	73.7	(1.3)
Infectious bovine rhinotracheitis (IBR)	65.7	(1.7)	81.7	(1.8)	88.4	(1.8)	70.4	(1.3)
Parainfluenza Type 3 (PI3)	57.1	(1.8)	70.2	(2.1)	76.2	(2.4)	61.0	(1.4)
Bovine respiratory syncytial virus (BRSV)	60.6	(1.8)	75.4	(2.0)	80.8	(2.2)	64.9	(1.4)
Haemophilus somnus	31.1	(1.7)	42.4	(2.3)	43.0	(2.6)	34.2	(1.3)
Leptospirosis	63.2	(1.7)	78.1	(1.9)	86.7	(1.9)	67.7	(1.3)
Salmonella	15.5	(1.3)	34.4	(2.2)	52.5	(3.0)	21.5	(1.1)
E. coli mastitis	17.6	(1.4)	36.6	(2.2)	61.8	(3.0)	24.1	(1.1)
Clostridia	28.3	(1.6)	48.8	(2.2)	63.4	(2.9)	34.6	(1.3)
Brucellosis	37.4	(1.7)	49.5	(2.2)	66.7	(2.5)	41.6	(1.3)
Mycobacterium avium subspecies *paratuberculosis* (Johne's disease)	3.4	(0.7)	8.7	(1.3)	10.6	(2.1)	5.0	(0.6)
Neospora	3.8	(0.7)	11.3	(1.6)	20.5	(2.4)	6.3	(0.6)
Other	6.9	(0.9)	6.3	(1.0)	7.8	(1.4)	6.8	(0.7)
Any disease	79.3	(1.5)	92.0	(1.3)	97.1	(0.8)	83.0	(1.1)

Operations in the West region were more likely to vaccinate heifers for the majority of the listed diseases than operations in the East region. Almost twice the percentage of operations in the West region vaccinated against *Salmonella, E. coli* mastitis, clostridia, brucellosis, and *Neospora* compared to operations in the East region.

b. Percentage of operations that normally vaccinated heifers for the following diseases, by region:

	Percent Operations			
	Region			
	West		East	
Disease	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Bovine viral diarrhea (BVD)	85.6	(2.3)	72.8	(1.4)
Infectious bovine rhinotracheitis (IBR)	78.4	(2.7)	69.8	(1.4)
Parainfluenza Type 3 (PI3)	67.0	(3.0)	60.5	(1.5)
Bovine respiratory syncytial virus (BRSV)	72.3	(2.9)	64.4	(1.5)
Haemophilus somnus	36.6	(3.0)	34.1	(1.4)
Leptospirosis	78.8	(2.4)	66.9	(1.4)
Salmonella	41.5	(2.9)	20.0	(1.1)
E. coli mastitis	48.3	(2.9)	22.1	(1.2)
Clostridia	65.3	(3.0)	32.2	(1.3)
Brucellosis	87.0	(1.8)	38.0	(1.4)
Mycobacterium avium subspecies *paratuberculosis* (Johne's disease)	8.3	(1.7)	4.7	(0.6)
Neospora	17.9	(2.5)	5.4	(0.6)
Other	7.5	(1.8)	6.8	(0.7)
Any disease	97.8	(0.7)	81.2	(1.2)

c. For operations that gave BVD vaccinations to heifers, percentage of operations by type of BVD vaccine given:

Type of Vaccine	Percent Operations	Standard Error
Killed	43.1	(1.6)
Modified live	62.2	(1.5)

8. BVD testing

Animals persistently infected (PI) with BVD become infected while in utero and shed large quantities of BVD virus following birth. This high shedding can infect susceptible animals and create the next generation of PI animals. The most efficient method of determining if the dam and her calf are PI with BVD is to test the calf. Since a PI cow will always produce a PI calf, the dam is negative if the calf tests negative. Few operations (4.0 percent) routinely tested heifer replacements for PI with BVD. The percentage of operations that did test increased as herd size increased.

a. Percentage of operations that routinely tested heifer replacements to determine if animals were PI with BVD, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1.9	(0.5)	6.7	(1.1)	21.2	(2.4)	4.0	(0.4)

Of operations that tested heifers, the majority (66.8 percent) used individual ear-notch tests, while 21.1 percent tested individual serum samples.

b. For operations that routinely tested heifer replacements to determine if animals were PI with BVD, percentage of operations by testing method used:

Testing Method	Percent Operations	Standard Error
Individual ear notch	66.8	(5.7)
Pooled ear notch	11.4	(4.0)
Individual serum sample	21.1	(5.4)
Pooled serum sample	6.0	(3.0)
Other	6.5	(2.4)

D. Heifer Health

1. Births, stillbirths, and dystocia

Delivery of a calf is an important event for both the health of the cow and the calf. Current literature suggests that the number of stillborn calves appears to be increasing, with bull calves more likely to be born dead than heifer calves. Additionally, calves born to older cows are less likely to be stillborn or require assistance during calving, compared to first-calf heifers.

During 2006, almost 9 of 10 cows and heifers (86.0 percent) delivered a calf that was alive at 48 hours. Of the calves born during 2006, 93.5 percent were alive at 48 hours, while 6.5 percent were either born dead or died prior to 48 hours of age. Almost one in five calves (17.2 percent) needed assistance during delivery. Essentially, half the calves born and alive at 48 hours (50.8 percent) were heifer calves.

a. Calves born during 2006 and alive at 48 hours, as a percentage of the January 1, 2007, cow inventory:

Percent	Standard Error
86.0	(0.6)

b. Calves born alive and dead, as a percentage of calves born during 2006:

Calf Status	Percent Calves	Standard Error
Born and alive at 48 hours	93.5	(0.1)
Stillborn (born dead or died within 48 hours of birth)	6.5	(0.1)
Total	100.0	

c. Calves that required any assistance during birth (dystocia), as a percentage of calves born during 2006:

Percent	Standard Error
17.2	(0.6)

d. Heifer calves as a percentage of all calves born during 2006 and alive at 48 hours:

Percent	Standard Error
50.8	(0.3)

E. Cow Management

1. Source of cow replacements

Cow replacements born and raised on the operation entered the milking string during 2006 on the majority of operations (89.8 percent). Replacements accounted for over one-third of cow inventory (38.4 percent). Almost all operations (97.0 percent) had some replacements enter the milking string during 2006.

Percentage of operations (and percentage of cow inventory) by source of cow replacements that entered the milking string in 2006:

Replacement Source	Percent Operations	Standard Error	Percent Cows*	Standard Error
Born and raised on operation	89.8	(0.8)	27.8	(0.8)
Born on operation raised off operation	6.8	(0.6)	8.0	(0.7)
Born off operation	14.1	(1.0)	2.6	(0.2)
Any replacements	97.0	(0.5)	38.4	(0.8)

*Number of replacements that entered the milking string during 2006, as a percentage of the January 1, 2007, cow inventory

Photo by Judy Rodriguez

2. Housing facilities

Animal housing designs play an important role in maximizing animal health, especially with the diverse climates across the United States. Housing for unweaned calves should provide a dry area with shelter that does not allow contact with other calves or older animals, especially. Hutches or individual animal pens usually are recommended for unweaned calves. Weaned heifers are more commonly grouped with animals of similar age. Lactating and dry cows are typically housed in facilities somewhat determined by local climate.

The majority of operations (74.9 percent) housed unweaned heifers in individual animal pens or hutches at some point during 2006. Approximately half the operations housed weaned heifers on pasture and/or in inside or outside multiple-animal areas (49.2, 55.6, and 44.6 percent of operations, respectively). Lactating cows were frequently housed in tie stall/stanchion barns, pasture, and freestalls (62.6, 49.4, and 41.1 percent of operations, respectively). Dry cows commonly had access to pasture on 60.1 percent of operations and to drylot/multiple-animal outside areas on 40.0 percent of operations.

a. Percentage of operations by type of housing used for any length of time during 2006, and by cattle class:

	Percent Operations							
	Cattle Class							
	Unweaned Heifers		**Weaned Heifers**		**Lactating Cows**		**Dry Cows** (Nonlactating)	
Housing Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall/stanchion	12.1	(1.0)	12.2	(1.0)	62.6	(1.0)	32.7	(1.3)
Freestall	5.6	(0.7)	20.9	(1.2)	41.1	(1.2)	30.9	(1.2)
Individual pen/hutch	74.9	(1.3)	15.6	(1.1)	3.2	(0.5)	4.4	(0.6)
Drylot/multiple animal outside area	5.2	(0.7)	44.6	(1.4)	26.8	(1.2)	40.0	(1.3)
Multiple animal inside area	23.6	(1.3)	55.6	(1.5)	14.7	(1.0)	27.3	(1.2)
Pasture	6.3	(0.7)	49.2	(1.5)	49.4	(1.4)	60.1	(1.4)
Other	1.5	(0.3)	1.8	(0.4)	0.4	(0.1)	1.1	(0.2)

The most common primary housing types were individual-animal pens/hutches for unweaned heifers, multiple-animal inside areas for weaned heifers, and tie stall/stanchion barns for lactating cows. The percentages of dry cow primary housing were similar for tie stall/stanchion, freestall, drylot/multiple-animal outside housing, and pasture.

b. Percentage of operations by primary housing facility/outside area used during 2006, and by cattle class:

	Percent Operations							
	Cattle Class							
	Unweaned Heifers		**Weaned Heifers**		**Lactating Cows**		**Dry Cows** (Nonlactating)	
Housing Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall/stanchion	8.9	(0.8)	5.9	(0.7)	49.2	(1.3)	23.3	(1.3)
Freestall	2.7	(0.5)	12.1	(0.9)	32.6	(1.1)	22.8	(1.1)
Individual pen/hutch	67.9	(1.3)	5.3	(0.7)	0.1	(0.1)	1.0	(0.3)
Drylot/multiple animal outside area	0.6	(0.2)	22.9	(1.1)	4.6	(0.5)	18.7	(1.0)
Multiple animal inside area	14.2	(1.1)	34.6	(1.4)	3.4	(0.6)	12.9	(0.9)
Pasture	0.6	(0.2)	10.8	(0.9)	9.9	(0.8)	20.5	(1.1)
Not housed on operation	4.7	(0.5)	7.7	(0.7)	0.0	(--)	0.2	(0.1)
Other	0.4	(0.2)	0.7	(0.2)	0.2	(0.1)	0.6	(0.2)
Total	100.0		100.0		100.0		100.0	

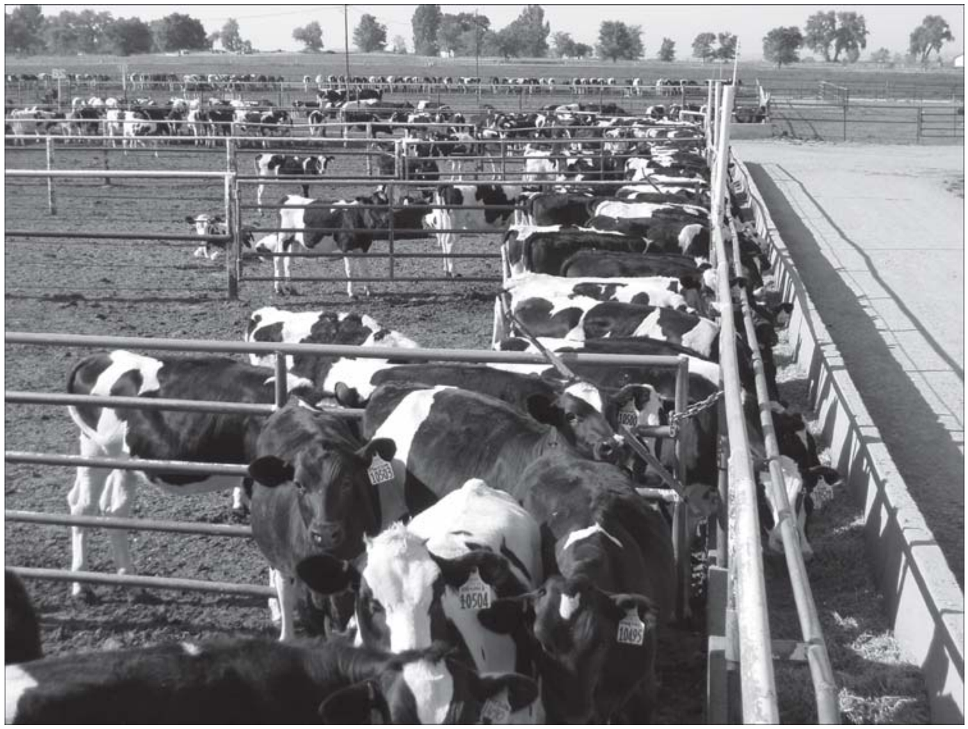


Photo by Dr. Jason Lombard

Separating dry cows from lactating cows allows the producer to formulate different diets to meet the specific needs of each group. Limiting potassium intake and providing anionic salts to dry cows are two preventive practices for milk fever that can be implemented when dry cows are housed separately from lactating cows. Dry cow or maternity housing was separate from lactating cow housing on 60.0 percent of operations, and the percentage of operations that used separate housing increased as herd size increased.

c. Percentage of operations where maternity housing was separate from housing used for lactating cows, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
51.5	(1.7)	80.8	(1.8)	90.4	(2.0)	60.0	(1.3)

3. Milking facilities

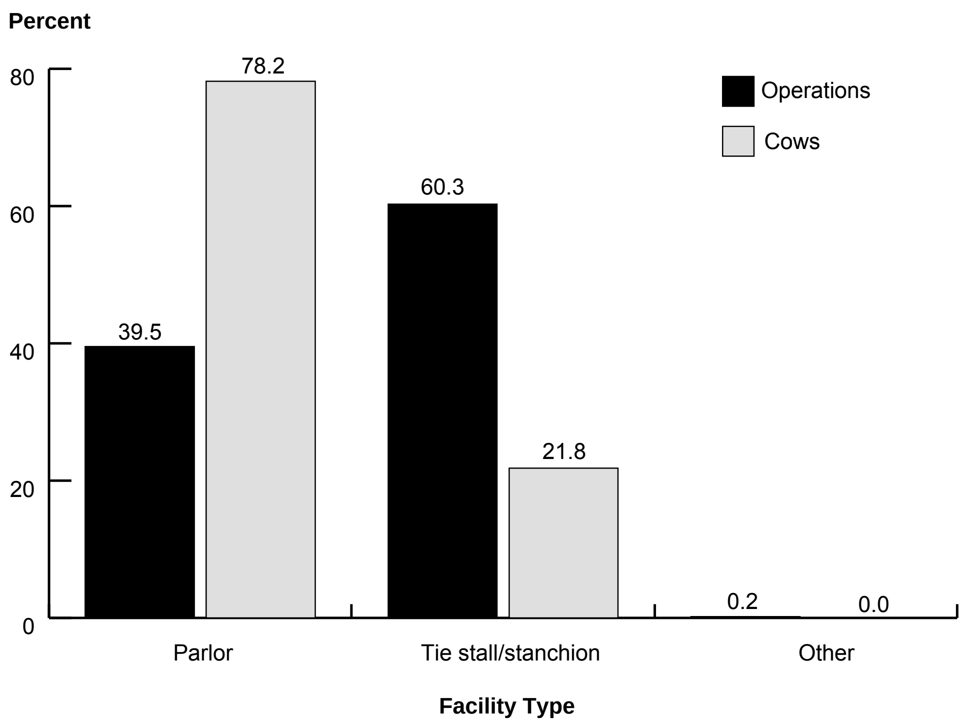
The majority of operations (60.3 percent) had a tie stall/stanchion milking facility. Although just 39.5 percent of operations used parlors, 78.2 percent of cows were on operations that milked in parlors.

a. Percentage of operations (and percentage of cows on these operations) by primary milking facility used in 2006:

Facility Type	Percent Operations	Standard Error	Percent Cows*	Standard Error
Parlor	39.5	(1.0)	78.2	(0.6)
Tie stall/stanchion	60.3	(1.0)	21.8	(0.6)
Other	0.2	(0.1)	0.0	(0.0)
Total	100.0		100.0	

*As a percentage of January 1, 2007, cow inventory.

Percentage of Operations (and Percentage of Cows* on These Operations) by Primary Milking Facility Used in 2006



As a percentage of January 1, 2007, cow inventory

Herringbone and parallel parlors were the two most common parlor types. Over half of operations that used parlors (54.4 percent) used a herringbone parlor, and these operations accounted for 48.7 percent of cows. Approximately one-fifth of operations (19.7 percent) used a parallel parlor to milk, and 30.6 percent of cows were on these operations.

b. For operations that primarily used a parlor milking facility, percentage of operations (and percentage of cows on these operations) by parlor type:

Parlor Type	Percent Operations	Standard Error	Percent Cows*	Standard Error
Side-opening (tandem)	6.6	(0.9)	3.7	(0.7)
Herringbone (fishbone)	54.4	(1.8)	48.7	(1.9)
Parallel (side-by-side)	19.7	(1.3)	30.6	(1.7)
Parabone (herringbone-parallel hybrid)	3.8	(0.6)	3.8	(0.6)
Swing	2.2	(0.6)	0.8	(0.2)
Rotary (carousel)	1.1	(0.3)	5.2	(1.3)
Flat barn	9.9	(1.2)	6.2	(0.8)
Other	2.3	(0.6)	1.0	(0.3)
Total	100.0		100.0	

*As a percentage of January 1, 2007, cow inventory.

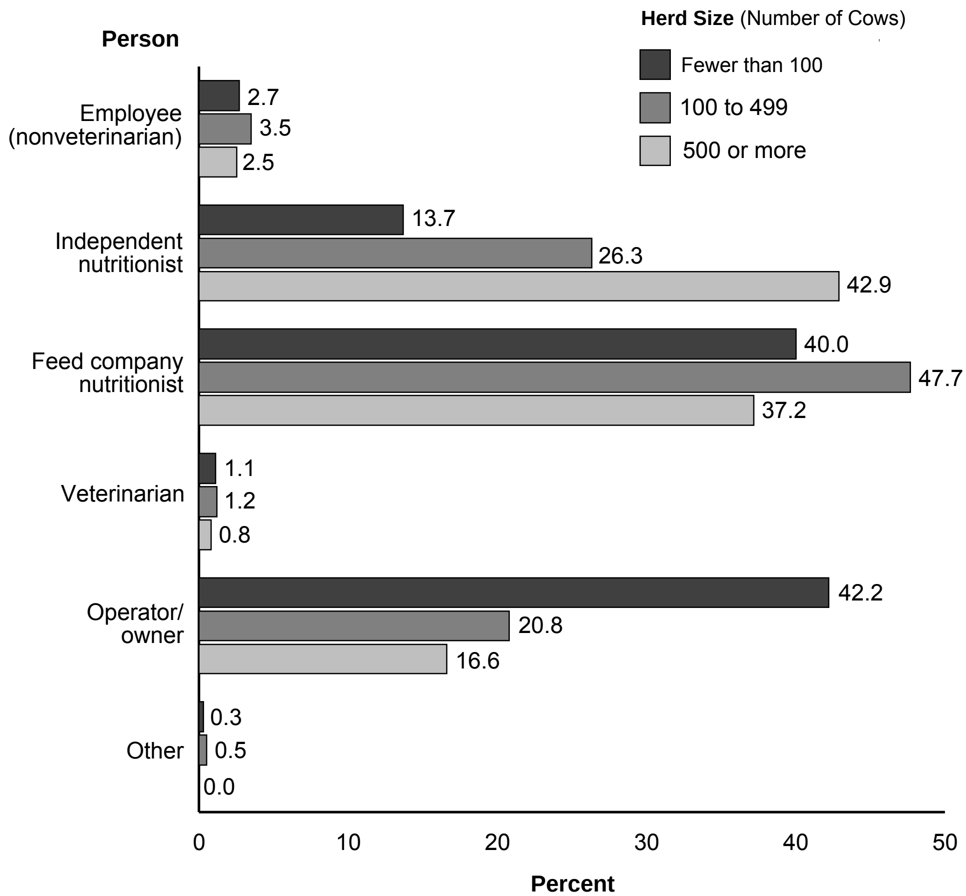
4. Cow nutrition

Nutrition is an important component of herd health and productivity. The majority of operations used either a feed company nutritionist or the owner/operator for balancing rations fed to cows (41.6 and 36.1 percent of operations, respectively). The percentage of operations that used an independent nutritionist to balance rations increased as herd size increased. The percentage of operations that used the owner/operator to balance rations decreased from 42.2 percent of small operations to 16.6 percent of large operations. Very few operations used an employee or veterinarian to balance feed rations.

a. Percentage of operations by person primarily responsible for balancing feed rations, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Person	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Employee (nonveterinarian)	2.7	(0.6)	3.5	(1.0)	2.5	(1.0)	2.8	(0.5)
Independent nutritionist	13.7	(1.3)	26.3	(2.1)	42.9	(2.6)	18.0	(1.0)
Feed company nutritionist	40.0	(1.7)	47.7	(2.3)	37.2	(2.9)	41.6	(1.4)
Veterinarian	1.1	(0.3)	1.2	(0.5)	0.8	(0.3)	1.1	(0.3)
Operator/owner	42.2	(1.8)	20.8	(1.9)	16.6	(2.5)	36.1	(1.4)
Other	0.3	(0.2)	0.5	(0.4)	0.0	(0.0)	0.4	(0.1)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Person Primarily Responsible for Balancing Feed Rations, and by Herd Size



Approximately half of operations (51.1 percent) fed a total mixed ration. Feeding a total mixed ration has the advantage of providing a consistent mixture of feeds to the cow and her rumen environment. Only 37.8 percent of small operations fed a total mixed ration, compared to 94.1 percent of large operations. This practice may be much more common in large herds because there are enough cows in a similar stage of lactation and/or level of milk production, and the facility design usually accommodates the efficient formulation of a total mixed ration.

b. Percentage of operations that fed a total mixed ration, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
37.8	(1.6)	84.7	(1.7)	94.1	(1.4)	51.1	(1.3)

A higher percentage of operations with RHA milk production of 20,000 lb/cow or more (70.7 percent) fed a total mixed ration, compared to 23.5 percent of operations with an RHA milk production of less than 16,000 lb/cow.

c. Percentage of operations that fed a total mixed ration, by RHA milk production (lb/cow):

Percent Operations					
RHA Milk Production (lb/cow)					
Less Than 16,000		16,000 to 19,999		20,000 or More	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
23.5	(2.4)	42.7	(2.3)	70.7	(1.9)

Forage test results were used to balance feed rations on three of four operations (75.5 percent). A lower percentage of small operations (70.1 percent) used forage test results to balance feed rations compared to medium and large operations (89.9 and 90.7 percent, respectively).

d. Percentage of operations that used forage test results to balance feed rations, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
70.1	(1.7)	89.9	(1.4)	90.7	(1.8)	75.5	(1.2)

The use of pasture decreased as herd size increased. The majority of small operations (68.7 percent) relied on pasture for forage while less than 1 in 5 large operations (18.6 percent) allowed cows access to pasture during the growing season. More than half of operations (58.9 percent) used pasture during the growing season to provide part of the ration forage component. The percentage of cows that had access to pasture also decreased as herd size increased, with 33.0 percent of all cows having access to pasture.

e. Percentage of operations (and percentage of cows on these operations) that relied on pasture during the growing season to provide part of the ration forage component for cows, by herd size:

	Percent Operations							
	Herd Size (Number of Dairy Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
	Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Operations	68.7	(1.6)	36.6	(2.2)	18.6	(2.3)	58.9	(1.3)
Cows	64.3	(1.7)	34.5	(2.1)	16.1	(2.0)	33.0	(1.3)

5. Number of bulls

The percentage of operations that used bulls for breeding increased as herd size increased. Approximately half of small operations (46.3 percent) used bulls for breeding compared to 82.6 percent of large operations.

a. Percentage of operations by the number of bulls in the January 1, 2007, inventory used for breeding dairy cows or heifers, and by herd size:

	Percent Operations							
	Herd Size (Number of Dairy Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Number of Bulls	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
0	53.7	(1.8)	38.1	(2.3)	17.4	(1.7)	48.3	(1.4)
1	31.9	(1.7)	22.6	(1.9)	6.5	(1.6)	28.5	(1.3)
2 to 4	14.2	(1.2)	31.8	(2.1)	22.8	(2.2)	18.6	(1.0)
5 or more	0.2	(0.1)	7.5	(0.9)	53.3	(2.5)	4.6	(0.3)
Total	100.0		100.0		100.0		100.0	

b. Of all bulls present on January 1, 2007, used for breeding dairy cows and heifers, percentage of bulls that were dairy bulls:

Percent Bulls*	Standard Error
87.3	(2.1)

*Number of dairy bulls used for breeding dairy cattle, as a percentage of all bulls used for breeding dairy cattle.

6. Adverse drug reactions

Adverse reactions, which include a lump or swelling at the injection site, hives, abortion, collapse, or death, can occur following the administration of preventive or therapeutic products. Only 12.7 percent of operations had at least one adverse reaction on their operation during 2006.

a. Percentage of operations with at least one cow that had an adverse reaction to an injection during 2006:

Percent Operations	Standard Error
12.7	(0.8)

The most common adverse reaction was a lump or swelling at the injection site (75.9 percent of operations). Loss of milk production was observed on 31.4 percent of operations reporting an adverse reaction.

b. For operations with at least one cow that had an adverse reaction to an injection, percentage of operations with any cows displaying clinical signs:

Clinical Sign	Percent Operations	Standard Error
Collapse	19.7	(2.8)
Hives	12.7	(2.1)
Abortion	13.2	(2.1)
Lump or swelling at injection site	75.9	(3.0)
Loss of milk production	31.4	(3.3)
Lack of product efficacy	5.4	(1.7)
Fever	11.1	(2.3)
Lethargy	9.4	(2.1)
Respiratory disease	6.3	(1.6)
Infertility	4.5	(1.4)
Other	6.0	(1.5)

For operations with at least one cow that had an adverse reaction to an injection, approximately one in three operations (29.8 percent) had a veterinarian examine any cows with adverse reactions.

c. For operations with at least one cow that had an adverse reaction to an injection, percentage of operations that had a veterinarian examine any cows with an adverse reaction:

Percent Operations	Standard Error
29.8	(3.2)

Vaccines, veterinary drugs, and medicated feeds are regulated by two different governmental agencies: vaccines and other biologics are regulated by the USDA's Centers for Veterinary Biologics; veterinary drugs, medicated feeds, and animal devices are regulated by the Food and Drug Administration, Center for Veterinary Medicine. Both agencies strongly encourage producers encountering any problems with veterinary products, including adverse reactions in animals, to contact the manufacturer and report the event prior to contacting the appropriate regulatory agency. Both agencies have Web sites where the adverse event can be reported.

To report adverse events associated with vaccines and other biologics, contact USDA—Center for Veterinary Biologics:
http://www.aphis.usda.gov/vs/cvb/html/adverseeventreport.html.

Adverse events associated with drugs, medicated feeds, and animal devices should be reported to the FDA—Center for Veterinary Medicine:
http://www.fda.gov/cvm/adetoc.htm.

Nearly half of operations (47.1 percent) reported the adverse reaction to their veterinarian. No producers reported reactions to either USDA or FDA, and only 3.9 percent of operations reported adverse reactions to the manufacturer. More than half of operations (52.4 percent) did not report the adverse reaction.

d. For operations with at least one cow that had an adverse reaction to an injection, percentage of operations that reported any adverse reaction, by official reported to:

Official	Percent Operations	Standard Error
Veterinarian	47.1	(3.5)
Manufacturer	3.9	(1.1)
USDA's Center for Veterinary Biologics	0.0	(--)
FDA's Center for Veterinary Medicine	0.0	(--)
Other	0.3	(0.3)
Did not report adverse reaction	52.4	(3.5)

7. Preventive practices

Almost all operations (95.3 percent) used some preventive practice for cows. Providing vitamin A-D-E or selenium in feed and deworming were the most frequently practiced preventives given on 80.2, 76.1, and 63.3 percent of operations, respectively.

Percentage of operations (and percentage of cows on these operations) by preventive practices normally used for cows:

Preventive Practice	Percent Operations	Standard Error	Percent Cows*	Standard Error
Dewormers	63.3	(1.4)	46.0	(1.3)
Ionophores in feed (e.g., Rumensin®)	26.8	(1.1)	40.0	(1.5)
Vitamins A-D-E injection	12.9	(0.8)	20.2	(1.2)
Vitamins A-D-E in feed	80.2	(1.2)	79.3	(1.2)
Selenium injection	14.9	(0.9)	19.8	(1.2)
Selenium in feed	76.1	(1.2)	73.5	(1.3)
Probiotics	26.1	(1.2)	34.8	(1.6)
Anionic salts in close-up dry cow feed	26.7	(1.2)	44.5	(1.5)
Limited potassium in dry cow ration	46.9	(1.4)	62.8	(1.4)
Other	3.6	(0.6)	2.8	(0.4)
Any preventive	95.3	(0.7)	96.0	(0.7)

*As a percentage of January 1, 2007, cow inventory.

8. Vaccination practices

Approximately four of five operations (82.2 percent) vaccinated cows. With the exception of “other” disease, a lower percentage of small operations vaccinated against any single disease listed in the table below compared to medium and large operations. Compared to medium operations, a higher percentage of large operations vaccinated against BVD, *Salmonella*, *E. coli* mastitis, and clostridia. Vaccinating for any disease increased as herd size increased, with 77.8, 92.7, and 98.4 percent of small, medium, and large operations, respectively, vaccinating for any disease.

a. Percentage of operations that normally vaccinated cows against the following diseases, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Disease	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Bovine viral diarrhea (BVD)	69.8	(1.7)	87.2	(1.6)	95.7	(1.0)	75.0	(1.3)
Infectious bovine rhinotracheitis (IBR)	66.1	(1.7)	84.3	(1.7)	88.0	(2.1)	71.3	(1.3)
Parainfluenza Type 3 (PI3)	58.0	(1.8)	72.3	(2.0)	72.9	(2.5)	61.9	(1.4)
Bovine respiratory syncytial virus (BRSV)	59.9	(1.8)	78.1	(1.8)	79.4	(2.5)	65.0	(1.4)
Haemophilus somnus	30.8	(1.7)	41.3	(2.3)	40.8	(2.9)	33.6	(1.3)
Leptospirosis	65.6	(1.7)	81.1	(1.8)	84.3	(2.4)	70.0	(1.3)
Salmonella	16.2	(1.3)	37.9	(2.3)	55.1	(3.0)	23.0	(1.1)
E. coli mastitis	25.3	(1.5)	50.0	(2.3)	79.1	(2.5)	33.5	(1.2)
Clostridia	20.7	(1.5)	42.7	(2.2)	60.8	(2.9)	27.7	(1.2)
Neospora	3.6	(0.7)	10.7	(1.6)	17.8	(2.3)	5.9	(0.6)
Other	7.6	(0.9)	6.6	(1.1)	7.7	(1.5)	7.4	(0.7)
Any vaccination	77.8	(1.5)	92.7	(1.2)	98.4	(0.5)	82.2	(1.1)

b. Percentage of operations that normally vaccinated cows against the following diseases, by region:

	Percent Operations			
	Region			
	West		East	
Disease	Pct.	Std. Error	Pct.	Std. Error
Bovine viral diarrhea (BVD)	82.2	(2.5)	74.4	(1.3)
Infectious bovine rhinotracheitis (IBR)	73.6	(2.8)	71.1	(1.4)
Parainfluenza Type 3 (PI3)	59.7	(3.0)	62.1	(1.5)
Bovine respiratory syncytial virus (BRSV)	66.8	(3.0)	64.8	(1.5)
Haemophilus somnus	30.9	(2.8)	33.8	(1.4)
Leptospirosis	74.7	(2.8)	69.6	(1.4)
Salmonella	44.5	(3.0)	21.3	(1.2)
E. coli mastitis	62.1	(2.9)	31.2	(1.3)
Clostridia	53.7	(3.1)	25.6	(1.3)
Neospora	14.2	(2.3)	5.3	(0.6)
Other	6.6	(1.4)	7.4	(0.8)
Any disease	89.7	(2.2)	81.6	(1.2)

9. Types of BVD vaccine

A higher percentage of operations administered killed versus modified live vaccines to cows (56.3 and 48.9 percent, respectively).

a. For operations that gave BVD vaccinations to cows, percentage of operations by type of BVD vaccine given:

Type of Vaccine	Percent Operations	Standard Error
Killed	56.3	(1.6)
Modified live	48.9	(1.6)

For operations that administered BVD vaccine, 60.8 percent reported that the vaccine contained both Type I and Type II strains. Approximately one-quarter of operations (27.2 percent) did not know which strain was included in the vaccine.

b. For operations that gave BVD vaccinations, percentage of operations by strain of BVD contained in vaccine administered:

BVD Strain	Percent Operations	Standard Error
Type I only	4.3	(0.6)
Type II only	7.7	(0.8)
Combination (Type I and Type II)	60.8	(1.5)
Did not know	27.2	(1.4)
Total	100.0	

More than four of five operations that administered BVD vaccine to cows (80.2 percent) reported giving annual booster vaccines.

c. For operations that gave BVD vaccinations to cows, percentage of operations that gave annual BVD booster injections:

Percent Operations	Standard Error
80.2	(1.3)

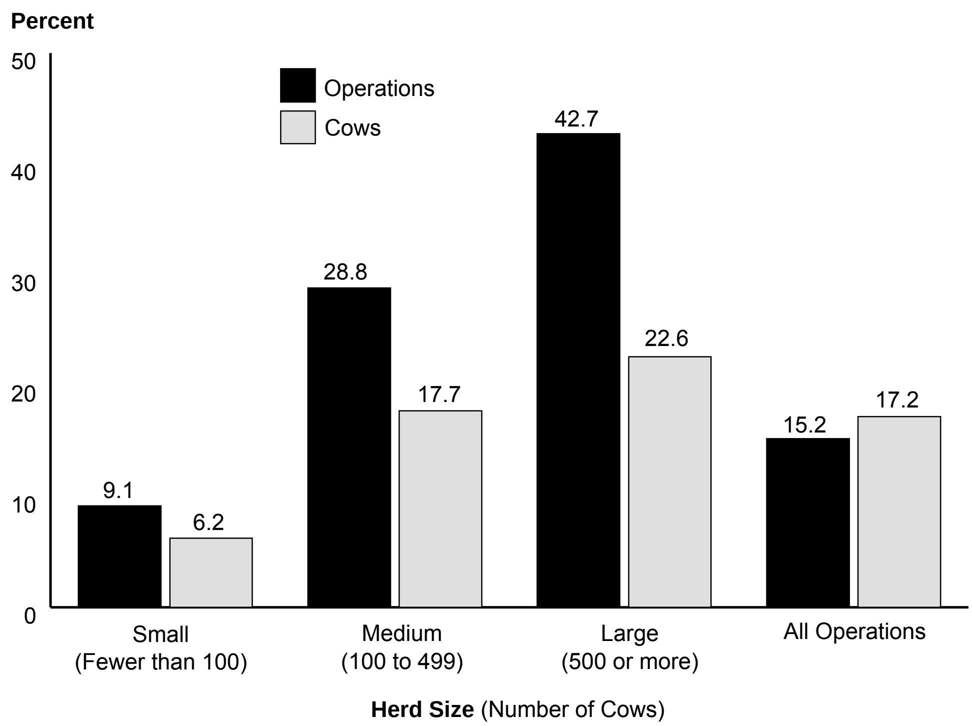
10. Bovine somatotropin (bST)

A total of 15.2 percent of operations used bST on 17.2 percent of cows. As herd size increased so did the percentage of operations that used bST, ranging from 9.1 percent of small operations to 42.7 percent of large operations.

a. Percentage of operations (and percentage of cows milked on January 1, 2007) that used bST in cows during the current lactation (at the time of the Dairy 2007 interview), by herd size:

	Percent							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Measure	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Operations	9.1	(0.9)	28.8	(2.0)	42.7	(2.5)	15.2	(0.8)
Cows	6.2	(0.7)	17.7	(1.4)	22.6	(1.5)	17.2	(0.8)

Percentage of Operations (and Percentage of Cows Milked on January 1, 2007) that Used bST in Cows During the Current Lactation (at the Time of the Dairy 2007 Interview), by Herd Size



Although the percentages of operations that used bST were similar between regions, a higher percentage of cows in the East region (20.8 percent) received bST compared to 12.3 percent in the West region.

b. Percentage of operations (and percentage of cows milked on January 1, 2007) that used bST in cows during the current lactation (at the time of the Dairy 2007 interview), by region:

	Percent			
	Region			
	West		East	
Measure	Percent	Std. Error	Percent	Std. Error
Operations	16.3	(1.6)	15.1	(0.9)
Cows	12.3	(1.3)	20.8	(1.1)

Operations that used bST on at least some cows had a RHA milk production of 3,000 to 5,000 lb/cow more milk compared to operations that did not use bST. Operations that used bST had a RHA of 23,304 lb/cow compared to 18,433 lb/cow for operations that did not use bST.

c. Operation average RHA milk production (lb/cow) by bST use and by herd size:

	Operation Average							
	Herd Size (Number of Dairy Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
bST Used	Lb/Cow	Std. Error	Lb/Cow	Std. Error	Lb/Cow	Std. Error	Lb/Cow	Std. Error
Yes	22,490	(392)	23,705	(281)	24,576	(249)	23,304	(210)
No	17,980	(142)	19,783	(184)	21,278	(275)	18,433	(118)

F. Cow Health

1. Abortions

Abortion is a term generally used to describe the expulsion of a dead fetus from 45 to 265 days of gestation. A goal is to have less than 2 percent of cows and heifers abort each year, although up to 5 percent is considered normal. The overall abortion percentage (including both heifers and cows) was 4.5 percent during 2006. The abortion percentage was higher for cows than for heifers (5.0 and 3.3 percent, respectively). Large operations had a higher percentage of abortions than medium and small operations.

a. Percentage of heifers, cows, and both heifers and cows (number aborted divided by inventory) that aborted during 2006, by herd size:

	Percent Abortions							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Heifers*	2.4	(0.2)	2.8	(0.2)	4.1	(0.4)	3.3	(0.2)
Cows**	4.4	(0.2)	4.1	(0.2)	5.8	(0.4)	5.0	(0.2)
Both heifers and cows***	3.7	(0.1)	3.7	(0.1)	5.3	(0.3)	4.5	(0.2)

*Breeding age or older heifers on January 1, 2007
**Cow inventory minus breeding age and older heifers on January 1, 2007
***Cow inventory on January 1, 2007

Over one-third of operations (38.2 percent) reported an abortion percentage of less than 2.0 percent. Less than 5 percent of cows and heifers aborted on 72.5 of operations, while on 6.9 percent of operations 10 percent or more of cows and heifers aborted during 2006.

b. Percentage of operations by reported total abortion percentage:

Abortion Percentage	Percent Operations	Standard Error
Less than 2.0	38.2	(1.4)
2.0 to 4.9	34.3	(1.3)
5.0 to 9.9	20.6	(1.1)
10.0 to 14.9	4.9	(0.6)
15.0 or more	2.0	(0.4)
Total	100.0	

2. Cow morbidity

During 2006, more than 80 percent of operations identified at least one case of clinical mastitis, lameness, retained placenta, infertility problems, or milk fever. With the exception of “other” health related problems, a higher percentage of large operations than small operations observed at least one cow with health problems. Large operations would be expected to observe more health problems due to the larger numbers of cows at risk for developing any health problem. All medium and large operations (100.0 percent) observed at least one case of clinical mastitis, lameness, and milk fever. Neurological problems and “other” health-related problems were identified on 10.7 and 7.7 percent of all operations, respectively.

a. Percentage of operations by producer-identified health problems occurring in cows during 2006, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Producer-Identified Health Problem	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Clinical mastitis	93.0	(1.0)	100.0	(--)	100.0	(--)	94.9	(0.8)
Lameness	83.4	(1.4)	100.0	(--)	100.0	(--)	87.9	(1.0)
Respiratory problems	38.0	(1.7)	98.1	(0.8)	100.0	(--)	51.5	(1.4)
Retained placenta (more than 24 hours)	76.9	(1.5)	99.7	(0.2)	100.0	(--)	82.6	(1.2)
Infertility problems (not pregnant 150 days after calving)	78.2	(1.5)	99.2	(0.4)	100.0	(--)	83.5	(1.1)
Other reproductive problems (e.g., dystocia, metritis)	31.0	(1.6)	58.1	(2.2)	67.4	(2.7)	38.8	(1.3)
Diarrhea for more than 48 hours	28.7	(1.6)	51.0	(2.3)	72.6	(2.8)	35.7	(1.3)
Milk fever	77.9	(1.5)	100.0	(--)	100.0	(--)	83.5	(1.2)
Displaced abomasum	51.2	(1.7)	98.9	(0.4)	100.0	(--)	62.3	(1.4)
Neurological problems	7.6	(1.0)	18.1	(1.7)	23.5	(2.3)	10.7	(0.8)
Other health-related problems	7.4	(1.0)	8.3	(1.3)	10.0	(1.7)	7.7	(0.8)

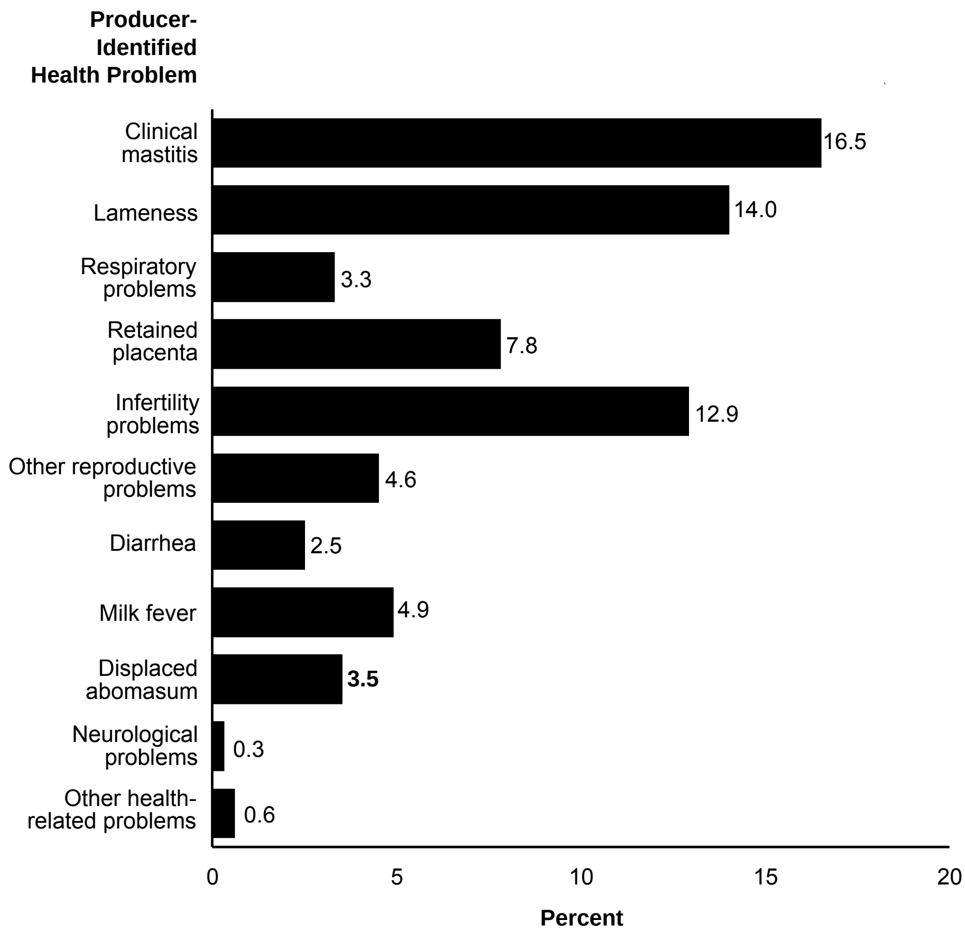
The three most prevalent diseases reported in cows were clinical mastitis, lameness, and infertility problems (16.5, 14.0, and 12.9 percent of cows, respectively). Small operations reported a lower percentage of cows with infertility problems and other reproductive problems compared to medium and large operations, while large operations reported a lower percentage of cows with retained placenta, diarrhea for more than 48 hours, milk fever, and displaced abomasum compared to medium and small operations.

b. Percentage of cows* by producer-identified health problems occurring in cows during 2006, and by herd size:

	Percent Cows*							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Producer-Identified Health Problem	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Clinical mastitis	16.5	(0.5)	14.8	(0.6)	17.5	(1.0)	16.5	(0.5)
Lameness	13.2	(0.5)	15.6	(0.6)	13.5	(0.8)	14.0	(0.4)
Respiratory problems	2.5	(0.2)	4.1	(0.3)	3.4	(0.3)	3.3	(0.1)
Retained placenta (more than 24 hours)	8.9	(0.3)	8.9	(0.3)	6.4	(0.4)	7.8	(0.2)
Infertility problems (not pregnant 150 days after calving)	10.8	(0.4)	13.2	(0.5)	14.1	(0.6)	12.9	(0.3)
Other reproductive problems (e.g., dystocia, metritis)	3.4	(0.2)	5.0	(0.3)	5.0	(0.5)	4.6	(0.3)
Diarrhea for more than 48 hours	3.9	(0.5)	2.5	(0.3)	1.6	(0.1)	2.5	(0.2)
Milk fever	6.6	(0.2)	5.9	(0.3)	3.0	(0.2)	4.9	(0.1)
Displaced abomasum	3.6	(0.2)	4.8	(0.2)	2.5	(0.2)	3.5	(0.1)
Neurological problems	0.3	(0.0)	0.3	(0.0)	0.2	(0.0)	0.3	(0.0)
Other health-related problems	0.8	(0.2)	1.0	(0.4)	0.2	(0.0)	0.6	(0.1)

*As a percentage of January 1, 2007, cow inventory

Percentage of Cows* by Producer-Identified Health Problems Occuring in Cows During 2006



*As a percentage of January 1, 2007, cow inventory

3. Permanently removed cows

The vast majority of operations permanently removed at least one cow during 2006, regardless of herd size.

a. Percentage of operations that permanently removed any cows from the operation (excluding cows that died) during 2006, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
96.5	(0.8)	98.7	(0.7)	97.3	(0.8)	97.0	(0.6)

There were no differences by region in the percentages of operations that permanently removed at least one cow during 2006.

b. Percentage of operations that permanently removed any cows from the operation (excluding cows that died) during 2006, by region:

Percent Operations			
Region			
West		**East**	
Percent	**Std. Error**	**Percent**	**Std. Error**
94.7	(2.2)	97.2	(0.6)

Approximately one in four cows (23.6 percent) was permanently removed from operations (excluding cows that died) during 2006. The percentages of permanently removed cows were not different across herd sizes or between regions.

c. Percentage of cows permanently removed from operations (excluding cows that died) during 2006, by herd size:

Percent Cows*							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
24.1	(0.6)	23.7	(0.5)	23.4	(0.7)	23.6	(0.4)

*As a percentage of January 1, 2007, cow inventory.

d. Percentage of cows permanently removed from operations (excluding cows that died) during 2006, by region:

Percent Cows*			
Region			
West		**East**	
Percent	**Std. Error**	**Percent**	**Std. Error**
22.8	(0.7)	24.3	(0.4)

*As a percentage of January 1, 2007, cow inventory

For operations that permanently removed cows during 2006, the majority (85.5 percent) sent some cows to a market, auction, or stockyard. Of permanently removed cows, the majority (76.2 percent) were sent to a market, auction, or stockyard.

e. For operations that permanently removed cows (excluding cows that died) during 2006, percentage of operations and percentage of cows removed, by destination of removed cows:

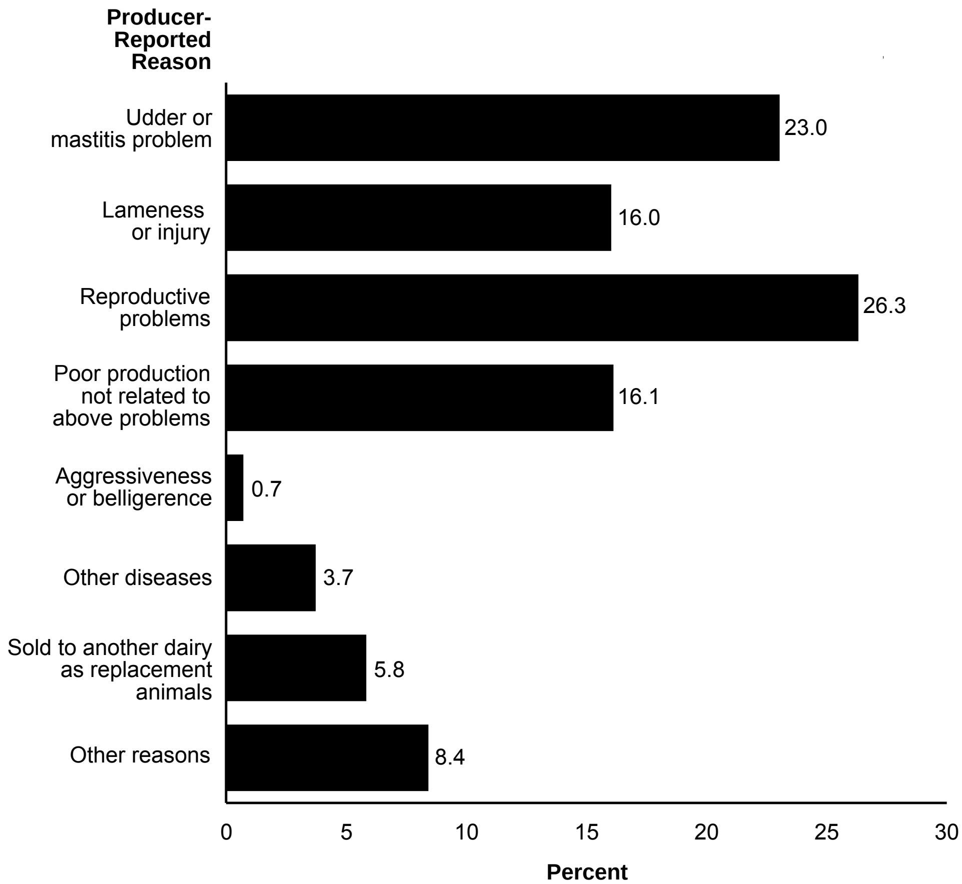
	Percent			
	Operations		**Cows**	
Destination	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Directly to another dairy	14.3	(1.0)	5.5	(0.7)
Market, auction, or stockyard	85.5	(1.0)	76.2	(1.1)
Directly to a packer or slaughter plant	26.5	(1.2)	17.5	(1.3)
Sent elsewhere	3.7	(0.6)	0.8	(0.3)
Total	NA		100.0	

For operations that permanently removed cows, the highest percentages removed some cows because of udder or mastitis problems, reproductive problems, and lameness or injury (79.2, 78.8, and 65.6 percent of operations, respectively). Of permanently removed cows, 26.3 percent were removed for reproductive problems and 23.0 percent for udder or mastitis problems. Lameness or injury and poor production not related to other listed problems led to the permanent removal of 16.0 and 16.1 percent of cows, respectively. Only 5.8 percent of permanently removed cows were sold to another dairy as replacement animals. Almost one in six operations (16.8 percent) reported “other” as a reason for permanently removing cows. These operations accounted for 8.4 percent of the cows permanently removed. Reasons listed in the “other” category included specific diseases such as Johne’s disease or reductions in herd size, but the majority of operations did not specify a reason.

f. For operations that permanently removed cows (excluding cows that died) during 2006, percentage of operations and percentage of cows removed, by producer-reported reason:

Producer-Reported Reason	Percent Operations	Standard Error	Percent Cows	Standard Error
Udder or mastitis problem	79.2	(1.2)	23.0	(0.6)
Lameness or injury	65.6	(1.4)	16.0	(0.4)
Reproductive problems	78.8	(1.2)	26.3	(0.7)
Poor production not related to above problems	47.2	(1.4)	16.1	(0.7)
Aggressiveness or belligerence (kickers)	9.6	(0.9)	0.7	(0.1)
Other diseases	15.4	(1.0)	3.7	(0.2)
Sold as replacement animals to another dairy	14.7	(1.0)	5.8	(0.7)
Other reasons	16.8	(1.1)	8.4	(1.1)
Total	NA		100.0	

For Operations That Permanently Removed Cows, Percentage of Cows Removed, by Producer-Reported Reason



G. Heifer and Cow Mortality

1. Mortality

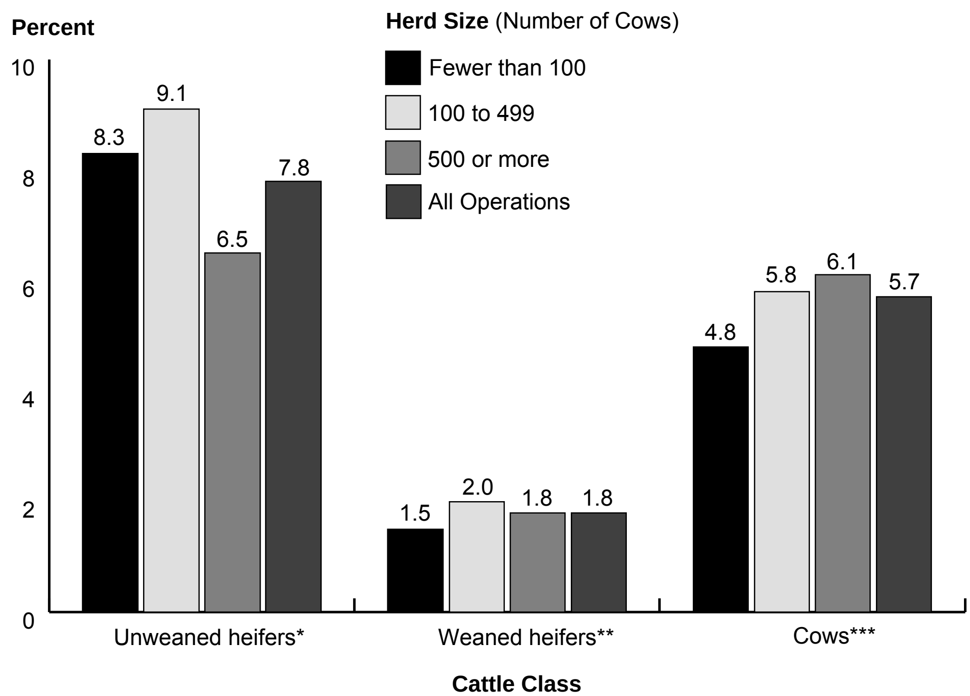
Compared to small operations, large operations had a lower percentage of unweaned heifer deaths but a higher percentage of cow deaths. Unweaned heifer deaths during 2006 accounted for the highest percentage of deaths among the animal classes at 7.8 percent, while 5.7 percent of cows and 1.8 percent of weaned heifers died.

a. Percentage of unweaned heifers, weaned heifers, and cows that died during 2006, by herd size:

	Percent							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Unweaned heifers*	8.3	(0.4)	9.1	(0.4)	6.5	(0.4)	7.8	(0.2)
Weaned heifers**	1.5	(0.1)	2.0	(0.1)	1.8	(0.1)	1.8	(0.1)
Cows***	4.8	(0.1)	5.8	(0.2)	6.1	(0.2)	5.7	(0.1)

*As a percentage of heifers born during 2006 and alive at 48 hours.
**As a percentage of January 1, 2007, heifer inventory (weaning age to calving).
***As a percentage of January 1, 2007, cow inventory.

Percentage of Unweaned Heifers, Weaned Heifers, and Cows that Died During 2006, by Herd Size



*As a percentage of heifers born during 2006 and alive at 48 hours.
**As a percentage of January 1, 2007, heifer inventory (weaning age to calving).
***As a percentage of January 1, 2007, cow inventory.

Determining the cause of death is important in preventing future deaths and improving the health of the herd. A relatively small percentage of operations performed necropsies on unweaned heifers, weaned heifers, or cows (8.0, 7.1, and 13.0 percent, respectively) in order to determine cause of death. With the exception of weaned heifers, the percentage of operations that performed any necropsy for a particular cattle class increased as herd size increased. Less than 1 in 10 small operations (8.4 percent) performed necropsies on cows compared to 33.3 percent of large operations.

b. For operations that had at least one death in the following cattle classes, percentage of operations that performed necropsies to determine the cause of death, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Unweaned heifers	4.4	(0.9)	11.9	(1.4)	22.6	(2.5)	8.0	(0.7)
Weaned heifers	5.8	(1.4)	6.9	(1.2)	13.5	(2.1)	7.1	(0.9)
Cows	8.4	(1.0)	20.2	(1.8)	33.3	(2.7)	13.0	(0.9)

Approximately 4 percent of deaths within any cattle class were necropsied to determine the cause of death. There were no substantial differences in the percentages of deaths necropsied among animal classes or herd sizes.

c. For operations that had at least one death in the following cattle classes, percentage of unweaned heifer deaths, weaned heifer deaths, and cow deaths where necropsies were performed to determine cause of death, by herd size:

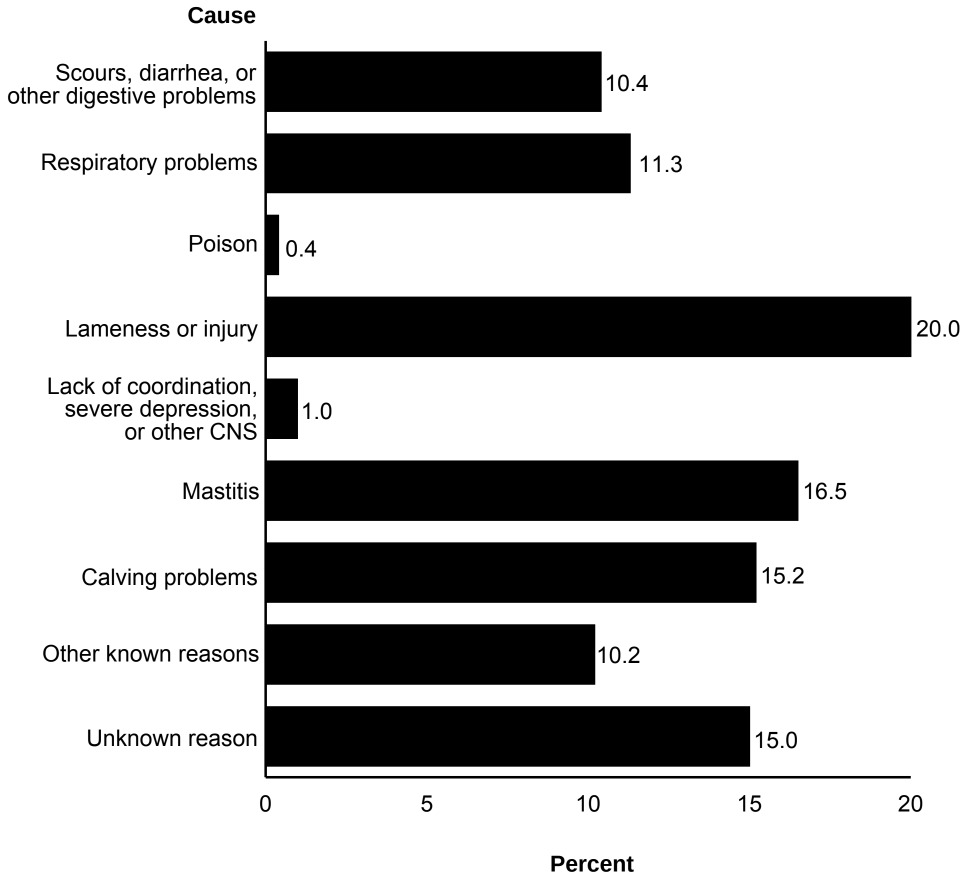
	Percent Deaths Necropsied							
	Herd Size (Number of Dairy Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Unweaned heifers	1.8	(0.4)	4.7	(1.1)	3.8	(0.5)	3.5	(0.4)
Weaned heifers	3.9	(1.0)	4.8	(1.5)	3.7	(0.7)	4.1	(0.6)
Cows	4.4	(0.7)	6.0	(0.9)	3.5	(0.4)	4.4	(0.4)

Scours, diarrhea, or other digestive problems accounted for the highest percentage of unweaned heifer deaths (56.5 percent), followed by respiratory problems (22.5 percent). For weaned heifers, respiratory disease was the single largest cause of death (46.5 percent), with unknown reasons, lameness or injury, scours, diarrhea or other digestive problems each accounting for between 12 and 15 percent of deaths. The single largest cause of cow deaths was lameness or injury (20.0 percent), followed by mastitis (16.5 percent), calving problems (15.2 percent), and unknown reasons (15.0 percent).

d. Percentage of unweaned heifer deaths, weaned heifer deaths, and cow deaths, by producer-attributed cause:

	Percent Deaths					
	Unweaned Heifers		**Weaned Heifers**		**Cows**	
Producer-Attributed Cause	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Scours, diarrhea, or other digestive problems	56.5	(1.3)	12.6	(1.0)	10.4	(0.5)
Respiratory problems	22.5	(0.9)	46.5	(1.7)	11.3	(0.7)
Poison	0.0	(0.0)	1.9	(0.9)	0.4	(0.1)
Lameness or injury	1.7	(0.3)	12.8	(1.0)	20.0	(0.8)
Lack of coordination, severe depression, or other CNS	0.3	(0.1)	0.7	(0.2)	1.0	(0.1)
Mastitis					16.5	(0.7)
Calving problems	5.3	(0.7)			15.2	(0.7)
Joint or navel problems	1.6	(0.3)	1.0	(0.3)		
Other known reasons	4.3	(0.7)	9.9	(1.0)	10.2	(0.8)
Unknown reason	7.8	(0.9)	14.6	(1.2)	15.0	(1.1)
Total	100.0		100.0		100.0	

Percentage of Cow Deaths, by Producer-Attributed Cause



2. Carcass disposal

Rendering and burial were the two most common forms of disposing of dead calves (36.5 and 32.6 percent of operations, respectively). Burial as a disposal method decreased as herd size increased. Conversely, rendering increased as herd size increased. Almost two of three large operations (65.4 percent) disposed of dead calves by rendering. Composting calf carcasses was more common on medium operations (29.5 percent) than on large operations (21.8 percent).

a. Percentage of operations by primary method used to dispose of ***dead calves,*** and by herd size:

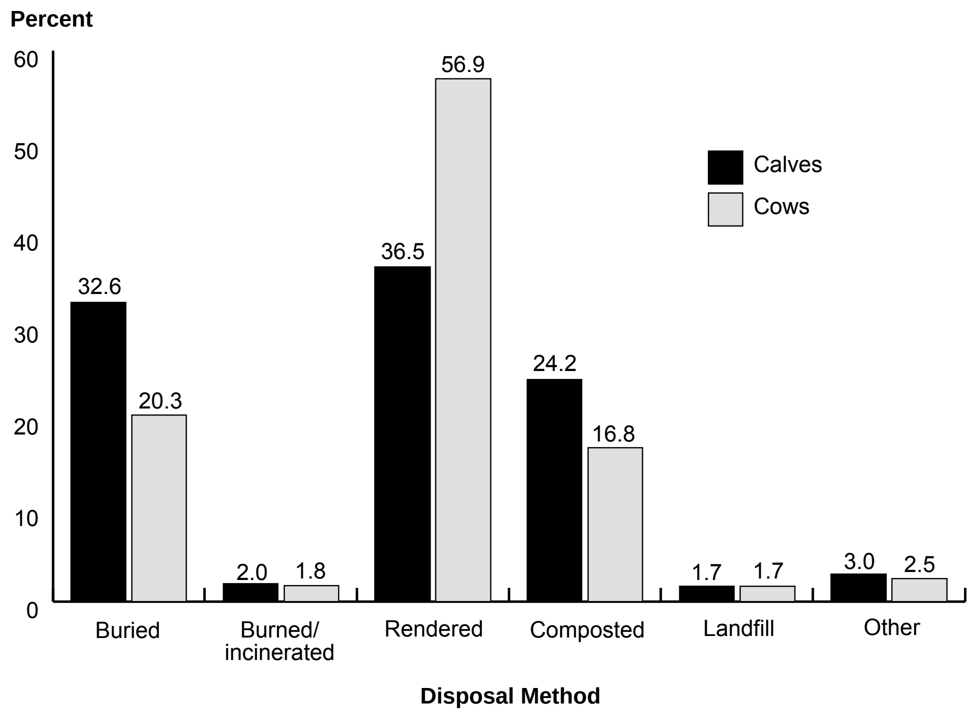
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Disposal Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Buried	36.5	(1.7)	25.5	(1.9)	7.8	(1.2)	32.6	(1.3)
Burned/ incinerated	2.5	(0.6)	0.8	(0.3)	0.3	(0.1)	2.0	(0.4)
Rendered	33.5	(1.7)	39.6	(2.2)	65.4	(2.2)	36.5	(1.3)
Composted	22.8	(1.5)	29.5	(1.9)	21.8	(1.8)	24.2	(1.2)
Landfill	1.6	(0.4)	2.2	(0.5)	1.4	(0.5)	1.7	(0.3)
Other	3.1	(0.6)	2.4	(0.7)	3.3	(1.1)	3.0	(0.5)
Total	100.0		100.0		100.0		100.0	

Rendering was the most common method of disposing of dead cows on all operations (56.9 percent). A lower percentage of large operations (6.2 percent) buried cow carcasses compared to medium or small operations (17.9 and 22.1 percent, respectively). A higher percentage of large operations (71.9 percent) had cow carcasses rendered compared to medium and small operations (55.6 and 56.2 percent, respectively). A lower percentage of small operations (15.0 percent) composted cow carcasses compared to medium operations (22.5 percent).

b. Percentage of operations by primary method used to dispose of ***dead cows,*** and by herd size:

	Percent Operations							
	Herd Size (Number of Dairy Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Disposal Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Buried	22.1	(1.4)	17.9	(1.5)	6.2	(1.1)	20.3	(1.1)
Burned/ incinerated	2.4	(0.5)	0.2	(0.2)	0.2	(0.1)	1.8	(0.4)
Rendered	56.2	(1.7)	55.6	(2.1)	71.9	(2.4)	56.9	(1.3)
Composted	15.0	(1.2)	22.5	(1.7)	17.0	(2.0)	16.8	(1.0)
Landfill	1.6	(0.3)	2.1	(0.4)	1.4	(0.5)	1.7	(0.3)
Other	2.7	(0.6)	1.7	(0.6)	3.3	(1.1)	2.5	(0.4)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Primary Method Used to Dispose of Dead Calves and Dead Cows



H. Biosecurity

1. Physical contact with unweaned calves

Unweaned calves are the most susceptible animals to illness on the operation. Separating calves from older animals is an effective management practice used to reduce disease exposure to unweaned calves. Seventy-six percent of operations representing 84.4 percent of calves did not allow unweaned calves to have physical contact with weaned calves, and approximately 85 percent of operations did not allow contact with bred heifers or adult cattle. More than two of three operations (69.5 percent) housing 78.7 percent of heifer calves did not allow weaned calves to have contact with older animals.

Percentage of operations (and percentage of heifer calves born on these operations) where after separation from the dam unweaned heifer calves did not have physical contact* with the following cattle classes:

Cattle Class	Percent Operations	Standard Error	Percent Calves	Standard Error
Weaned calves not yet of breeding age	76.0	(1.2)	84.4	(1.1)
Bred heifers not yet calved	86.8	(1.0)	91.3	(0.8)
Adult cattle	84.3	(1.1)	89.2	(0.9)
No contact with above classes	69.5	(1.3)	78.7	(1.2)

*Physical contact is defined as nose-to-nose contact or sniffing/touching/licking each other, including through a fence

2. Physical contact with other animals

Cattle can contract disease agents directly from other animals or by ingesting fecal material from other animals that have contaminated their feed or water. For example, *Neospora,* which can cause abortions, is transmitted via the feces of dogs and other canids.

More than 40 percent of operations reported that cats, dogs, and deer or other members of the deer family had contact with cattle, their feed, and/or water supply. Cattle on operations in the East region were more likely to have contact with sheep, beef cattle, cats, and deer compared to cattle on operations in the West region. Almost 4 of 5 operations in the West region (79.2 percent) and 9 of 10 operations in the East region (95.2 percent) reported that at least one of the listed animals had physical contact with cattle and/or contact with their feed, minerals, or water.

a. Percentage of operations where the following animals had physical contact with cattle and/or contact with their feed, minerals, or water supply, by region:

	Percent Operations					
	Region					
	West		East		All Operations	
Animal Type	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Chickens or other poultry	9.2	(2.1)	8.3	(0.8)	8.3	(0.8)
Horses or other equids	10.2	(2.2)	13.6	(1.1)	13.3	(1.0)
Pigs	2.0	(0.6)	2.0	(0.5)	2.0	(0.4)
Sheep	0.1	(0.1)	1.0	(0.3)	0.9	(0.3)
Goats	4.8	(1.6)	2.3	(0.4)	2.5	(0.4)
Beef cattle	5.1	(1.5)	11.8	(1.0)	11.3	(1.0)
Exotic species (e.g., llamas, alpacas, emus, etc.)	1.0	(0.6)	0.7	(0.2)	0.7	(0.2)
Dogs	63.4	(2.7)	69.4	(1.4)	68.9	(1.3)
Cats	62.1	(2.8)	87.1	(1.0)	85.2	(0.9)
Deer or other members of the deer family (e.g., elk, moose, etc.)	20.9	(2.9)	51.6	(1.5)	49.3	(1.4)
Any animal	79.2	(2.0)	95.2	(0.6)	94.0	(0.6)

Cattle that have direct contact with deer could pose a risk of transmitting diseases such as tuberculosis (TB). TB is transmitted most commonly by the respiratory route, whereby invisible droplets (aerosols) containing TB bacteria are exhaled or coughed by infected animals and then inhaled by susceptible animals or humans. The risk of exposure is greatest in enclosed areas, such as barns; however, livestock can become infected if they share a common watering place contaminated with saliva and other discharges from infected deer or other animals.

For operations where deer or members of the deer family had contact with cattle, their feed, or water, the majority of operations (90.8 percent) reported that cattle could possibly or sometimes have face-to-face contact with deer. There were no differences by region in the percentages of operations that reported face-to-face contact with deer.

b. For operations where deer had physical contact with cattle and/or contact with their feed, minerals, or water supply, percentage of operations by frequency with which members of the deer family had face-to-face contact with cattle, and by region:

	Percent Operations					
	Region					
	West		**East**		**All Operations**	
Frequency	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Never	4.8	(2.1)	9.4	(1.2)	9.2	(1.2)
Possibly	56.3	(8.0)	64.3	(2.1)	64.1	(2.0)
Sometimes	38.9	(7.9)	26.3	(1.9)	26.7	(1.9)
Total	100.0		100.0		100.0	

3. Biosecurity for new arrivals

NOTE: The percentage of operations that brought bred dairy heifers onto the operation (12.2 percent) [table a.] is similar to the percentage of operations where dairy cow replacements were born off the operation (14.1 percent), see “Source of cow replacements” p. 62. However, these percentages are higher than the percentage of heifers born off the operation (6.6 percent), see “Source of heifer inventory” p. 28. This discrepancy between the percentage of operations and the source of heifers and cow replacements could be due to a difference in the survey questions, since the source of heifers in the herd on January 1, 2007, may not be representative of the source of heifers brought on over the course of 2006.

The introduction of new animals can introduce diseases to the herd, especially if the new additions are not properly screened for disease prior to introduction. Almost 4 of 10 operations (38.9 percent) brought at least 1 new addition onto the operation during 2006. Approximately one in eight operations brought on bred dairy heifers, lactating dairy cows, or dairy bulls (12.2, 13.8, and 12.5 percent, respectively). A lower percentage of large operations brought on unweaned calves compared to small operations (1.0 and 3.8 percent, respectively), but a higher percentage of large operations brought on dairy heifers, bred dairy heifers, dairy bulls, and “any beef or dairy cattle” compared to medium or small operations.

a. Percentage of operations that brought the following classes of cattle onto the operation during 2006, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Unweaned calves (dairy or beef)	3.8	(0.8)	2.5	(0.6)	1.0	(0.3)	3.4	(0.6)
Dairy heifers (weaned but not bred)	5.3	(0.8)	7.6	(1.2)	16.3	(2.6)	6.4	(0.7)
Bred dairy heifers	8.9	(1.0)	18.1	(1.8)	34.7	(2.6)	12.2	(0.9)
Lactating dairy cows	13.2	(1.3)	16.0	(1.7)	13.0	(1.9)	13.8	(1.0)
Dry dairy cows	4.1	(0.8)	4.3	(0.9)	5.5	(1.5)	4.3	(0.6)
Beef heifers and cows	0.9	(0.3)	2.5	(0.7)	1.1	(0.6)	1.3	(0.3)
Dairy bulls (weaned)	11.4	(1.1)	14.1	(1.6)	22.5	(2.4)	12.5	(0.9)
Beef bulls (weaned)	1.5	(0.4)	2.2	(0.6)	1.5	(0.5)	1.7	(0.3)
Steers (weaned)	2.0	(0.5)	1.3	(0.5)	0.7	(0.6)	1.8	(0.4)
Any cattle	35.6	(1.7)	44.3	(2.3)	61.6	(2.8)	38.9	(1.4)

Although more operations in the West region brought on animals during 2006 compared to operations in the East region (49.3 and 38.0 percent, respectively), a higher percentage of operations in the East region brought on unweaned calves, lactating dairy cows, and steers.

b. Percentage of operations that brought the following classes of cattle onto the operation during 2006, by region:

	Percent Operations			
	Region			
	West		East	
Cattle Class	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Unweaned calves (dairy or beef)	0.6	(0.3)	3.6	(0.6)
Dairy heifers (weaned but not bred)	12.6	(2.2)	5.9	(0.7)
Bred dairy heifers	21.1	(2.3)	11.5	(0.9)
Lactating dairy cows	8.5	(1.5)	14.3	(1.1)
Dry dairy cows	2.3	(0.7)	4.4	(0.7)
Beef heifers and cows	1.5	(0.7)	1.3	(0.3)
Dairy bulls (weaned)	21.8	(2.6)	11.8	(0.9)
Beef bulls (weaned)	2.8	(0.9)	1.6	(0.3)
Steers (weaned)	0.3	(0.3)	1.9	(0.4)
Any cattle	49.3	(3.0)	38.0	(1.5)

For operations that introduced bred heifers, the percentage of cow inventory brought on as bred heifers was similar across herd sizes, ranging from 15.1 percent on small operations to 17.3 percent on large operations. For operations that introduced dry cows, the percentage of inventory brought on as dry cows ranged from 3.5 percent on medium operations to 9.5 percent on small operations.

c. For operations that brought the specified cattle classes onto the operation during 2006, percentage of cow inventory that was brought on as bred heifers, lactating cows, and dry cows, by herd size:

	Percent Inventory*							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Bred heifers	15.1	(1.7)	15.6	(1.8)	17.3	(1.4)	16.7	(1.1)
Lactating cows	15.1	(1.7)	14.0	(2.2)	10.9	(1.4)	13.1	(1.1)
Dry cows	9.5	(1.1)	3.5	(1.0)	4.2	(2.1)	5.0	(1.0)

*As a percentage of January 1, 2007, cow inventory

The most common herd additions—bred dairy heifers, lactating cows, and dairy bulls—were quarantined on less than 20 percent of operations (14.5, 12.1, and 17.1 percent, respectively). Approximately one in five operations (20.3 percent) that brought cattle onto the operation during 2006 quarantined new additions. For operations that quarantined new additions, the operation average number of days quarantined ranged from 15 to 45 days. One-sixth of cattle brought on were quarantined upon arrival at the operation.

d. For operations that brought the following classes of cattle onto the operation during 2006, percentage of operations that quarantined the following classes of cattle upon arrival, percentage of arriving cattle quarantined, and operation average number of days quarantined:

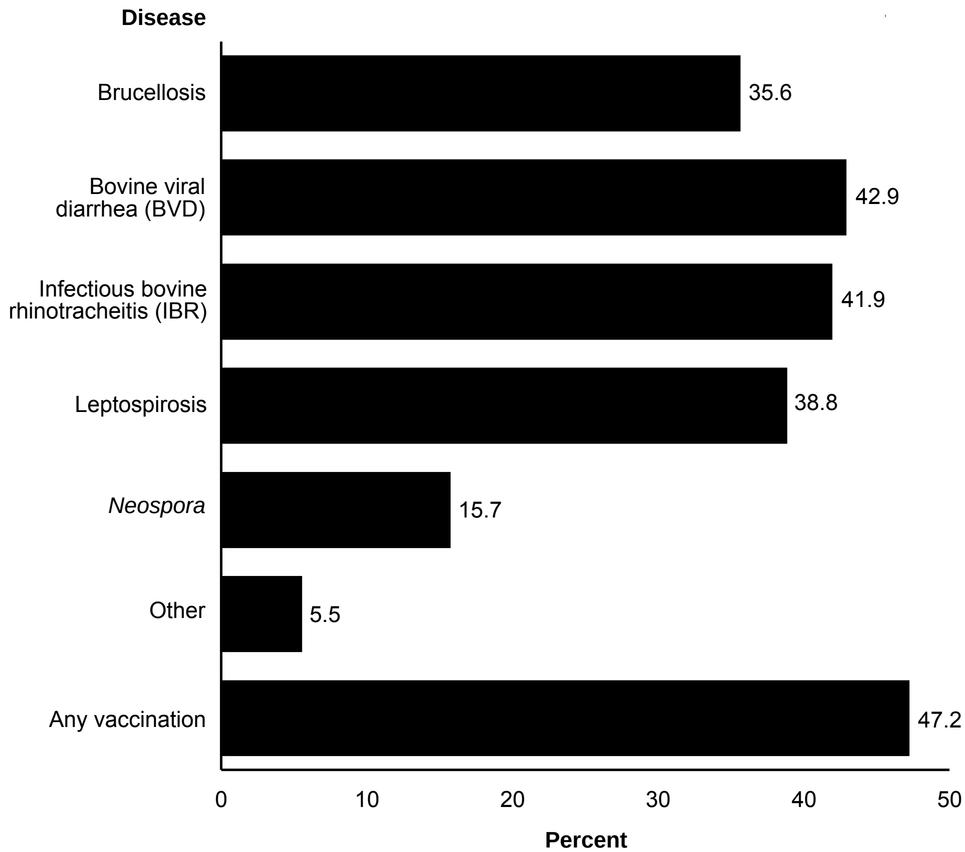
Cattle Class	Percent Operations	Standard Error	Percent Cattle Quarantined	Standard Error	Operation Average Days Quarantined	Standard Error
Unweaned calves (dairy or beef)	44.2	(8.3)	20.1	(12.6)	42.4	(4.8)
Dairy heifers (weaned but not bred)	23.0	(4.7)	7.1	(2.6)	20.0	(3.6)
Bred dairy heifers	14.5	(2.3)	19.7	(3.5)	22.0	(3.1)
Lactating dairy cows	12.1	(2.4)	17.4	(3.9)	15.6	(2.5)
Dry dairy cows	15.9	(4.8)	39.5	(14.8)	16.5	(4.3)
Beef heifers and cows	30.1	(9.8)	14.7	(7.2)	33.3	(12.1)
Dairy bulls (weaned)	17.1	(2.9)	25.6	(6.3)	25.3	(3.5)
Beef bulls (weaned)	20.3	(6.5)	53.2	(14.6)	31.9	(12.6)
Steers (weaned)	30.0	(9.6)	32.7	(14.5)	40.7	(18.7)
Any cattle	20.3	(1.7)	16.7	(2.4)	31.2	(3.5)

Less than 50 percent of operations that brought cattle onto the operation during 2006 required vaccination of new additions prior to arrival. Cattle were required to be vaccinated against BVD, IBR, and leptospirosis on 42.9, 41.9, and 38.8 percent of all operations, respectively. For all diseases listed below, a lower percentage of small operations required vaccination of new additions prior to arrival compared to medium and large operations.

e. For operations that brought any dairy cattle onto the operation during 2006, percentage of operations that normally required vaccination against the following diseases before bringing animals onto the operation, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Disease	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Brucellosis	28.0	(2.6)	50.2	(3.5)	52.2	(3.9)	35.6	(2.0)
Bovine viral diarrhea (BVD)	34.8	(2.8)	59.9	(3.4)	56.7	(3.7)	42.9	(2.1)
Infectious bovine rhinotracheitis (IBR)	34.2	(2.8)	57.3	(3.4)	57.1	(3.7)	41.9	(2.1)
Leptospirosis	32.0	(2.7)	53.6	(3.4)	48.4	(3.8)	38.8	(2.1)
Neospora	10.8	(1.7)	26.6	(3.1)	22.4	(3.3)	15.7	(1.5)
Other	4.2	(1.1)	8.7	(1.8)	6.5	(1.6)	5.5	(0.9)
Any vaccination	37.7	(2.9)	65.2	(3.3)	68.5	(3.2)	47.2	(2.2)

For Operations That Brought Any Cattle onto the Operation During 2006, Percentage of Operations That Normally Required Vaccination Against the Following Diseases Before Bringing Animals onto the Operation

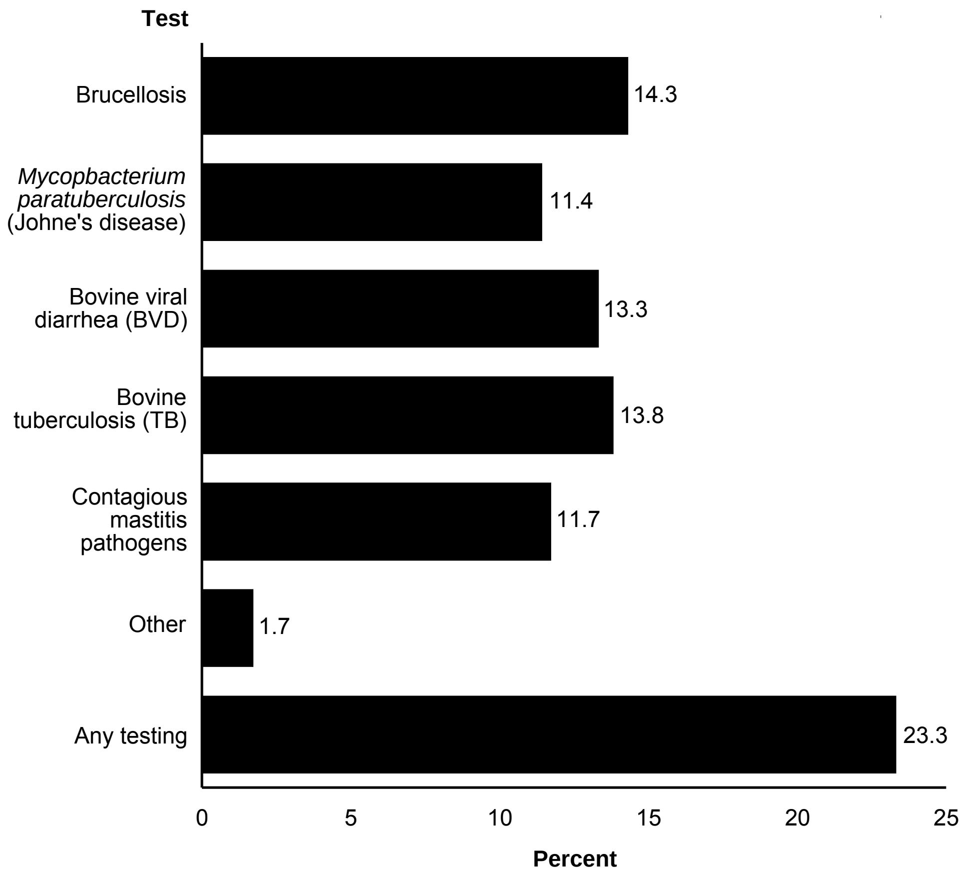


Testing individual animals prior to purchase can reduce the chances of bringing new diseases to an operation. Almost one-fourth of operations (23.3 percent) required testing of animals brought onto the operation.

f. For operations that brought beef or dairy cattle onto the operation during 2006, percentage of operations that tested individual animals brought onto the operation, by testing normally required by operation and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Test	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Brucellosis	11.6	(1.9)	19.8	(2.8)	19.0	(3.0)	14.3	(1.5)
Mycobacterium avium subspecies *paratuberculosis* (Johne's disease)	9.9	(1.8)	16.6	(2.7)	7.2	(1.8)	11.4	(1.4)
Bovine viral diarrhea (BVD)	10.7	(1.8)	19.4	(2.8)	15.8	(2.7)	13.3	(1.4)
Bovine tuberculosis (TB)	12.0	(1.8)	17.8	(2.7)	15.8	(2.3)	13.8	(1.4)
Contagious mastitis pathogens	10.5	(1.8)	13.1	(2.3)	16.3	(3.3)	11.7	(1.4)
Other	1.6	(0.6)	2.2	(1.0)	0.4	(0.2)	1.7	(0.5)
Any testing	20.2	(2.4)	28.2	(3.2)	34.7	(3.8)	23.3	(1.8)

For Operations that Brought any Beef or Dairy Cattle Onto the Operation During 2006, Percentage of Operations That Tested Individual Animals Brought Onto the Operation, by Testing Normally Required by Operation



Approximately 25 percent of operations reported that testing was already performed at the herd of origin or that the disease was not a concern to their operation. “Other” reasons included animals not eligible for testing or were not at risk for disease transmission (such as testing weaned heifers or bulls for contagious mastitis pathogens), owners trusted the herd of origin, owners vaccinated and tested after the animals arrived, owners did not know to vaccinate and/or test, and owners were bringing back their own cattle.

g. For operations that brought beef or dairy cattle onto the operation during 2006 and did not require individual animal testing, percentage of operations by reason for not testing and by disease:

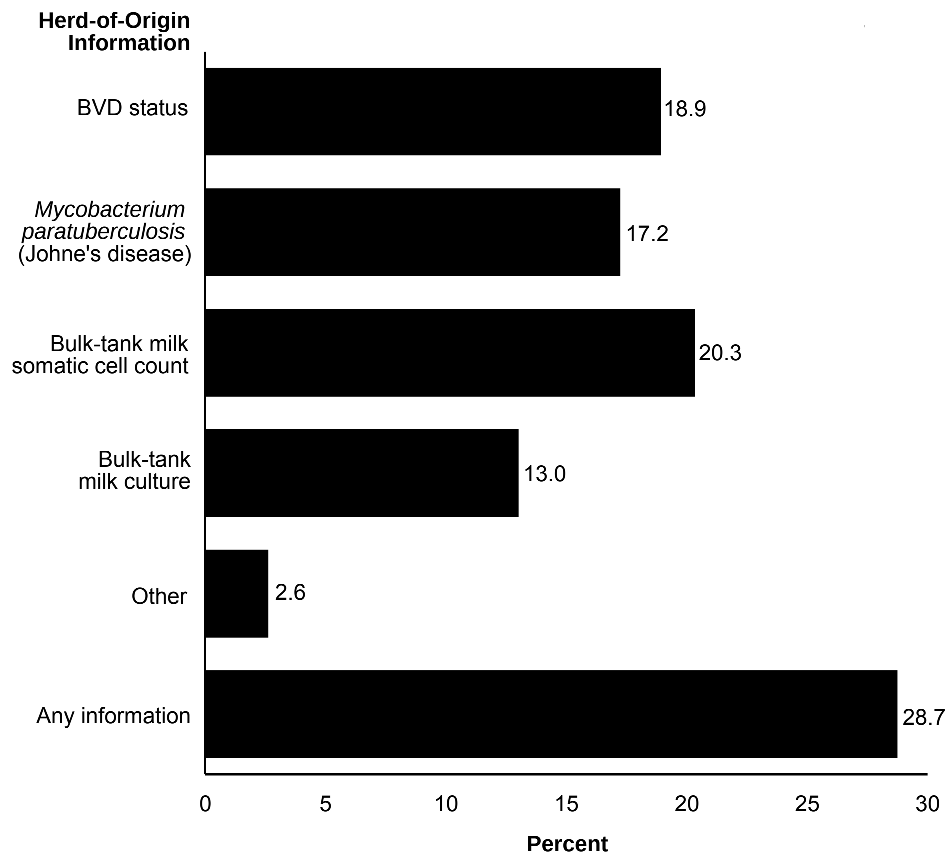
	Percent Operations									
	Disease									
	Brucellosis		Johne's Disease		BVD		TB		Contagious Mastitis Pathogens	
Reason	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Tests already performed by herd of origin	25.6	(2.0)	22.3	(1.9)	25.9	(2.1)	25.1	(2.0)	23.8	(1.9)
Too expensive to test	4.3	(1.1)	5.9	(1.3)	4.1	(1.0)	4.2	(1.1)	4.3	(1.0)
Not enough time to test	9.5	(1.7)	8.9	(1.5)	9.9	(1.6)	9.4	(1.6)	10.7	(1.7)
Not recommended by veterinarian	7.7	(1.3)	6.8	(1.2)	6.1	(1.2)	7.4	(1.3)	5.7	(1.1)
Too many sources to test	2.5	(0.9)	1.8	(0.6)	2.7	(0.9)	2.3	(0.9)	2.8	(0.9)
Tests not reliable	0.2	(0.2)	4.4	(1.0)	1.0	(0.4)	0.7	(0.3)	0.7	(0.3)
Disease is not a concern to my operation	28.0	(2.3)	28.6	(2.2)	27.5	(2.2)	29.1	(2.3)	27.9	(2.2)
Other	22.2	(1.9)	21.3	(1.9)	22.8	(2.0)	21.8	(1.9)	24.1	(2.0)
Total	100.0		100.0		100.0		100.0		100.0	

For many diseases, such as Johne's diseaseand contagious mastitis, knowing the status of the herd of origin can be more reliable than testing individual animals. Almost 3 of 10 operations (28.7 percent) required herd-of-origin information on disease status prior to purchasing cattle. The only herd-size difference was in the percentage of operations performing bulk-tank milk cultures for contagious mastitis pathogens, where a lower percentage of small operations performed the culture compared to large operations (10.1 and 20.9 percent, respectively).

h. For operations that brought beef or dairy cattle onto the operation during 2006, percentage of operations by information on herd of origin normally required by operation, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Herd-of-origin Information	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
BVD status	16.7	(2.3)	24.5	(3.0)	19.8	(3.0)	18.9	(1.7)
Mycobacterium avium subspecies *paratuberculosis* (Johne'sdisease) status	16.0	(2.2)	21.9	(2.9)	12.7	(2.3)	17.2	(1.7)
Bulk-tank milk somatic cell count	18.8	(2.4)	24.4	(3.1)	19.8	(2.9)	20.3	(1.8)
Bulk-tank milk culture	10.1	(1.7)	17.8	(2.8)	20.9	(2.9)	13.0	(1.4)
Other	2.8	(1.0)	2.3	(1.2)	1.3	(0.8)	2.6	(0.7)
Any information	25.4	(2.7)	36.0	(3.4)	32.9	(3.3)	28.7	(2.0)

For Operations that Brought Beef or Dairy Cattle Onto the Operation During 2006, Percentage of Operations by Information on Herd-of-Origin Normally Required by Operation



The most common reason given for not requiring herd-of-origin information on disease status was that the disease was not a concern to the operation (approximately 30 percent of operations). Interestingly, mastitis was the most prevalent disease causing illness in cows, the second highest reported reason for removing cows from the herd, and the second highest reported cause of cattle death during 2006. A percentage of these mastitis cases would be due to contagious pathogens. Infertility, which could be associated with BVD, was the third most prevalent disease on operations, and reproductive problems, such as infertility, was the most common reason that cows were permanently removed from the operation. Close to 25 percent of operations listed “other” as the reason for not evaluating herd-of-origin information. Other reasons for not evaluating herd-of-origin information were similar to reasons for not testing incoming cattle: trusted the herd of origin, owned the herd of origin, would address disease issues after cattle arrived, and didn’t know to test or inquire about diseases.

i. For operations that brought beef or dairy cattle onto the operation during 2006 and did not require herd-of-origin information on the status of the following diseases and bulk-tank milk, percentage of operations by reason for not normally requiring information:

	Percent Operations							
	Herd-of-Origin Information							
	BVD Status		Johne’s Disease Status		Bulk-Tank Milk Somatic Cell Count		Bulk-Tank Milk Culture	
Reason Not Required	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tests already performed by herd of origin	18.6	(1.8)	15.2	(1.6)	15.2	(1.6)	15.7	(1.6)
Too expensive to test	3.9	(1.1)	4.4	(1.2)	3.2	(1.0)	3.8	(1.1)
Not enough time to test	9.3	(1.6)	9.3	(1.5)	9.2	(1.6)	10.6	(1.6)
Not recommended by veterinarian	8.1	(1.4)	8.9	(1.4)	8.6	(1.4)	8.4	(1.4)
Too many sources to test	3.0	(1.0)	3.0	(1.0)	3.5	(1.1)	3.1	(1.0)
Tests not reliable	1.1	(0.4)	3.3	(0.9)	1.5	(0.5)	1.4	(0.5)
Disease is not a concern to the operation	30.5	(2.4)	31.6	(2.3)	30.2	(2.3)	30.0	(2.3)
Other	25.5	(2.2)	24.3	(2.1)	28.6	(2.2)	27.0	(2.1)
Total	100.0		100.0		100.0		100.0	

Section II: Methodology

A. Needs Assessment

NAHMS develops study objectives by exploring existing literature and contacting industry members about their informational needs and priorities during a needs-assessment phase. The objective of the needs assessment for the NAHMS Dairy 2007 study was to collect information from U.S. dairy producers and other dairy specialists about what they perceived to be the most important dairy health and productivity issues. A driving force of the needs assessment was the desire of NAHMS to receive as much input as possible from a variety of producers, industry experts and representatives, veterinarians, extension specialists, universities, and dairy organizations. Information was collected via focus groups and through a Needs Assessment Survey.

Focus group teleconferences and meetings were held to help determine the focus of the study.

Teleconference, March 30, 2006
National Johne's Working Group

Louisville, KY, April 2, 2006
National Johne's Working Group
National Institute for Animal Agriculture

Louisville, KY, April 3, 2006
National Milk Producers Federation
Animal Health Committee

Teleconference, December 15, 2006
Bovine Alliance on
Management and Nutrition

In addition, a Needs-Assessment Survey was designed to ascertain the top three management issues, diseases/disorders, and producer incentives from producers, veterinarians, extension personnel, university researchers, and allied industry groups. The survey, created in SurveyMonkey, was available online from early February through late April 2006. The survey was promoted via electronic newsletters, magazines, and Web sites. Organizations/magazines promoting the study included Vance Publishing's "Dairy Herd Management, Dairy Alert", "Dairy Today", "Hoard's Dairyman", NMC, "Journal of the American Veterinary Medical Association", and the American Association of Bovine Practitioners. E-mail messages were also sent to cooperative members of the National Milk Producers Federation as well as State and Federal personnel asking for input and identifying the online site. A total of 313 people completed the questionnaire.

Universities/extension personnel accounted for 23 percent of respondents, while producers accounted for 22 percent, and veterinarians/consultants accounted for another 20 percent.

Fort Collins, CO, May 18, 2006
CEAH Focus Group meeting

Draft objectives for the Dairy 2007 study, using input from teleconferences, face-to-face meetings, and the online survey, were drafted prior to the CEAH focus group meeting. Attendees included producers, university/extension personnel, veterinarians, and government personnel. The day-long meeting culminated in the formulation of eight objectives for the study:

- Describe trends in dairy cattle health and management practices,
- Evaluate management factors related to cow comfort and removal rates,
- Describe dairy-calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices,
- Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVD),
- Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens,
- Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis* (Johne's disease),
- Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices, and
- Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns.

B. Sampling and Estimation

1. State selection

The preliminary selection of States to be included in the study was done in February 2006, using the National Agricultural Statistics Service (NASS) January 27, 2006, "Cattle Report". A goal for NAHMS national studies is to include States that account for at least 70 percent of the animals and producer population in the United States. The initial review of States identified 16 major States representing 82.0 percent of the milk cow inventory and 79.3 percent of the operations with milk cows (dairy herds). The States were: California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Washington, and Wisconsin.

A memo identifying these 16 States was provided in March 2006 to the USDA-APHIS-VS CEAH Director and, in turn, the VS Regional Directors. Each Regional Director sought input from the respective States about being included or excluded from the study. Virginia expressed interest in participating and was included, bringing the total number of participating States to 17.

2. Operation selection

The list sampling frame was provided by NASS. Within each State a stratified random sample was selected. The size indicator was the number of milk cows for each operation. NASS selected a sample of dairy producers in each State for making their January 1 cattle estimates. The list sample from the January 2006 survey was used as the screening sample. Those producers in the 17 States reporting one or more milk cows on January 1, 2006, were included in the sample for contact in January 2007.

3. Population inferences

a. Phase I: General Dairy Management Report

Inferences cover the population of dairy producers with at least 1 milk cow in the 17 participating States. As of January 1, 2007, these States accounted for 82.5 percent (7,533,000 head) of milk cows and 79.5 percent (59,740) of operations with milk cows in the United States. (See Appendix II for respective data on individual States.) All respondent data were statistically weighted to allow the sample to reflect the population from which it was selected. The inverse of the probability of selection for each operation was the initial selection weight. This selection weight was adjusted for nonresponse within each State and size group to allow for inferences back to the original population from which the sample was selected.

C. Data Collection

1. Data collectors and data collection period

a. Phase I: General Dairy Management Report

From January 1-31, 2007, NASS enumerators administered the General Dairy Management Report. The interview took slightly over 1 hour.

D. Data Analysis

1. Phase I: Validation—General Dairy Management Report

Initial data entry and validation for the General Dairy Management Report were performed in individual NASS State offices. Data were entered into a SAS data set. NAHMS national staff performed additional data validation on the entire data set after data from all States were combined.

E. Sample Evaluation

The purpose of this section is to provide various performance measurement parameters. Historically, the term "response rate" was used as a catch-all parameter, but there are many ways to define and calculate response rates. Therefore, the table below presents an evaluation based upon a number of measurement parameters, which are defined with an "x" in categories that contribute to the measurement.

1. Phase I: General Dairy Management Report

A total of 3,554 operations were selected for the survey. Of these operations, 3,304 (93.0 percent) were contacted. There were 2,519 operations that provided usable inventory information (70.9 percent of the total selected and 76.2 percent of those contacted). In addition, there were 2,194 operations (61.7 percent) that provided "complete" information for the questionnaire. Of operations that provided complete information and were eligible to participate in the VMO phase of the study (2,067 operations), 1,077 (52.1 percent) consented to be contacted for consideration/discussion about further participation.

			Measurement Parameter		
Response Category	**Number Operations**	**Percent Operations**	**Contacts**	**Usable[1]**	**Complete[2]**
Survey complete and VMO consent	1,077	30.3	x	x	x
Survey complete, refused VMO consent	990	27.9	x	x	x
Survey complete, ineligible[4] for VMO	127	3.6	x	x	x
No dairy cows on January 1, 2007	214	6.0	x	x	
Out of business	111	3.1	x	x	
Out of scope	6	0.2			
Refusal of GDMR	785	22.1	x		
Office hold (NASS elected not to contact)	126	3.5			
Inaccessible	118	3.3			
Total	3,554	100.0	3,304	2,519	2,194
Percent of total operations			93.0	70.9	61.7
Percent of total operations weighted[3]			94.0	74.1	59.6

[1]Useable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions for at least one site.
[3] Weighted response—the rate was calculated using the initial selection weights.
[4]Ineligible—less than 30 head of milk cows on January 14, 2007.

Appendix I: Sample Profile

A. Responding Operations

1. Total inventory, by herd size

Herd Size (Total Inventory)	Number of Responding Sites
Less than 100	1,028
100 to 499	691
500 or more	475
Total	2,194

2. Number of responding operations, by region

Region	Number of Responding Sites
West	426
East	1768
Total	2,194

Appendix II: U.S. Milk Cow Population and Operations

Number of milk cows on January 1, 2007*

		Number of Milk Cows (Thousand Head)		Number of Operations 2006	
Region	**State**	**Milk cows on operations with 1 or more head**	**Milk cows on operations with 30 or more head**	**Operations with 1 or more head**	**Operations with 30 or more head**
West	California	1,790	1,788.2	2,300	1,950
	Idaho	502	501.0	800	620
	New Mexico	360	359.3	450	180
	Texas	347	344.2	1,300	660
	Washington	235	234.3	790	540
	Total	3,234	3,227.0	5,640	3,950
East	Indiana	166	154.4	2,100	1,150
	Iowa	210	203.7	2,400	1,870
	Kentucky	93	86.5	2,000	1,180
	Michigan	324	317.5	2,700	1,910
	Minnesota	455	441.3	5,400	4,800
	Missouri	114	108.3	2,600	1,400
	New York	628	612.3	6,400	5,100
	Ohio	274	252.1	4,400	2,500
	Pennsylvania	550	536.3	8,700	7,000
	Vermont	140	137.2	1,200	1,060
	Virginia	100	97.5	1,300	820
	Wisconsin	1,245	1,213.9	14,900	12,800
	Total	4,299	4,161.0	54,100	41,590
Total (17 States)		7,533	7,388.0	59,740	45,540
Percentage of U.S.		82.5	82.5	79.5	84.6
Total U.S. (50 States)		9,129.0	8,955.5	75,140	53,860

*Source: NASS Cattle report, February 2, 2007, and NASS Farms, Land in Farms, and Livestock Operations 2006 Summary report, February 2007. An operation is any place having one or more head of milk cows, excluding cows used to nurse calves, on hand at any time during the year.

Appendix III: Study Objectives and Related Outputs

1. Describe trends in dairy cattle health and management practices
- Part II: Changes in the United States Dairy Cattle Industry 1991-2007, expected December 2008
- Part V: Changes in Dairy Cattle Health and Management in the United States, 1991-2007, expected May 2008

2. Evaluate management factors related to cow comfort and removal rates
- Dairy Facilities and Cow Comfort on U.S Dairy Operations, 2007 interpretive report, expected spring 2008
- Info sheets, expected spring 2008

3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices
- **Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007**
- Colostrum Management info sheet, October 2007
- Off-Site Heifer Raising info sheet, October 2007
- Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, expected April 2008
- Calf Health and Management Practices on U.S. Dairy Operations, 2007 interpretive report, expected spring 2008
- Additional info sheets, expected spring 2008

4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVD)
- Info sheets, expected spring 2008.

5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens
- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, expected February 2008.
- Info sheets, expected spring 2008.

6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis*
- Info sheets, expected spring 2008.

7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices
- **Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007**

- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, expected February 2008
- Interpretive report and info sheets, expected spring 2008

8. Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns

- Info sheets, expected spring 2008

United States Department of Agriculture

Animal and Plant Health Inspection Service

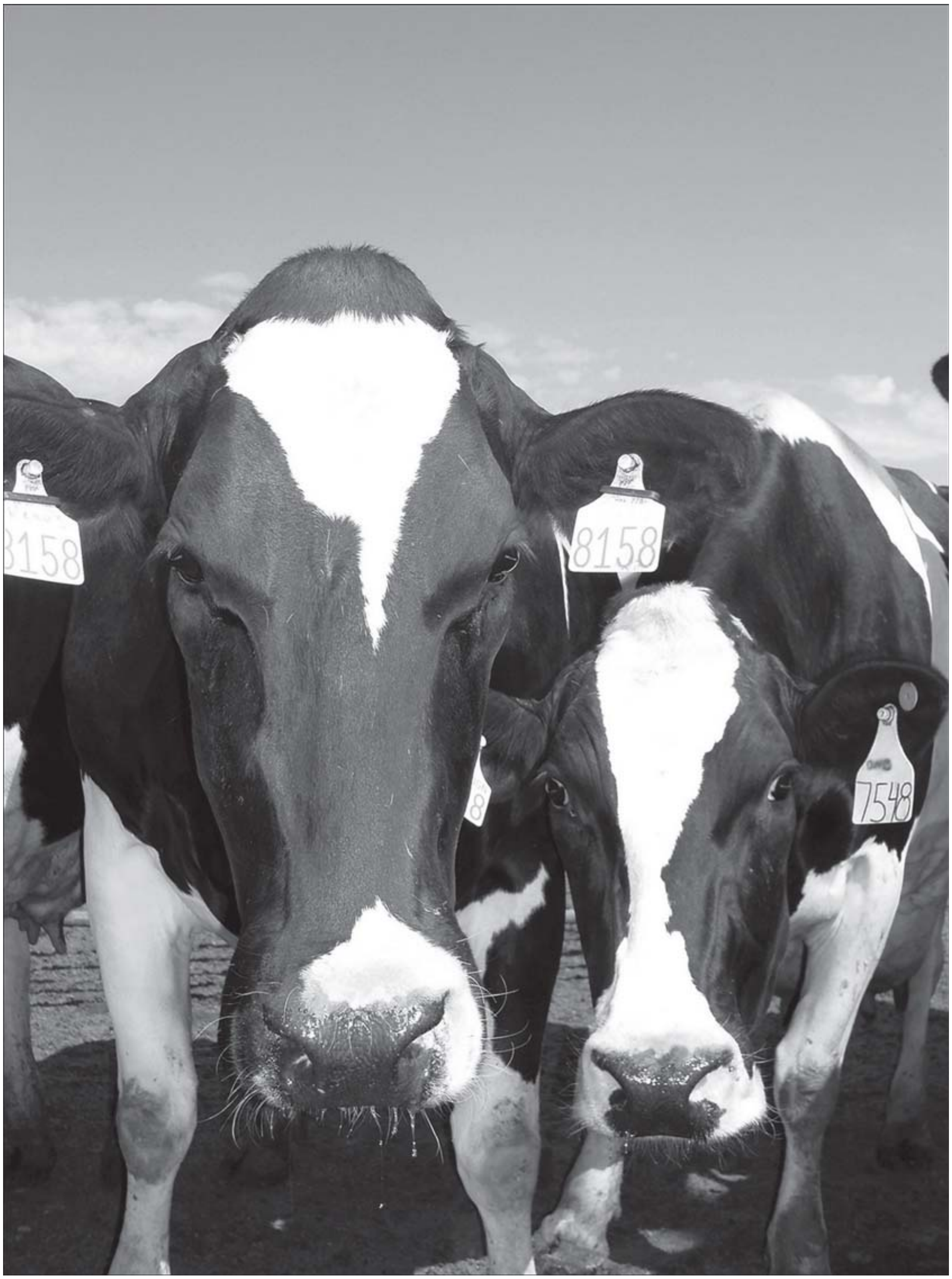
Veterinary Services

National Animal Health Monitoring System

March 2007

Dairy 2007

Part II: Changes in the U.S. Dairy Cattle Industry, 1991–2007



USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

#N481.0308

Cover photo courtesy of
Dr. Jason Lombard

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This report has been prepared from material received and analyzed by the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS) via four national studies of health management and animal health on U.S. dairy operations conducted between 1991 and 2007.

The 1991 National Dairy Heifer Evaluation Project, Dairy 1996, Dairy 2002, and Dairy 2007 were cooperative efforts between State and Federal agricultural statisticians, animal health officials, university researchers, and extension personnel. We want to thank the National Agricultural Statistics Service (NASS) enumerators, State and Federal veterinary medical officers (VMOs), and animal health technicians (AHTs) who visited the farms and collected the data. Their hard work and dedication to the National Animal Health Monitoring System (NAHMS) are invaluable. The roles of the producer, Area Veterinarian in Charge (AVIC), NAHMS Coordinator, VMOs, AHTs, and NASS enumerators were critical in providing quality data for Dairy 2007 reports. Thanks also to the personnel at the Centers for Epidemiology and Animal Health (CEAH) for their efforts in generating and distributing valuable reports from Dairy 2007 data.

Additional biological sampling and testing were afforded by the generous contributions of collaborators for the Dairy 2007 study, including:

- USDA-APHIS, National Veterinary Services Laboratories
- USDA-ARS, Beltsville Agricultural Research Center
- USDA-ARS, Russell Research Center
- Antel BioSystems, Inc.
- Cornell University Animal Health Diagnostic Laboratory
- Quality Milk Production Services
- Tetracore, Inc
- University of Pennsylvania, New Bolton Center
- University of Wisconsin, Madison
- Wisconsin Veterinary Diagnostic Laboratory

All participants are to be commended, particularly the producers whose voluntary efforts made the Dairy 2007 study possible.

Larry M. Granger
Director
Centers for Epidemiology and Animal Health

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Contacts for further information:
Questions or comments on data analysis: Dr. Jason Lombard (970) 494-7000
Information on reprints or other reports: Ms. Kathy Snover (970) 494-7000
E-mail: NAHMS@aphis.usda.gov

Table of Contents

Introduction

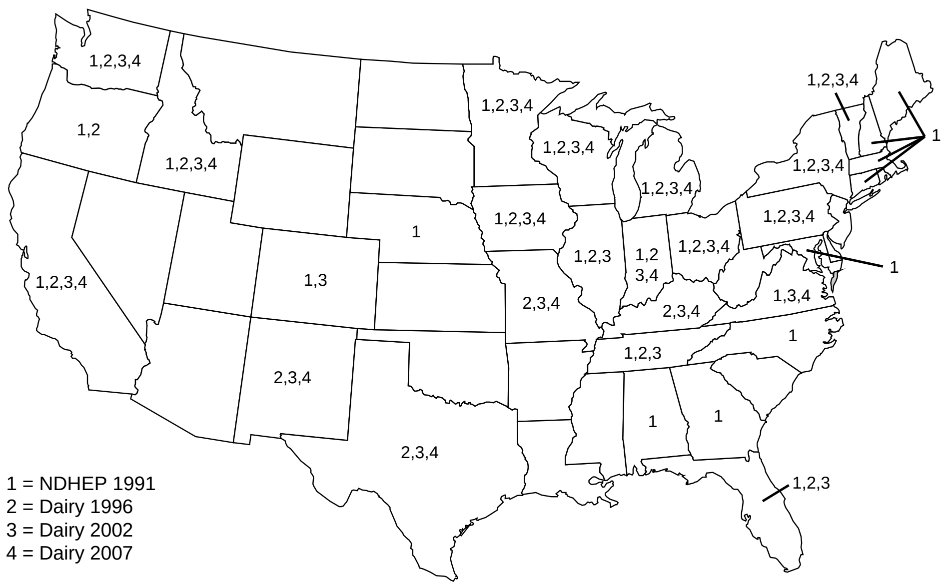
In 1983, promoters of the concept that would become the USDA's National Animal Health Monitoring System (NAHMS) envisioned a program that would monitor changes and trends in national animal health and management. They hoped to provide periodic snapshots of U.S. food animal industries. With these industry overviews, members could identify opportunities for improvement, provide changing foundations for research and special studies, and detect emerging problems.

Section I of this report shows demographic changes of the U.S. dairy industry from a historical perspective using data provided by the USDA's National Agricultural Statistics Service (NASS) and Agricultural Marketing Service (AMS). Section II shows demographic changes of the world dairy industry using data provided by USDA's Foreign Agricultural Service (FAS). Results of four NAHMS national studies in Section III complete the overview of change in the U.S. dairy industry during the 16-year period of 1991 to 2007.

NAHMS' first national study of the U.S. dairy industry, the 1991 National Dairy Heifer Evaluation Project (NDHEP), provided the snapshot of animal health and management that would serve as a baseline from which to measure industry changes in animal health and management. NAHMS' Dairy 1996, Dairy 2002, and Dairy 2007 studies have fulfilled the vision of the program's founding objective, monitoring the trends in national animal health and management practices.

The NDHEP 1991 included herds of 30 or more milk cows and heifer-rearing operations in 28 States representing 83 percent of U.S. milk cows. Dairy 1996 described dairy production for operations with one or more milk cows in 20 States representing 83 percent of the Nation's milk cows. Dairy 2002 described dairy production for operations with one or more milk cows in 21 States representing 85 percent of the Nation's dairy cows. Dairy 2007 was conducted in 17 of the Nation's major dairy States and provides information representing 80 percent of U.S. dairy operations and 83 percent of U.S. dairy cows. This report, Part II: Changes in the United States Dairy Industry, 1991-2007, provides national estimates of animal health management practices for comparable populations from all four studies. Reports from all four NAHMS dairy studies—including the studies' methodologies—are available at http://nahms.usda.aphis.gov.

States Participating in NAHMS Dairy Studies, 1991, 1996, 2002, 2007



Further information on NAHMS studies and reports is available at:
http://nahms.aphis.usda.gov.

For questions about this report or additional copies, please contact:

USDA-APHIS-VS-CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000

Terms Used In This Report

Cow: Female dairy bovine that has calved at least once.

Cow average: The average value for all cows; the reported value for each operation multiplied by the number of cows on that operation is summed over all operations and divided by the number of cows on all operations. This way, the result is adjusted for the number of cows on each operation. For instance, on p 41 the cow average age at first calving is multiplied by the number of cows for each operation. This product is then summed over all operations and divided by the sum of cows over all operations. The result is the average age at first calving for all cows.

Dairy Herd Improvement Association (DHIA): An organization with programs and objectives intended to improve the production and profitability of dairy farming. DHIA also aids farmers in keeping milk production and management records.

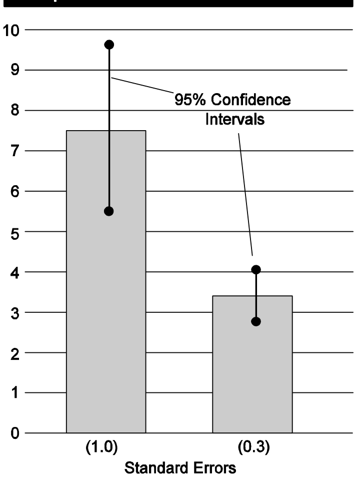
Heifer: Female dairy bovine that has not yet calved.

Herd size: Herd size is based on January 1 respective inventories. Small herds are those with fewer than 100 head; medium herds are those with 100 to 499 head; and large herds are those with 500 or more head.

NA: Not available.

Operation average: A single value for each operation is summed over all operations reporting divided by the number of operations reporting. For instance, operation average age at first calving (shown on p 41) is calculated by summing reported average age over all operations divided by the number of operations.

Examples of a 95% Confidence Interval



Population estimates: Estimates in this report are provided with a measure of precision called the **standard error**. A 95-percent confidence interval can be created with bounds equal to the estimate, plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean 95 out of 100 times. In the example to the left, an estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). The second estimate of 3.4 shows a standard error of 0.3 and results in limits of 2.8 and 4.0. Alternatively, the 90-percent confidence interval would be created by multiplying the standard error by 1.65 instead of 2. Most estimates in this report are rounded to the nearest tenth. If rounded to 0, the standard error was reported. If there were no reports of the event, no standard error was reported.

Rolling Herd Average (RHA): Average milk production per cow (lb/cow) in the herd during the previous 12 months.

Section I: Historical Changes in the U.S. Dairy Industry

A. General Trends

Note: Unless otherwise noted, tables in this section are comprised from data collected by USDA's National Agricultural Statistics Service (NASS).

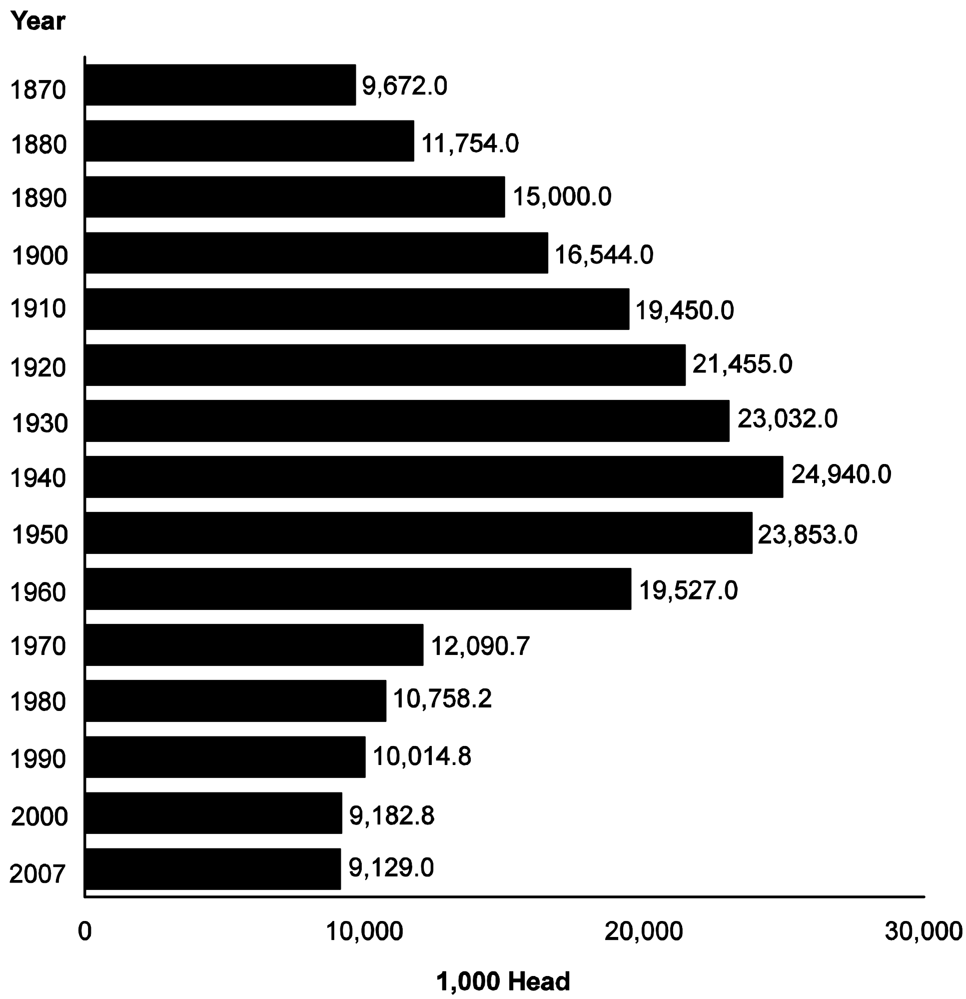
1. Milk cow inventory

On January 1, 2007, U.S. milk cows numbered 9,129,000 head, 94.4 percent of the 9,672,000 milk cows in 1870. All U.S. cattle and calves numbered 97,002,900 head in 2007, about three times the number of cattle and calves in 1870 (31,082,000 head).

a. Long-term changes in U.S. milk cow January 1 inventory, 1870-2007:

	Milk Cows			All Cattle and Calves
Year	1,000 Head	Percent of 1870	Percent of All Cattle and Calves	1,000 Head
1870	9,672.0	100.0	31.1	31,082.0
1880	11,754.0	121.5	27.1	43,347.0
1890	15,000.0	155.1	25.0	60,014.0
1900	16,544.0	171.1	27.7	59,739.0
1910	19,450.0	201.1	33.0	58,993.0
1920	21,455.0	221.8	30.5	70,400.0
1930	23,032.0	238.1	37.8	61,003.0
1940	24,940.0	257.9	36.5	68,309.0
1950	23,853.0	246.6	30.6	77,963.0
1960	19,527.0	201.9	20.3	96,236.0
1970	12,090.7	125.0	10.8	112,368.7
1980	10,758.2	111.2	9.7	111,242.4
1990	10,014.8	103.5	10.5	95,816.2
2000	9,182.8	94.9	9.4	98,199.0
2007	9,129.0	94.4	9.4	97,002.9

Long-term Changes in U.S. Milk Cow January 1 Inventory, 1870-2007



The number of milk cows that calved each year decreased about 6 percent from 1992 to 2002 but remained stable from 2002 to 2007.

b. Recent changes in U.S. milk cow January 1 inventory, 1992-2007:

Milk Cows					
Year	**1,000 Head**	**Percent Previous Year**	**Percent of 1992**	**Percent of 1996**	**Percent of 2002**
1992	9,728.2	97.6	100.0	--	--
1993	9,658.1	99.3	99.3	--	--
1994	9,507.0	98.4	97.7	--	--
1995	9,481.8	99.7	97.5	--	--
1996	9,419.9	99.3	96.8	100.0	--
1997	9,317.9	98.9	95.8	98.9	--
1998	9,199.0	98.7	94.6	97.7	--
1999	9,128.0	99.2	93.8	96.9	--
2000	9,182.8	100.6	94.4	97.5	--
2001	9,171.7	99.9	94.3	97.4	--
2002	9,105.6	99.3	93.6	96.7	100.0
2003	9,141.7	100.4	94.0	97.0	100.4
2004	8,989.5	98.3	92.4	95.4	98.7
2005	9,005.0	100.2	92.6	95.6	98.9
2006	9,062.9	100.6	93.2	96.2	99.5
2007	9,129.0	100.7	93.8	96.9	100.3

The January 1, 2007, number of replacement heifers has increased 4.3 percent since 1992. Replacement heifers as a percentage of the milk cow inventory remains between 42.5 and 47.2 percent, with recent years showing the larger percentage.

c. Recent changes in U.S. replacement heifer January 1 inventory, 1992-2007:

Milk Cow Replacement Heifers

Year	1,000 Head	Percent Previous Year	Percent of 1992	Percent of 1996	Percent of 2002	Percent of Milk Cows
1992	4,131.4	100.9	100.0	--	--	42.5
1993	4,176.2	101.1	101.1	--	--	43.2
1994	4,124.5	98.8	99.8	--	--	43.4
1995	4,121.3	99.9	99.8	--	--	43.5
1996	4,090.3	99.2	99.0	100.0	--	43.4
1997	4,058.4	99.2	98.2	99.2	--	43.6
1998	3,985.7	98.2	96.5	97.4	--	43.3
1999	4,068.8	102.1	98.5	99.5	--	44.6
2000	3,999.8	98.3	96.8	97.8	--	43.6
2001	4,057.0	101.4	98.2	99.2	--	44.2
2002	4,054.8	99.9	98.1	99.1	100.0	44.5
2003	4,113.9	101.5	99.6	100.6	101.5	45.0
2004	4,020.0	97.7	97.3	98.3	99.1	44.7
2005	4,118.3	102.4	99.7	100.7	101.6	45.7
2006	4,275.0	103.8	103.5	104.5	105.4	47.2
2007	4,309.9	100.8	104.3	105.4	106.3	47.2

2. Number and size of dairy operations

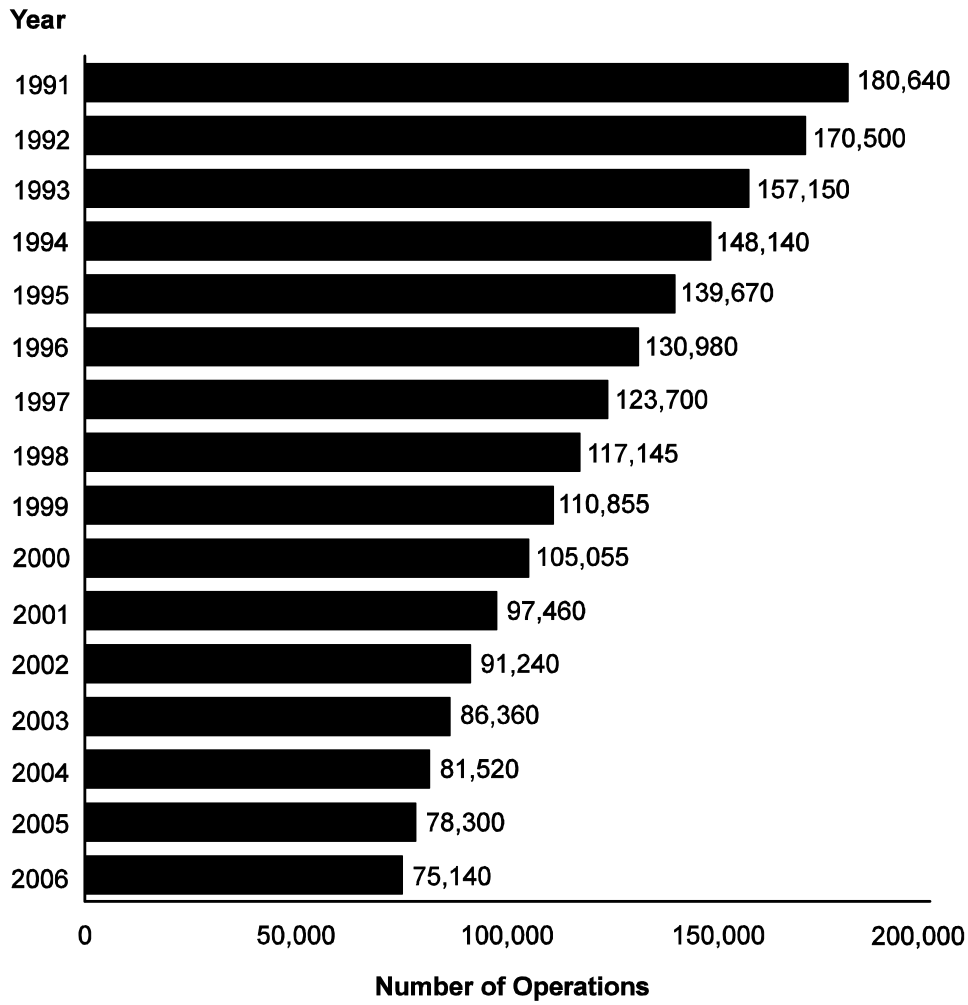
Approximately 4 to 7 percent of dairy operations have gone out of business each year since 1991. Since 1991, the number of dairy operations decreased by 58.4 percent, while milk cow numbers in 2007 were at 93.8 percent of 1992 numbers. In this time frame, milk per cow increased by 32.7 percent and total milk production increased by 23.1 percent.

a. Recent changes in the number of U.S. dairy operations*, 1991-2006:

Year	Number of Operations	Percent Previous Year	Percent of 1991	Percent of 1995	Percent of 2001
1991	180,640	93.8	100.0	--	--
1992	170,500	94.4	94.4	--	--
1993	157,150	92.2	87.0	--	--
1994	148,140	94.3	82.0	--	--
1995	139,670	94.3	77.3	100.0	--
1996	130,980	93.8	72.5	93.8	--
1997	123,700	94.4	68.5	88.6	--
1998	117,145	94.7	64.8	83.9	--
1999	110,855	94.6	61.4	79.4	--
2000	105,055	94.8	58.2	75.2	--
2001	97,460	92.8	54.0	69.8	100.0
2002	91,240	93.6	50.5	65.3	93.6
2003	86,360	94.7	47.8	61.8	88.6
2004	81,520	94.4	45.1	58.4	83.6
2005	78,300	96.1	43.3	56.1	80.3
2006	75,140	96.0	41.6	53.8	77.1

* An operation is any place having one or more milk cows—excluding cows used to nurse calves—on hand any time during the year.

Recent Changes in the Number of U.S. Dairy Operations*, 1991-2006



*An operation is any place having one or more milk cows-excluding cows used to nurse calves-on hand any time during the year.

The percentage of operations with fewer than 50 cows has decreased since 1991, while the percentage of operations with more than 100 head has increased every year since 1991. More than 1 in 10 operations (11.5 percent) had more than 100 cows in 1991 compared to about 2 in 10 (23.3 percent) in 2006.

b. Percentage of U.S. dairy operations by herd size, 1991-2006:

	Percent Operations					
	Herd Size (Number of Cows)					
Year	**1-29**	**30-49**	**50-99**	**100-199**	**200-499**	**500+**
1991	39.8	22.8	25.9	11.5[1]		
1992	38.9	22.1	26.0	13.0[1]		
1993	37.3	22.2	26.8	9.3	4.4[2]	
1994	36.1	22.0	27.4	9.8	4.7[2]	
1995	34.5	22.2	28.1	10.2	5.0[2]	
1996	32.9	22.3	28.7	10.7	5.4[2]	
1997	31.6	22.1	29.0	11.3	4.1	1.9
1998	30.8	21.8	29.1	11.9	4.4	2.0
1999	29.7	21.7	29.6	11.9	4.8	2.3
2000	29.3	21.2	29.7	12.2	5.1	2.5
2001	29.0	20.4	29.8	12.6	5.3	2.9
2002	28.9	19.8	30.0	12.6	5.5	3.2
2003	29.0	19.5	29.9	12.7	5.5	3.4
2004	29.2	19.0	29.5	12.8	5.8	3.7
2005	28.7	19.0	29.6	12.8	6.0	3.9
2006	28.3	18.8	29.6	13.0	6.1	4.2

[1]These estimates include herds of 100 or more head.
[2]These estimates include herds of 200 or more head.

Operations with more than 200 cows accounted for 61.7 percent of cows in 2006 compared to 31.8 percent in 1993.

c. Percentage of U.S. milk cow inventory by herd size, 1991-2006:

	Percent Inventory					
	Herd Size (Number of Cows)					
Year	**1-29**	**30-49**	**50-99**	**100-199**	**200-499**	**500+**
1991	6.3	16.6	31.7	45.4[1]		
1992	5.5	15.2	30.0	49.3[1]		
1993	5.0	14.8	29.2	19.2	31.8[2]	
1994	4.6	14.0	28.7	19.3	33.4[2]	
1995	4.0	13.0	28.0	20.0	35.0[2]	
1996	4.0	12.0	27.0	20.0	37.0[2]	
1997	3.5	11.5	26.0	20.0	14.6	24.4
1998	3.6	10.5	24.3	19.3	15.5	26.8
1999	3.2	10.2	23.3	18.4	16.3	28.6
2000	2.9	9.1	22.0	18.1	16.6	31.3
2001	2.7	8.0	20.8	17.2	16.3	35.0
2002	2.4	7.4	19.6	16.4	15.9	38.3
2003	2.3	6.9	18.8	15.7	15.4	40.9
2004	2.1	6.6	17.8	15.1	15.5	42.9
2005	2.0	6.4	17.1	14.6	15.4	44.5
2006	1.9	6.0	16.3	14.1	15.0	46.7

[1]These estimates include herds of 100 or more head.
[2]These estimates include herds of 200 or more head.

3. Milk production

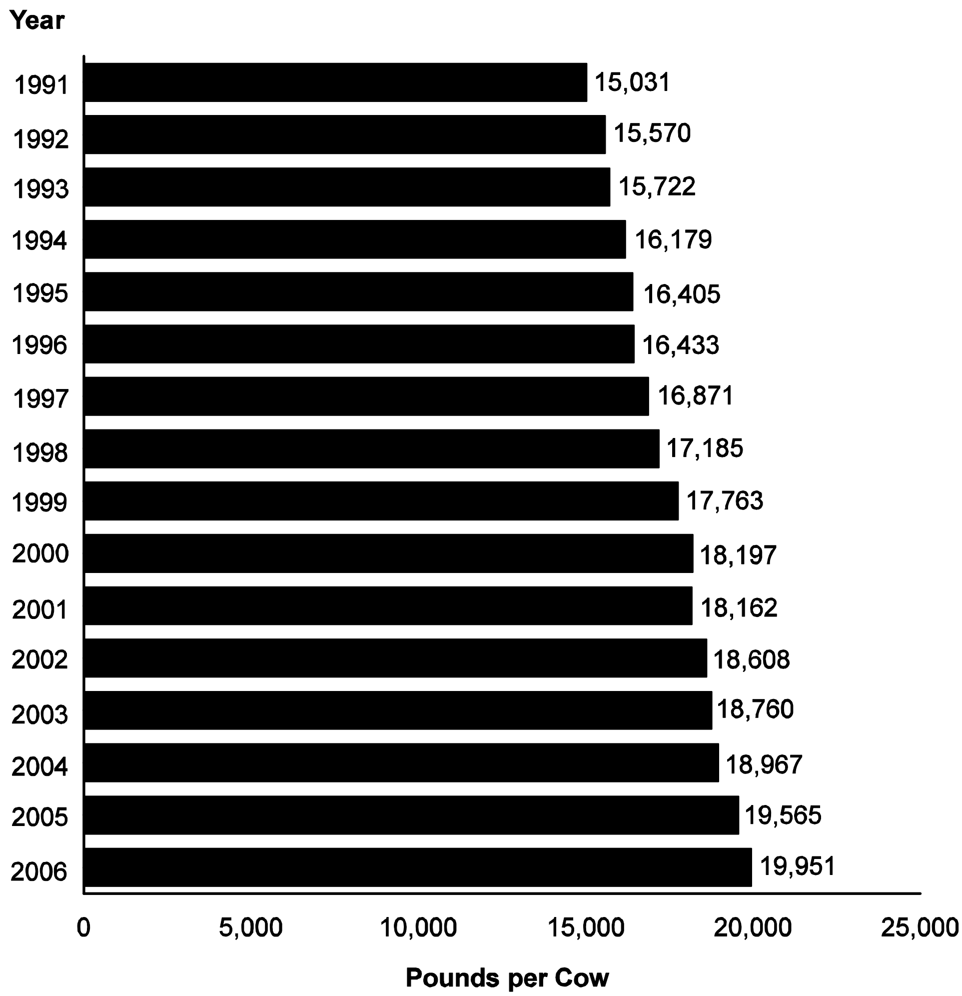
Milk production per cow has increased as much as 1 to 3 percent annually since 1991, with the exception of 2001. Milk production per cow was 19,951 pounds in 2006 compared to 15,031 pounds in 1991—a 32.7-percent increase.

a. Recent changes in U.S. milk production per cow, 1991-2006:

		Milk per Cow				
Year	**Average Number of Milk Cows*** (1,000 Head)	**Pounds per Cow**	**Percent Previous Year**	**Percent of 1991**	**Percent of 1995**	**Percent of 2001**
1991	9,826	15,031	101.7	100.0	--	--
1992	9,688	15,570	103.6	103.6	--	--
1993	9,581	15,722	101.0	104.6	--	--
1994	9,494	16,179	102.9	107.6	--	--
1995	9,466	16,405	101.4	109.1	100.0	--
1996	9,372	16,433	100.2	109.3	100.2	--
1997	9,252	16,871	102.7	112.2	102.8	--
1998	9,151	17,185	101.9	114.3	104.8	--
1999	9,153	17,763	103.4	118.2	108.3	--
2000	9,199	18,197	102.4	121.1	110.9	--
2001	9,103	18,162	99.8	120.8	110.7	100.0
2002	9,139	18,608	102.5	123.8	113.4	102.5
2003	9,083	18,760	100.8	124.8	114.4	103.3
2004	9,012	18,967	101.1	126.2	115.6	104.4
2005	9,043	19,565	103.2	130.2	119.3	107.7
2006	9,112	19,951	102.0	132.7	121.6	109.9

*Average number during the year, excluding heifers not yet fresh.

Recent Changes in U.S. Milk Production per Cow, 1991-2006



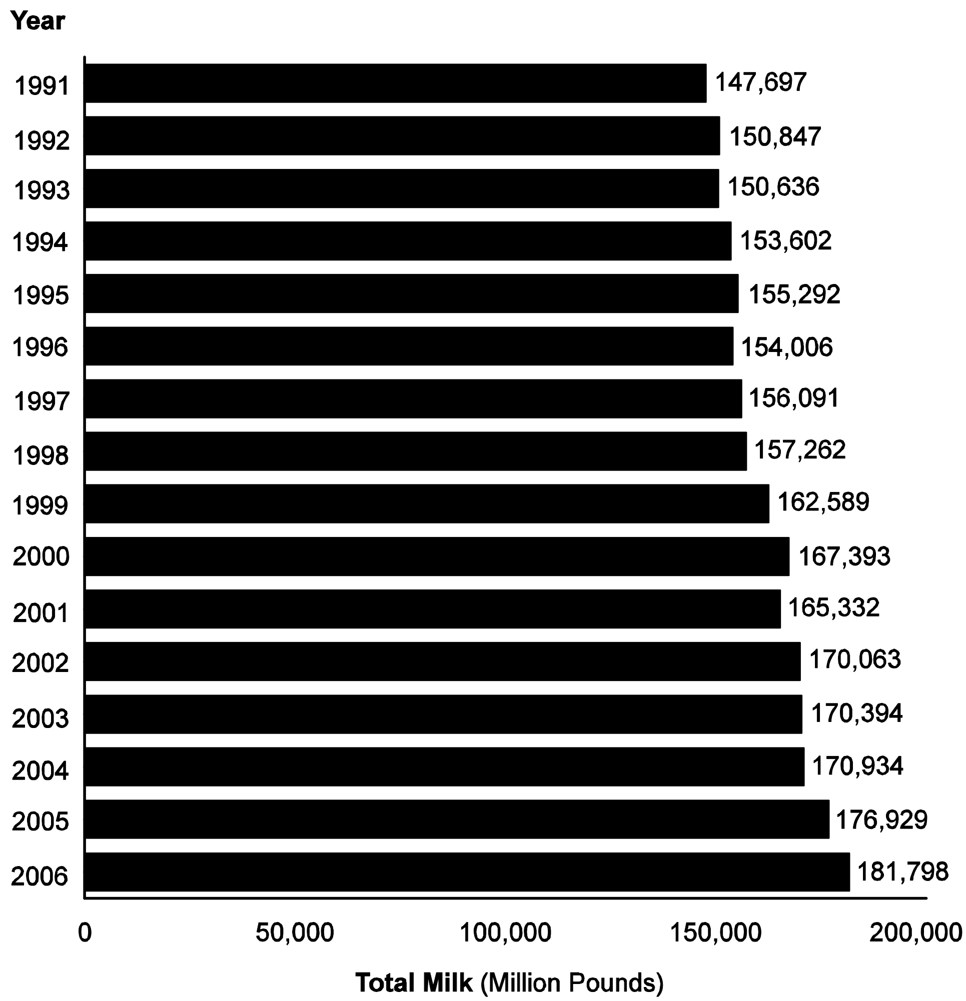
Total milk production in the United States has increased more than 20 percent since 1991, despite an approximate 6-percent drop in the number of cows. In 2006, total milk production was 181,798 million pounds compared to 147,697 million pounds in 1991.

b. Recent changes in U.S. total milk production, 1991-2006:

Total Milk Production					
Year	**Total Milk*** (Million Pounds)	**Percent Previous Year**	**Percent of 1991**	**Percent of 1995**	**Percent of 2001**
1991	147,697	100.0	100.0	--	--
1992	150,847	102.1	102.2	--	--
1993	150,636	99.8	102.0	--	--
1994	153,602	102.0	104.0	--	--
1995	155,292	101.1	105.1	100.0	--
1996	154,006	99.2	104.3	99.2	--
1997	156,091	101.4	105.7	100.5	--
1998	157,262	100.8	106.5	101.3	--
1999	162,589	103.4	110.1	104.7	--
2000	167,393	103.0	113.3	107.8	--
2001	165,332	98.8	111.9	106.5	100.0
2002	170,063	102.9	115.1	109.5	102.9
2003	170,394	100.2	115.4	109.7	103.1
2004	170,934	100.3	115.7	110.1	103.4
2005	176,929	103.5	119.8	113.9	107.0
2006	181,798	102.8	123.1	117.1	110.0

*Excluding milk nursed by calves.

Recent Changes in U.S. Total Milk Production*, 1991-2006



*Excluding milk nursed by calves

4. Bulk-tank somatic cell counts

Bulk tank somatic cell counts (BTSCCs) from 4 of the 10 U.S. Federal Milk Marketing Orders were analyzed from 1995 to 2006. Monthly BTSCCs were weighted based on the pounds of milk shipped, and, subsequently, a geometric mean of all milk-weighted somatic cell counts was calculated. BTSCCs from the four Federal Milk Marketing Orders have decreased over the last 12 years. Typically, BTSCCs spike during summer months and decline quickly during fall. BTSCCs have ranged from a high of 384,100 in August 1995 to a low of 234,200 in March 2006. Beginning in 2004, BTSCCs have decreased in January through July for each subsequent year.

a. Milk-weighted bulk tank somatic cell counts from Federal Milk Marketing Orders, 1995–2006* (January through June):

	Bulk Tank Somatic Cell Counts (x1,000 cells/ml), 1995–2006					
	Month (January–June)					
Year	**January**	**February**	**March**	**April**	**May**	**June**
1995	298.8	293.2	297.0	289.3	286.1	308.6
1996	275.5	283.5	283.3	277.0	280.4	309.2
1997	288.2	294.9	295.9	291.3	293.4	299.9
1998	284.4	280.2	282.4	282.6	284.2	298.6
1999	278.5	288.8	282.8	283.9	286.4	315.3
2000	258.0	279.9	283.7	282.5	292.6	311.9
2001	286.5	280.2	281.7	284.5	291.6	305.9
2002	283.4	281.8	279.1	279.5	270.9	284.9
2003	274.4	279.9	281.0	271.5	277.6	292.2
2004	250.0	257.6	266.3	264.4	260.5	274.7
2005	246.7	248.2	243.8	244.9	245.5	264.3
2006	240.8	234.7	234.2	236.4	234.7	249.1

*Agricultural Marketing Service data summarized by NAHMS.

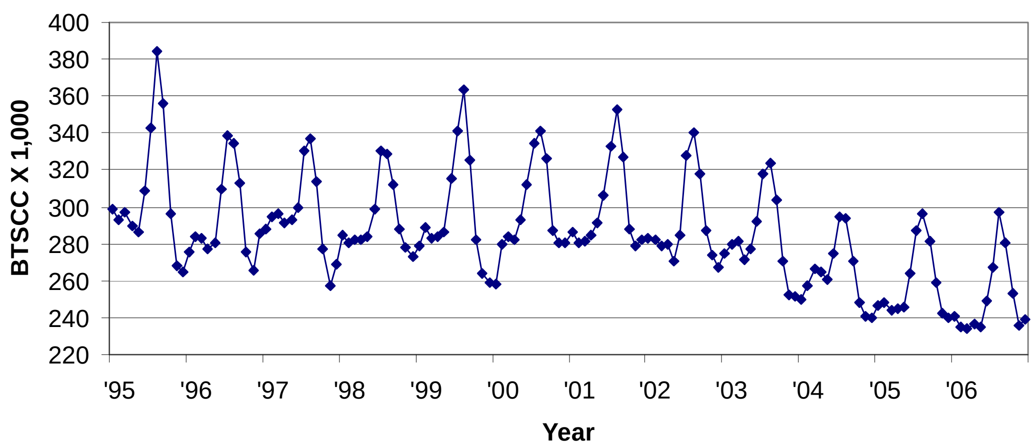
b. Milk-weighted bulk tank somatic cell counts from Federal Milk Marketing Orders, 1995–2006* (July through December):

Bulk Tank Somatic Cell Counts (x1,000 cells/ml), 1995–2006

	Month (July–December)					
Year	**July**	**August**	**September**	**October**	**November**	**December**
1995	342.8	384.1	356.4	296.6	267.7	265.2
1996	338.7	334.1	313.0	275.6	265.3	285.4
1997	330.3	336.7	314.1	276.9	257.0	269.3
1998	330.2	328.4	312.3	288.2	278.2	272.7
1999	341.4	363.7	325.5	282.4	263.6	259.3
2000	334.2	341.4	326.4	287.4	280.4	280.5
2001	332.5	352.5	327.3	288.1	278.7	282.6
2002	328.0	340.1	318.0	287.0	273.6	267.2
2003	317.8	323.7	304.1	270.3	252.0	251.2
2004	294.5	293.6	270.4	247.9	240.9	239.5
2005	286.8	296.1	281.7	258.9	242.5	240.1
2006	267.1	296.9	280.3	253.0	235.4	239.4

*Agricultural Marketing Service data summarized by NAHMS.

Monthly milk-weighted bulk tank somatic cell counts from Federal Milk Marketing Orders, 1995–2006



5. Milk prices

From 1991 through 2006, milk prices paid to producers ranged from a low of $11.00 per hundred pounds of milk from March through June 2003 to a high of $19.30 in May of 2004. On average, milk prices during this time were between $13.00 and $14.00. In general, milk prices rise during late summer and early fall, decrease in mid-winter, and remain stable through the summer.

a. Monthly milk prices received by farmers, all milk 1991–2006 (January through June):

	Milk Prices* 1991–2006 (Dollars)					
	Month (January–June)					
Year	**January**	**February**	**March**	**April**	**May**	**June**
1991	11.70	11.60	11.40	11.30	11.30	11.40
1992	13.40	12.90	12.50	12.60	12.80	13.20
1993	12.50	12.20	12.20	12.60	12.90	13.00
1994	13.60	13.40	13.50	13.40	12.80	12.60
1995	12.60	12.50	12.60	12.30	12.30	12.10
1996	14.10	13.90	13.80	13.90	14.30	14.80
1997	13.50	13.40	13.60	13.20	12.70	12.20
1998	14.70	14.90	14.50	14.00	13.30	14.20
1999	17.40	15.20	15.20	12.60	12.80	13.10
2000	12.00	11.80	11.80	11.90	12.00	12.30
2001	13.00	13.10	13.90	14.60	15.50	16.20
2002	13.60	13.10	12.60	12.50	12.10	11.50
2003	11.80	11.30	11.00	11.00	11.00	11.00
2004	13.20	13.60	15.50	18.10	19.30	18.20
2005	16.10	15.40	15.50	15.20	14.70	14.40
2006	14.40	13.50	12.60	12.10	11.90	11.90

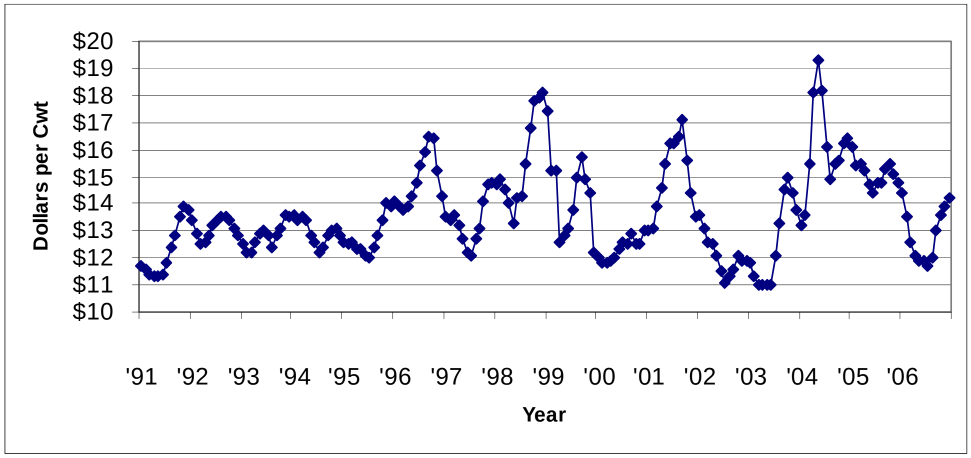
*Per 100 pounds of milk.

b. Monthly milk prices received by farmers, all milk 1991–2006 (July through December):

	Milk Prices* 1991–2006 (Dollars)					
	Month (July–December)					
Year	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1991	11.80	12.40	12.80	13.50	13.90	13.80
1992	13.40	13.50	13.50	13.40	13.10	12.80
1993	12.80	12.40	12.80	13.10	13.60	13.50
1994	12.20	12.40	12.80	13.00	13.10	12.80
1995	12.00	12.40	12.80	13.40	14.00	13.90
1996	15.40	15.90	16.50	16.40	15.20	14.30
1997	12.10	12.70	13.10	14.10	14.70	14.80
1998	14.30	15.50	16.80	17.80	17.90	18.10
1999	13.80	15.00	15.70	14.90	14.40	12.20
2000	12.60	12.50	12.90	12.50	12.50	13.00
2001	16.20	16.50	17.10	15.60	14.40	13.50
2002	11.10	11.30	11.60	12.10	11.90	11.90
2003	12.10	13.30	14.50	15.00	14.40	13.80
2004	16.10	14.90	15.50	15.60	16.20	16.40
2005	14.80	14.80	15.30	15.50	15.10	14.80
2006	11.70	12.00	13.00	13.60	13.90	14.20

*Per 100 pounds of milk.

Monthly Milk Prices Received by Farmers, All Milk 1991–2006



c. Annual milk prices received by farmers, all milk 1991–2006:

	Annual Milk Prices[1] 1991–2006 (Dollars)	
	Nominal Dollars[2]	**2000 Dollars[3]**
1991	12.27	14.53
1992	13.15	15.22
1993	12.84	14.52
1994	13.01	14.41
1995	12.78	13.87
1996	14.75	15.71
1997	13.36	14.00
1998	15.46	16.02
1999	14.38	14.69
2000	12.40	12.40
2001	15.05	14.70
2002	12.18	11.69
2003	12.55	11.80
2004	16.13	14.78
2005	15.19	13.48
2006	12.97	11.16

[1]Per 100 pounds of milk.
[2]Prices producers received.
[3]Nominal prices adjusted for inflation.

6. Milk cow prices

Cow prices were stable from 1991 through 1998, with prices averaging between $1,000 and $1,200 per cow. Since 1998, cow prices have varied more, with a low of $1,240 per cow in 1999 and a high of $1,870 in 2005.

Milk-cow prices received by producers, 1991–2006:

			Milk–Cow Prices[1] (Dollars)			
Year	**January**	**April**	**July**	**October**	**Annual Nominal Dollars[2]**	**2002 Dollars[3]**
1991	1,100	1,090	1,090	1,100	1,100	1,303
1992	1,100	1,120	1,150	1,150	1,130	1,308
1993	1,140	1,160	1,170	1,170	1,160	1,312
1994	1,170	1,190	1,160	1,160	1,170	1,296
1995	1,150	1,140	1,130	1,090	1,130	1,227
1996	1,060	1,070	1,090	1,130	1,090	1,161
1997	1,090	1,110	1,100	1,090	1,100	1,153
1998	1,070	1,110	1,120	1,180	1,120	1,161
1999	1,250	1,240	1,280	1,380	1,280	1,308
2000	1,330	1,340	1,350	1,350	1,340	1,340
2001	1,320	1,400	1,590	1,700	1,500	1,465
2002	1,610	1,710	1,670	1,430	1,600	1,536
2003	1,380	1,300	1,310	1,380	1,340	1,259
2004	1,390	1,580	1,720	1,640	1,580	1,444
2005	1,620	1,770	1,830	1,870	1,770	1,570
2006	1,840	1,770	1,680	1,650	1,730	1,488

[1]Cows that calved.
[2]Prices producers received.
[3]Nominal prices adjusted for inflation.

7. Dairy cow slaughter

Approximately 2 to 3 million dairy cows have been slaughtered annually since 1991. The number of cows slaughtered as a percentage of January 1 inventory ranged from 25.0 to 32.2 percent.

Recent changes in dairy-cow slaughter, 1991-2006:

	Dairy-Cow Slaughter		
Year	**1,000 Head**	**Percent of January 1 Cow Inventory**	**Percent Previous Year**
1991	2,840.0	28.5	106.3
1992	2,892.0	29.7	101.8
1993	2,994.8	31.0	103.6
1994	2,857.8	30.1	95.4
1995	2,861.7	30.2	100.1
1996	3,036.9	32.2	106.1
1997	2,926.2	31.4	96.4
1998	2,619.6	28.5	89.5
1999	2,573.3	28.2	98.2
2000	2,631.5	28.7	102.3
2001	2,581.9	28.2	98.1
2002	2,606.9	28.6	101.0
2003	2,859.9	31.3	109.7
2004	2,362.7	26.3	82.6
2005	2,252.1	25.0	95.3
2006	2,353.5	26.0	104.5

8. Value of production

In 2006, milk sales accounted for 23.6 percent of the value of selected U.S. commodities (cattle, milk, poultry, swine, sheep and wool, catfish and trout, and honey). Since dairy cows, bulls, and steers are also marketed for beef (cattle), the percentage of value assigned to the entire dairy industry totals more than one-quarter of the selected U.S. commodity value.

Value of production for selected U.S. commodities, 2002-2006:

	Year									
	2002		2003		2004		2005		2006	
Commodity	**Value** ($1,000)	**Pct.**	**Value** ($1,000)	**Pct.**	**Value** ($1,000)	**Pct.**	**Value** ($1,000)	**Pct.**	**Value** ($1,000)	**Pct.**
Cattle	27,097,532	34.7	32,112,931	36.7	34,830,872	33.0	36,628,658	34.4	35,740,774	35.7
Milk	20,720,482	26.6	21,381,324	24.4	27,567,726	26.1	26,873,946	25.2	23,573,744	23.6
Poultry[1]	20,501,173	26.3	23,295,445	26.6	28,857,215	27.4	28,174,715	26.5	26,842,833	26.8
Swine	8,690,923	11.1	9,663,024	11.0	13,072,025	12.4	13,606,780	12.8	12,703,842	12.7
Sheep and wool	335,635	0.4	419,891	0.5	441,199	0.4	479,397	0.4	392,598	0.4
Catfish and trout[2]	476,902	0.6	484,894	0.5	546,390	0.5	551,483	0.5	555,675	0.6
Honey	228,338	0.3	253,106	0.3	196,259	0.2	160,428	0.2	161,314	0.2
Total	78,050,985	100.0	87,610,615	100.0	105,511,686	100.0	106,475,407	100.0	99,970,780	100.0

[1]Includes boilers, eggs, turkeys, and chickens (value of sales).
[2]Total of sales for trout (excluding eggs), and catfish foodsize, broodfish, stocker, and fingerling sales.

B. Dairy Industry Changes by State

Note: The following tables describe U.S. dairy industry changes by State between 1991 and 2007, based on USDA–NASS data. The tables also identify which States were in the four NAHMS national dairy studies: the National Dairy Heifer Evaluation Project (NDHEP) 1991, Dairy 1996, Dairy 2002, and Dairy 2007.

1. Milk cow inventory

States in the Western United States have shown the largest growth in the number of milk cows since 1992. Arizona, California, Colorado, Idaho, Kansas, Nevada, New Mexico, Oregon, and Utah have all increased cow numbers since 1992. States in the Southeast, including Alabama, Arkansas, Louisiana, and Mississippi, had the largest percentage decline in dairy cows, but these States represented less than 5 percent of the overall dairy population. In 2007, California had the largest number of dairy cows (1.79 million) followed by Wisconsin (1.245 million), and New York (628,000).

Changes in U.S. milk cow inventories by State:

	Number of Milk Cows that Calved (1,000 Head) **January**						
State	**1992**	**1996**	**2002**	**2007**	**2007 as Percent of 1992**	**2007 as Percent of 1996**	**2007 as Percent of 2002**
Alabama	43*	32	20	13	30.2	40.6	65.0
Alaska	0.8	0.8	1.2	0.6	75.0	75.0	50.0
Arizona	96	118	140	175	182.3	148.3	125.0
Arkansas	69	58	33	19	27.5	32.8	57.6
California	1,160*	1,320*	1,620*	1,790*	154.3	135.6	110.5
Colorado	77*	82	93*	115	149.4	140.2	123.7
Connecticut	33*	31	24	19	57.6	61.3	79.2
Delaware	9	10	9	7	77.8	70.0	77.8
Florida	179*	155*	152*	130	72.6	83.9	85.5
Georgia	105*	98	86	75	71.4	76.5	87.2
Hawaii	10	10	7	3.8	38.0	38.0	54.3
Idaho	178*	245*	377*	502*	282.0	204.9	133.2
Illinois	170*	145*	115*	103	60.6	71.0	89.6
Indiana	145*	140*	154*	166*	114.5	118.6	107.8
Iowa	270*	245*	205*	210*	77.8	85.7	102.4
Kansas	95	83	96	110	115.8	132.5	114.6
Kentucky	185	160*	125*	93*	50.3	58.1	74.4
Louisiana	79	72	54	30	38.0	41.7	55.6
Maine	41*	40	38	32	78.0	80.0	84.2
Maryland	95*	91	81	60	63.2	65.9	74.1
Massachusetts	31*	27	21	15.5	50.0	57.4	73.8
Michigan	332*	326*	299*	324*	97.6	99.4	108.4
Minnesota	660*	585*	500*	455*	68.9	77.8	91.0
Mississippi	60	53	34	22	36.7	41.5	64.7
Missouri	210	185*	140*	114*	54.3	61.6	81.4
Montana	24	20	19	18	75.0	90.0	94.7
Nebraska	90*	70	68	60	66.7	85.7	88.2
Nevada	20	23	25	27	135.0	117.4	108.0
New Hampshire	21*	20	18	14.5	69.0	72.5	80.6
New Jersey	24	23	13	10.5	43.8	45.7	80.8
New Mexico	101	195*	290*	360*	356.4	184.6	124.1
New York	740*	700*	675*	628*	84.9	89.7	93.0
North Carolina	99*	84	66	48	48.5	57.1	72.7
North Dakota	80	63	42	31	38.8	49.2	73.8
Ohio	320*	285*	260*	274*	85.6	96.1	105.4
Oklahoma	97	94	84	70	72.2	74.5	83.3
Oregon	100*	95*	105	115	115.0	121.1	109.5
Pennsylvania	663*	636*	588*	550*	83.0	86.5	93.5
Rhode Island	2.4*	2.1	1.4	1.1	45.8	52.4	78.6
South Carolina	33	26	20	17	51.5	65.4	85.0
South Dakota	132	115	87	81	61.4	70.4	93.1
Tennessee	165*	120*	90*	67	40.6	55.8	74.4
Texas	385	400*	315*	347*	90.1	86.8	110.2
Utah	76	90	93	86	113.2	95.6	92.5
Vermont	163*	157*	154*	140*	85.9	89.2	90.9
Virginia	140*	128	120*	100*	71.4	78.1	83.3
Washington	238*	260*	247*	235*	98.7	90.4	95.1
West Virginia	23	21	16	13	56.5	61.9	81.3
Wisconsin	1,650*	1,475*	1,280*	1,245*	75.5	84.4	97.3
Wyoming	9	6	5	7	77.8	116.7	140.0
U.S.	9,728.2	9,419.9	9,105.6	9,129	93.8	96.9	100.3
NAHMS total	7,910.4	7,829	7,799	7,533	95.2	96.2	96.6

*NAHMS participating States.

Photo by Dr. Jason Lombard

2. Number of U.S. dairy operations

With the exception of Alaska, the number of dairy operations in all States has decreased since 1991. In 2006, Wisconsin had the largest number of dairy operations (14,900) followed by Pennsylvania (8,700) and New York (6,400). California reported 2,300 operations, but had the highest number of dairy cows, demonstrating a large number of cows per herd.

a. Changes in number of U.S. dairy operations, by State:

	Number of Operations[1] with Milk Cows						
State	1991[2]	1995[3]	2001[4]	2006[5]	2006 as Percent of 1991	2006 as Percent of 1995	2006 as Percent of 2001
Alabama	1,100*	510	250	170	15.5	33.3	68.0
Alaska	30	30	30	30	100.0	100.0	100.0
Arizona	500	300	250	200	40.0	66.7	80.0
Arkansas	2,000	1,700	700	280	14.0	16.5	40.0
California	4,200*	3,300*	2,500*	2,300*	54.8	69.7	92.0
Colorado	1,400*	1,000	800*	630	45.0	63.0	78.8
Connecticut	500*	380	310	220	44.0	57.9	71.0
Delaware	160	150	110	90	56.3	60.0	81.8
Florida	1,000*	800*	510*	460	46.0	57.5	90.2
Georgia	1,400*	1,100	720	580	41.4	52.7	80.6
Hawaii	80	60	30	30	37.5	50.0	100.0
Idaho	1,900*	1,500*	1,000*	800*	42.1	53.3	80.0
Illinois	3,000*	2,600*	1,900*	1,300	43.3	50.0	68.4
Indiana	4,500*	3,900*	2,900*	2,100*	46.7	53.8	72.4
Iowa	7,000*	5,200*	3,500*	2,400*	34.3	46.2	68.6
Kansas	2,300	1,600	1,200	900	39.1	56.3	75.0
Kentucky	5,500	4,000*	2,900*	2,000*	36.4	50.0	69.0
Louisiana	1,800	1,100	610	350	19.4	31.8	57.4
Maine	1,100*	750	600	460	41.8	61.3	76.7
Maryland	1,600*	1,100	950	810	50.6	73.6	85.3
Massachusetts	800*	500	350	240	30.0	48.0	68.6
Michigan	6,000*	4,700*	3,300*	2,700*	45.0	57.4	81.8
Minnesota	15,000*	12,000*	7,800*	5,400*	36.0	45.0	69.2
Mississippi	1,300	800	480	330	25.4	41.3	68.8
Missouri	6,900	5,000*	3,700*	2,600*	37.7	52.0	70.3
Montana	1,600	900	650	600	37.5	66.7	92.3
Nebraska	2,700*	1,800	1,100	700	25.9	38.9	63.6
Nevada	260	200	150	100	38.5	50.0	66.7
New Hampshire	400*	400	260	200	50.0	50.0	76.9
New Jersey	450	400	230	150	33.3	37.5	65.2
New Mexico	1,300	900*	500*	450*	34.6	50.0	90.0
New York	12,200*	10,000*	7,300*	6,400*	52.5	64.0	87.7
North Carolina	1,800*	1,300	900	590	32.8	45.4	65.6
North Dakota	2,100	1,500	850	500	23.8	33.3	58.8
Ohio	8,900*	6,800*	5,200*	4,400*	49.4	64.7	84.6
Oklahoma	3,000	2,400	1,700	1,400	46.7	58.3	82.4
Oregon	1,900*	1,300*	820	720	37.9	55.4	87.8
Pennsylvania	14,500*	11,800*	10,300*	8,700*	60.0	73.7	84.5
Rhode Island	60*	40	30	30	50.0	75.0	100.0
South Carolina	800	350	240	200	25.0	57.1	83.3
South Dakota	3,300	2,400	1,400	750	22.7	31.3	53.6
Tennessee	3,500*	2,600*	1,500*	1,100	31.4	42.3	73.3
Texas	5,300	4,000*	2,100*	1,300*	24.5	32.5	61.9
Utah	1,500	1,000	760	560	37.3	56.0	73.7
Vermont	2,600*	2,100*	1,600*	1,200*	46.2	57.1	75.0
Virginia	2,800*	2,100	1,500*	1,300*	46.4	61.9	86.7
Washington	3,000*	1,800*	1,000*	790*	26.3	43.9	79.0
West Virginia	2,000	1,100	600	470	23.5	42.7	78.3
Wisconsin	33,000*	28,000*	19,100*	14,900*	45.2	53.2	78.0
Wyoming	600	400	270	250	41.7	62.5	92.6
U.S.	180,640	139,670	97,460	75,140	41.6	53.8	77.1
NAHMS total	137,860	112,300	80,910	59,740	43.3	53.2	73.8

[1]An operation is any place having one or more milk cows, excluding cows used to nurse calves, on hand any time during the year.
[2]NASS, Milk Final Estimates 1988-92.
[3]NASS, Milk Cows and Production Final Estimates 1993-97, January 1999.
[4]NASS, Livestock Operations, Final Estimates 1998-2002, April 2004.
[5]NASS, Farms, Land in Farms, and Livestock Operations, 2006 Summary, February 2007.
*NAHMS participating States.

Similar to the changes in the number of dairy operations, the number of licensed dairy operations (Grade A or B) decreased from 2002 to 2006 for every State except Alaska, which remained the same over the 5-year period. More than four of five U.S. dairy operations (82.5 percent) were licensed.

b. Changes in U.S. licensed dairy operations by State:

	Number of U.S. Licensed Dairy Operations (Grade A or B)						
	Year						
State	**2002**	**2003**	**2004**	**2005**	**2006**	**2006 as Percent of 2002**	**2006 as Percent of NASS Operations**
Alabama	120*	110	100	90	75	62.5	44.1
Alaska	10	10	10	10	10	100.0	33.3
Arizona	160	160	150	140	130	81.3	65.0
Arkansas	320	290	240	210	190	59.4	67.9
California	2,030*	2,060*	2,030*	1,970*	1,960	96.6	85.7
Colorado	180*	180	170*	170	170	94.4	27.0
Connecticut	210*	200	180	170	170	81.0	77.3
Delaware	95	90	90	90	60	63.2	66.7
Florida	210*	190*	190*	180	160	76.2	34.8
Georgia	380*	360	330	320	300	78.9	55.2
Hawaii	10	10	10	5	5	50.0	16.7
Idaho	815*	775*	755*	725*	690	84.7	86.3
Illinois	1,340*	1,295*	1,210*	1,155	1,105	82.5	85.0
Indiana	2,150*	2,010*	1,900*	1,830*	1,750	81.4	83.3
Iowa	2,760*	2,500*	2,420*	2,370*	2,230	80.8	92.9
Kansas	565	530	490	460	450	79.6	50.0
Kentucky	1,835	1,630*	1,435*	1,335*	1,240	67.6	62.0
Louisiana	380	340	310	280	250	65.8	71.4
Maine	430*	400	390	370	350	81.4	76.1
Maryland	735*	715	695	655	630	85.7	77.8
Massachusetts	250*	230	220	200	190	76.0	79.2
Michigan	3,040*	2,840*	2,680*	2,590*	2,530	83.2	93.7
Minnesota	6,775*	6,235*	5,810*	5,530*	5,295	78.2	98.1
Mississippi	300	270	250	230	190	63.3	57.8
Missouri	2,110	1,980*	1,840*	1,780*	1,710	81.0	65.8
Montana	120	110	120	120	110	91.7	18.3
Nebraska	540*	500	450	405	380	70.4	54.3
Nevada	35	30	30	30	30	85.7	30.0
New Hampshire	170*	150	140	140	130	76.5	65.0
New Jersey	140	130	130	120	120	85.7	80.0
New Mexico	160	170*	170*	170*	170	106.3	37.8
New York	6,930*	6,700*	6,600*	6,430*	5,970	86.1	93.3
North Carolina	420*	395	375	365	345	82.1	58.5
North Dakota	510	440	400	360	320	62.7	64.0
Ohio	4,100*	3,960*	3,780*	3,610*	3,530	86.1	80.2
Oklahoma	440	420	400	380	350	79.5	25.0
Oregon	350*	350*	350	330	320	91.4	44.4
Pennsylvania	9,240*	9,130*	8,720*	8,700*	8,610	93.2	99.0
Rhode Island	20*	20	20	20	15	75.0	50.0
South Carolina	120	120	110	95	95	79.2	47.5
South Dakota	860	780	700	650	600	69.8	80.0
Tennessee	860*	820*	760*	710	650	75.6	59.1
Texas	890	850*	810*	780*	740	83.1	56.9
Utah	405	365	360	345	320	79.0	57.1
Vermont	1,480*	1,390*	1,280*	1,230*	1,170	79.1	97.5
Virginia	940*	910	850*	815*	775	82.4	59.6
Washington	660*	640*	620*	610*	610	92.4	77.2
West Virginia	170	150	140	130	120	70.6	25.5
Wisconsin	17,300*	16,400*	15,570*	15,100*	14,640	84.6	98.3
Wyoming	40	35	35	30	30	75.0	12.0
U.S.	74,110	70,375	66,825	64,540	61,990	83.6	82.5
NAHMS total	64,435	61,925	59,600	55,575			

3. U.S. average dairy herd size

Average dairy herd sizes in 2006 ranged from 20 cows in Alaska to 875 in Arizona. The U.S. average dairy herd size in 2006 was 121.5 cows, more than double the average in 1991 (53.9 cows).

Changes in U.S. average dairy herd size by State:

	Average Herd Size[1] (Number of Milk Cows)						
State	**1991**	**1995**	**2001**	**2006**	**2006 as Percent of 1991**	**2006 as Percent of 1995**	**2006 as Percent of 2001**
Alabama	39.1*	62.7	80.0	76.5	195.7	121.9	95.6
Alaska	26.7	26.7	43.3	20.0	74.9	75.0	46.2
Arizona	192.0	403.3	588.0	875.0	455.7	216.9	148.8
Arkansas	34.5	32.9	45.7	67.9	196.8	206.0	148.4
California	276.2*	408.8*	659.2*	778.3*	281.8	190.4	118.1
Colorado	55.0*	84.0	125.0*	182.5	331.8	217.3	146.0
Connecticut	66.0*	78.9	77.4	86.4	130.9	109.4	111.6
Delaware	56.3	64.7	81.8	77.8	138.2	120.3	95.1
Florida	179.0*	195.0*	294.1*	282.6	157.9	144.9	96.1
Georgia	75.0*	88.2	118.1	129.3	172.4	146.6	109.5
Hawaii	125.0	156.7	220.0	126.7	101.4	80.9	57.6
Idaho	93.7*	170.7*	388.0*	627.5*	669.7	367.7	161.7
Illinois	56.7*	53.8*	60.5*	79.2	139.7	147.1	130.9
Indiana	32.2*	35.9*	52.1*	79.0*	245.3	220.2	151.8
Iowa	38.6*	46.3*	59.7*	87.5*	226.7	188.8	146.5
Kansas	41.3	51.3	89.2	122.2	295.9	238.5	137.1
Kentucky	33.6	38.3*	42.1*	46.5*	138.4	121.6	110.5
Louisiana	43.9	62.7	78.7	85.7	195.2	136.6	108.9
Maine	37.3*	54.7	61.7	69.6	186.6	127.3	112.8
Maryland	59.4*	79.1	85.3	74.1	124.7	93.7	86.9
Massachusetts	38.8*	54.0	60.0	64.6	166.5	119.6	107.6
Michigan	55.3*	68.1*	91.2*	120.0*	217.0	176.3	131.6
Minnesota	44.0*	48.6*	62.4*	84.3*	191.6	173.4	135.0
Mississippi	46.2	63.8	70.8	66.7	144.4	104.6	94.1
Missouri	30.4	36.4*	37.0*	43.8*	144.1	120.5	118.4
Montana	15.0	22.2	27.7	30.0	200.0	135.0	108.3
Nebraska	33.3*	38.3	60.9	85.7	257.4	223.6	140.7
Nevada	76.9	125.0	166.7	270.0	351.1	216.0	162.0
New Hampshire	52.5*	50.0	69.2	72.5	138.1	145.0	104.7
New Jersey	53.3	55.0	56.5	70.0	131.3	127.3	123.8
New Mexico	77.7	216.7*	602.0*	800.0*	1029.6	369.2	132.9
New York	60.7*	70.2*	92.5*	98.1*	161.6	139.8	106.1
North Carolina	55.0*	63.1	71.1	81.4	148.0	129.0	114.4
North Dakota	38.1	41.3	47.1	62.0	162.7	150.0	131.8
Ohio	36.0*	41.3*	50.4*	62.3*	173.1	150.7	123.6
Oklahoma	32.3	39.2	49.4	50.0	154.8	127.7	101.2
Oregon	52.6*	71.5*	139.0	159.7	303.6	223.3	114.9
Pennsylvania	45.7*	53.7*	56.8*	63.2*	138.3	117.7	111.3
Rhode Island	40.0*	50.0	46.7	36.7	91.8	73.3	78.6
South Carolina	41.3	74.3	83.3	85.0	205.8	114.4	102.0
South Dakota	40.0	46.7	61.4	108.0	270.0	231.4	175.8
Tennessee	47.1*	45.0*	58.7*	60.9	129.3	135.4	103.8
Texas	72.6	99.3*	151.0*	266.9*	367.6	268.9	176.8
Utah	50.7	91.0	122.4	153.6	303.0	168.8	125.5
Vermont	62.7*	74.3*	96.3*	116.7*	186.1	157.1	121.2
Virginia	50.0*	60.0	79.3*	76.9*	153.8	128.2	97.0
Washington	79.3*	142.8*	247.0*	297.5*	375.2	208.3	120.4
West Virginia	11.5	18.2	26.7	27.7	240.9	152.1	103.7
Wisconsin	50.0*	51.8*	66.5*	83.6*	167.2	161.5	125.6
Wyoming	15.0	16.5	16.3	28.0	186.7	169.7	171.8
U.S.	53.9	67.1	93.8	121.5	225.4	181.1	129.6
NAHMS total	57.4	69.7	96.4	126.1	219.7	181.4	130.4

[1]Average herd size = NASS published number of dairy operations/following-year January 1 milk cow inventory.

*NAHMS participating States.

Photo by Judy Rodriguez

4. Milk production per cow

Milk production per cow has increased in every State except Alaska since 1991. In 2006, Colorado had the highest milk production per cow at 23,155 pounds. In addition, Arizona (22,855), Idaho (22,326), Michigan (22,188), and Washington (23,055) all had milk production per cow higher than 22,000 pounds during 2006. The U.S. average milk per cow was 19,951 pounds in 2006, up 32.7 percent from 15,031 pounds in 1991.

Changes in milk per cow, by State:

	Milk per Cow Production (Pounds)						
State	**1991**[1]	**1995**[2]	**2001**[3]	**2006**[4]	**2006 as Percent of 1991**	**2006 as Percent of 1995**	**2006 as Percent of 2001**
Alabama	12,707*	14,176	14,286	14,500	114.1	102.3	101.5
Alaska	13,300	17,000	13,055	12,250	92.1	72.1	93.8
Arizona	18,032	19,735	22,036	22,855	126.7	115.8	103.7
Arkansas	11,687	12,150	12,343	13,250	113.4	109.1	107.3
California	18,534*	19,573*	20,904*	21,815*	117.7	111.5	104.4
Colorado	17,338*	18,687	21,413*	23,155	133.6	123.9	108.1
Connecticut	15,848*	16,438	18,240	19,316	121.9	117.5	105.9
Delaware	14,130	14,500	16,667	17,429	123.3	120.2	104.6
Florida	13,933*	14,698*	15,758*	16,417	117.8	111.7	104.2
Georgia	13,523*	15,550	16,663	18,234	134.8	117.3	109.4
Hawaii	13,056	13,654	14,107	13,256	101.5	97.1	94.0
Idaho	16,399*	18,147*	21,194*	22,326*	136.1	123.0	105.3
Illinois	14,936*	15,887*	17,414*	19,204	128.6	120.9	110.3
Indiana	15,439*	15,375*	16,778*	19,994*	129.5	130.0	119.2
Iowa	15,095*	16,124*	18,024*	20,146*	133.5	124.9	111.8
Kansas	12,680	14,390	17,312	20,920	165.0	145.4	120.8
Kentucky	11,231	12,469*	12,969*	13,276*	118.2	106.5	102.4
Louisiana	11,675	11,908	11,704	12,375	106.0	103.9	105.7
Maine	14,786*	16,025	17,211	17,938	121.3	111.9	104.2
Maryland	14,480*	14,725	15,780	17,078	117.9	116.0	108.2
Massachusetts	15,000*	16,000	17,000	17,375	115.8	108.6	102.2
Michigan	15,690*	17,071*	19,373*	22,188*	141.4	130.0	114.5
Minnesota	14,354*	15,894*	17,278*	18,587*	129.5	116.9	107.6
Mississippi	12,098	12,909	14,200	14,826	122.5	114.9	104.4
Missouri	13,451	14,158*	13,441*	16,000*	119.0	113.0	119.0
Montana	13,750	15,000	18,211	18,632	135.5	124.2	102.3
Nebraska	13,913*	14,797	16,194	18,328	131.7	123.9	113.2
Nevada	17,500	18,128	19,412	20,667	118.1	114.0	106.5
New Hampshire	15,143*	16,300	17,889	19,533	129.0	119.8	109.2
New Jersey	14,160	13,913	16,643	16,182	114.3	116.3	97.2
New Mexico	19,561	18,969*	20,750*	21,515*	110.0	113.4	103.7
New York	15,005*	16,501*	17,530*	18,879*	125.8	114.4	107.7
North Carolina	15,424*	16,314	17,224	18,510	120.0	113.5	107.5
North Dakota	12,622	13,094	14,000	14,688	116.4	112.2	104.9
Ohio	14,446*	15,917*	16,519*	17,737*	122.8	111.4	107.4
Oklahoma	12,354	13,611	15,407	16,630	134.6	122.2	107.9
Oregon	16,590*	17,289*	18,074	19,000	114.5	109.9	105.1
Pennsylvania	15,263*	16,492*	18,112*	19,390*	127.0	117.6	107.1
Rhode Island	14,333*	14,773	16,571	17,273	120.5	116.9	104.2
South Carolina	12,273	14,481	17,476	16,353	133.2	112.9	93.6
South Dakota	12,309	13,398	15,393	18,580	150.9	138.7	120.7
Tennessee	11,863*	13,740*	14,511*	15,657	132.0	114.0	107.9
Texas	14,036	15,244*	15,666*	21,328*	152.0	139.9	136.1
Utah	15,975	16,739	17,211	20,291	127.0	121.2	117.9
Vermont	14,683*	16,210*	17,444*	18,383*	125.2	113.4	105.4
Virginia	14,614*	15,116	15,975*	17,363*	118.8	114.9	108.7
Washington	18,814*	20,091*	22,324*	23,055*	122.5	114.8	103.3
West Virginia	11,739	12,667	15,563	15,385	131.1	121.5	98.9
Wisconsin	14,140*	15,397*	17,182*	18,824*	133.1	122.3	109.6
Wyoming	12,563	13,197	14,000	17,612	140.2	133.5	125.8
U.S.	15,031	16,405	18,162	19,951	132.7	121.6	109.9

[1]NASS, Milk Final Estimates 1988-92.
[2]NASS, Milk Cows and Production Final Estimates 1993-97, May 1999.
[3]NASS, Milk Cows and Production Final Estimates 1998-2002, May 2004.
[4]NASS, Milk Production, Disposition and Income 2006 Summary, April 2007.
*NAHMS participating States

Section II: Changes in World Dairy Production

General Trends

Note: Tables in this section are comprised from data collected by USDA's Foreign Agricultural Service (FAS).

1. Milk cow inventory

In 2006 India had 38 million milk cows, more than any other nation in the world. China showed the largest increase in number of milk cows from 1991 to 2006 (approximatley 1.5 to 7.9 million, respectively). The former Soviet Union had the largest decrease in number of milk cows from 1991 to 2006 (approximately 20.6 to 9.9 million, respectively). Total milk cow numbers for these selected countries decreased 5.9 percent since 1991 but remained steady from 2001 to 2006 at approximately 125.6 million.

Changes in milk cow inventories in selected countries:

		Number of Milk Cows (1,000 Head)						
Continent/Country		**1991**	**1995**	**2001**	**2006**	**2006 as Percent of 1991**	**2006 as Percent of 1995**	**2006 as Percent of 2001**
North America	Canada	1,410	1,244	1,091	1,019	72.3	81.9	93.4
	Mexico	6,440	6,440	6,800	6,875	106.8	106.8	101.1
	United States	9,826	9,466	9,103	9,112	92.7	96.3	100.1
	Subtotal	*17,676*	*17,150*	*16,994*	*17,006*	96.2	99.2	100.1
South America	Argentina	2,000	2,350	2,450	2,150	107.5	91.5	87.8
	Brazil	15,500	17,500	15,900	15,290	98.6	87.4	96.2
	Subtotal	*17,500*	*19,850*	*18,350*	*17,440*	99.7	87.9	95.0
European Union[1]	*Subtotal*	*25,392*[2]	*22,434*[2]	*25,747*[3]	*24,944*[4]	98.2	111.2	96.9
Eastern Europe	Poland	4,707	3,715	[3]	[4]	--	--	--
	Romania	1,600	1,778	1,564	[4]	--	--	--
	Subtotal	*6,307*	*5,493*	*1,564*	[4]	--	--	--
Former Soviet Union	Russia	20,557	18,400	12,500	9,900	48.2	53.8	79.2
	Ukraine	8,378	7,818	4,958	3,491	41.7	44.7	70.4
	Subtotal	*28,935*	*26,218*	*17,458*	*13,391*	46.3	51.1	76.7
South Asia	India	30,700	33,000	35,900	38,000	123.8	115.2	105.8
	Subtotal	*30,700*	*33,000*	*35,900*	*38,000*	123.8	115.2	105.8
Asia	China	1,459	2,252	2,848	7,900	541.5	350.8	277.4
	Japan	1,081	1,034	971	900	83.3	87.0	92.7
	Subtotal	*2,540*	*3,286*	*3,819*	*8,800*	346.5	267.8	230.4
Oceania	Australia[5]	1,629	1,786	2,281	1,870	114.8	104.7	82.0
	New Zealand[6]	2,723	2,994	3,557	4,100	150.6	136.9	115.3
	Subtotal	*4,352*	*4,780*	*5,838*	*5,970*	137.2	124.9	102.3
Total		133,402	132,211	125,670	125,551	94.1	95.0	99.9

[1]Based on deliveries.
[2]EU-15 includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, U.K.
[3]EU-25 includes Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, U.K.
[4]EU-27 includes Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, U.K.
[5]Year ending June 30 of year shown.
[6]Year ending May 31 of year shown.
Source: FAS Dairy: World Markets and Trade. Based upon counselor and attaché reports, official statistics, and results of office research.

2. Milk production

The European Union produced the most milk in 2006 at 132.2 million metric tons, a 7.5 percent increase from 1991. China showed the largest increase in production with a 687 percent increase from 1991 to 2006, which is not surprising considering the nation's large increase in cow numbers. Excluding China, milk production in 2006 as a percentage of 2001 increased no more than 15.5 percent and decreased no more than 6 percent in any country. Milk production over all selected countries was approximately 419 million metric tons in 2006, an increase of about 41 million metric tons since 1991.

Changes in milk production in selected countries:

Continent/Country		**Milk Production** (1,000 Metric Tons) 1991	1995	2001	2006	2006 as Percent of 1991	2006 as Percent of 1995	2006 as Percent of 2001
North America	Canada	7,790	7,920	8,106	8,041	103.2	101.5	99.2
	Mexico	10,200	7,399	9,501	10,051	98.5	135.8	105.8
	United States	66,994	70,440	74,994	82,462	123.1	117.1	110.0
	Subtotal	*84,984*	*85,759*	*92,601*	*100,554*	118.3	117.3	108.6
South America	Argentina	6,400	8,500	9,500	10,200	159.4	120.0	107.4
	Brazil	14,200	18,375	22,300	25,230	177.7	137.3	113.1
	Subtotal	*20,600*	*26,875*	*31,800*	*35,430*	172.0	131.8	111.4
European Union[1]	*Subtotal*	*122,961*[2]	*121,740*[2]	*130,069*[3]	*132,206*[4]	107.5	108.6	101.6
Eastern Europe	Poland	14,504	11,420	[3]	[4]	--	--	--
	Romania	4,391	5,885	5,188	[4]	--	--	--
	Subtotal	*18,895*	*17,305*	*5,188*	[4]	--	--	--
Former Soviet Union	Russia	51,971	39,300	33,000	31,100	59.8	79.1	94.2
	Ukraine	22,409	17,181	13,169	13,017	58.1	75.8	98.8
	Subtotal	*74,380*	*56,481*	*46,169*	*44,117*	59.3	78.1	95.6
South Asia	India	28,200	32,500	36,400	41,000	145.4	126.2	112.6
	Subtotal	*28,200*	*32,500*	*36,400*	*41,000*	145.4	126.2	112.6
Asia	China	4,646	5,764	10,255	31,934	687.3	554.0	311.4
	Japan	8,260	8,382	8,300	8,138	98.5	97.1	98.0
	Subtotal	*12,906*	*14,146*	*18,555*	*40,072*	310.5	283.3	216.0
Oceania	Australia[5]	6,578	8,433	10,864	10,395	158.0	123.3	95.7
	New Zealand[6]	8,122	9,684	13,162	15,200	187.1	157.0	115.5
	Subtotal	*14,700*	*18,117*	*24,026*	*25,595*	174.1	141.3	106.5
Total		377,626	372,923	384,808	418,974	110.9	112.3	108.9

[1]Based on deliveries.
[2]EU-15 includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, U.K.
[3]EU-25 includes Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, U.K.
[4]EU-27 includes Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, U.K.
[5]Year ending June 30 of year shown.
[6]Year ending May 31 of year shown.
Source: FAS Dairy: World Markets and Trade. Based upon counselor and attaché reports, official statistics, and results of office research.

Section III: Management, NAHMS Population Estimates

Note: The NDHEP 1991 study included only herds with 30 or more milk cows; the Dairy 1996, Dairy 2002, and Dairy 2007 studies included operations with one or more milk cows.

A. Dairy Herd Information

1. Record-keeping systems

The percentage of operations using hand-written records decreased from 88.3 percent in 1991 to 73.5 percent in 2007, while the percentage of operations using on-farm computers increased from 13.7 percent to 19.4 during the same time period. These changes in record-keeping systems are consistent with the need to quickly store and access information on larger operations.

a. Percentage of operations by…

	…type of record-keeping systems used for the dairy operation.		…type of individual animal record-keeping systems used.					
System	NDHEP 1991	Std. Error	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Handwritten, such as a ledger or notebook	88.3	(1.0)	80.7	(1.0)	74.3	(1.1)	73.5	(1.2)
Dairy Herd Improvement Association	57.5	(1.8)	43.4	(1.2)	44.8	(1.3)	45.9	(1.4)
Computer located on the operation	13.7	(1.1)	15.1	(0.8)	19.4	(0.9)	19.4	(0.9)
Computer located off the operation	11.8	(1.2)	9.9	(0.8)	5.0	(0.5)	4.9	(0.5)
Other system	11.4	(1.1)	6.0	(0.7)	4.1	(0.5)	4.4	(0.6)
Any	99.9	(0.1)	100.0	(0.0)	95.2	(0.6)	95.1	(0.7)

For operations using on- or off-farm computer data records systems, the percentage of ***operations*** that used Dairy Comp 305 increased from 19.4 percent in 2002 to 34.9 percent in 2007. The percentage of ***cows*** whose records were kept using Dairy Comp 305 increased from 48.5 percent in 2002 to 60.3 percent in 2007.

b. For operations using on- or off-farm computer record systems, percentage of operations (and percentage of cows on these operations) by primary computerized record system used:

	Dairy 2002				Dairy 2007			
	Operations		Cows		Operations		Cows	
Primary Computer Record System	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Dairy Comp 305	19.4	(1.7)	48.5	(1.9)	34.9	(2.3)	60.3	(2.0)
PC Dart	12.5	(1.4)	10.3	(0.8)	19.3	(1.9)	10.2	(0.9)
DHI Plus	13.3	(1.7)	13.7	(1.3)	15.0	(1.7)	15.9	(1.7)
Other	54.8	(2.5)	27.5	(1.6)	30.8	(2.4)	13.6	(1.3)
Total	100.0		100.0		100.0		100.0	

2. Identification

Identification methods for dairy cattle have changed little since 1996. The percentage of operations using ear tags or electronic identification (ID) increased slightly, while the percentage of operations using collars or photographs or sketches showed a slight decrease. These changes are expected, as herd sizes increase and housing systems change from individual animal stalls to freestalls and drylot housing.

a. Percentage of operations by type of ***individual*** animal ID used on at least some dairy cows:

	Percent Operations					
ID Type	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Ear tags	81.2	(1.1)	85.8	(1.0)	86.5	(1.0)
Collars	22.3	(1.0)	16.8	(1.0)	12.7	(0.9)
Photographs or sketches	17.4	(1.0)	14.1	(0.9)	13.3	(1.0)
Branding (all methods)	4.9	(0.5)	4.9	(0.5)	4.4	(0.5)
Electronic ID	0.3	(0.1)	0.1	(0.1)	4.1	(0.5)
Tattoos (other than for brucellosis)	6.5	(0.6)	8.8	(0.7)	7.7	(0.6)
Other	10.1	(0.9)	10.8	(0.8)	10.5	(0.9)
Any	91.2	(0.9)	93.7	(0.8)	93.0	(0.8)

The percentage of operations that used ear tags as herd identification at the operation level increased from 29.1 percent in 2002 to 34.5 percent in 2007, but the percentage of cows that had ear tags as herd ID remained unchanged. The use of electronic ID increased, as only 0.4 percent of cows were equipped with electronic ID in 2002 as a method to indentify animals as part of a herd compared with 3.9 percent in 2007.

b. Percentage of operations (and percentage of cows) by type of ***herd*** identification used:

	Dairy 2002				Dairy 2007			
	Operations		Cows		Operations		Cows	
ID Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Ear tags	29.1	(1.1)	41.5	(1.2)	34.5	(1.3)	41.0	(1.5)
Collars	4.2	(0.5)	3.9	(0.5)	2.8	(0.4)	2.9	(0.5)
Branding (all methods)	3.7	(0.3)	18.0	(1.1)	3.1	(0.3)	18.7	(1.4)
Electronic ID	0.1	(0.0)	0.4	(0.2)	1.8	(0.3)	3.9	(0.6)
Tattoos (other than for brucellosis)	3.4	(0.4)	3.8	(0.5)	2.5	(0.4)	4.6	(0.8)
Other	2.7	(0.4)	2.9	(0.4)	2.0	(0.4)	1.7	(0.4)
Any	34.2	(1.1)	53.6	(1.1)	36.4	(1.3)	54.0	(1.5)

3. Breed of dairy cows

Holsteins remain the predominant breed in the United States, and the percentage of operations with specific breeds has not changed since 1991.

Percentage of operations by primary breed:

	Percent Operations							
Breed	**NDHEP 1991**	**Std. Error**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Holstein	94.9	(0.7)	93.0	(0.8)	92.4	(0.7)	92.2	(0.7)
Jersey	2.4	(0.4)	4.1	(0.6)	3.8	(0.5)	3.5	(0.4)
Ayrshire	0.6	(0.3)	0.3	(0.1)	0.3	(0.1)	0.3	(0.1)
Brown Swiss	1.0	(0.4)	0.4	(0.2)	0.9	(0.2)	0.9	(0.3)
Guernsey	0.9	(0.3)	1.7	(0.4)	1.1	(0.3)	0.9	(0.3)
Other	0.2	(0.2)	0.5	(0.2)	1.5	(0.4)	2.2	(0.5)
Total	100.0		100.0		100.0		100.0	

4. Cow registration

The percentage of operations with no registered cows increased from 59.6 in 1991 to 71.7 percent in 2007. Operations with 100 percent of cows registered remained similar from 1991 to 2007.

Percentage of operations by percentage of dairy cows registered with a breed association:

	Percent Operations								
Percent Dairy Cows Registered	**NDHEP 1991**	**Std. Error**	**Percent Dairy Cows Registered**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
0	59.6	(1.7)	0	65.5	(1.2)	71.6	(1.2)	71.7	(1.3)
1 to 9	10.8	(1.1)	0.1 to 9.9	6.7	(0.6)	5.3	(0.6)	5.6	(0.6)
10 to 50	16.3	(1.3)	10.0 to 49.9	10.3	(0.7)	8.1	(0.7)	6.5	(0.7)
51 to 75	3.2	(0.6)	50.0 to 74.9	4.4	(0.6)	3.2	(0.4)	2.1	(0.4)
76 to 99	4.2	(0.6)	75.0 to 99.9	5.5	(0.6)	4.2	(0.5)	5.2	(0.6)
100	5.9	(0.7)	100	7.6	(0.7)	7.6	(0.7)	8.9	(0.8)
Total	100.0		Total	100.0		100.0		100.0	

5. Quality assurance programs

The percentage of operations participating in any milk quality assurance program increased from 40.6 percent in 2002 to 47.3 percent in 2007. Local milk-cooperative or processor-sponsored programs showed the largest increase in the percentage of operation participation from 2002 to 2007 (35.2 to 42.2 percent of operations, respectively).

Percentage of operations that participated in quality assurance programs, by type of program:

	Percent Operations			
Program Type	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
State sponsored	7.8	(0.6)	8.8	(0.7)
Local milk cooperative/ processor sponsored	35.2	(1.3)	42.2	(1.4)
National industry sponsored	2.8	(0.4)	3.1	(0.4)
Other	2.8	(0.4)	2.0	(0.3)
Any	40.6	(1.3)	47.3	(1.4)

B. Productivity

1. Rolling herd average milk production

Rolling herd average (RHA) milk production for all herds and for herds with primarily Holsteins has increased approximately 4,000 pounds (cow average) since 1991.

a. Operation average RHA milk production (lb/cow):

NDHEP 1991		Dairy 1996		Dairy 2002		Dairy 2007	
Op. Avg.	Std. Error	Op. Avg.	Std. Error	Op. Avg.	Std. Error	Op. Avg.	Std. Error
16,703	(96)	16,587	(100)	18,235	(103)	19,175	(112)
Primarily Holsteins*							
Op. Avg.	Std. Error	Op. Avg.	Std. Error	Op. Avg.	Std. Error	Op. Avg.	Std. Error
16,925	(96)	16,925	(99)	18,590	(102)	19,482	(115)

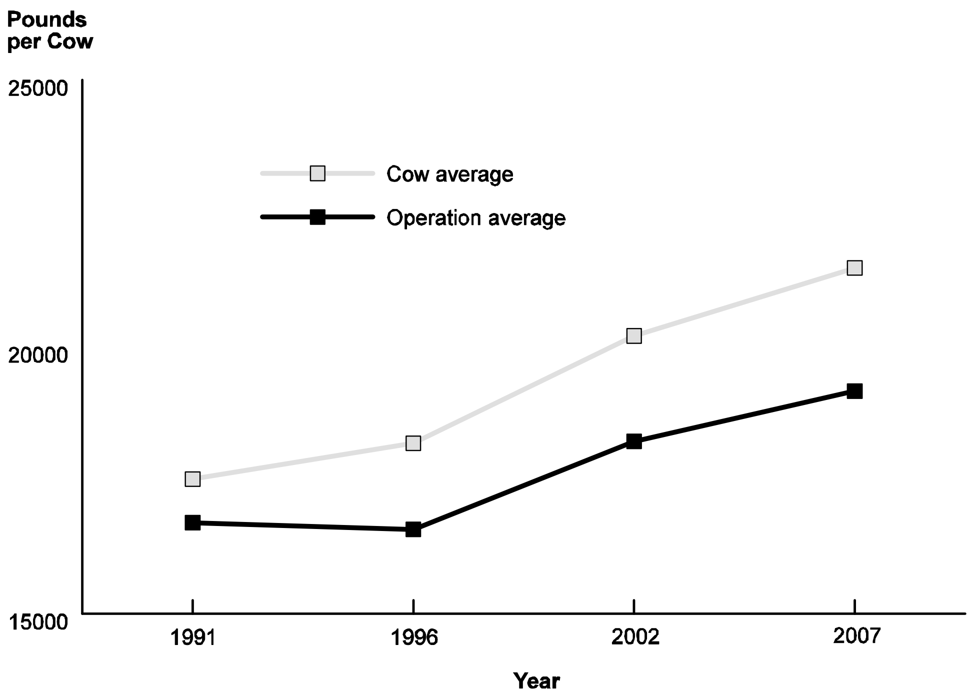
*Operations where Holsteins accounted for 50 percent or more of the January 1, 1998, January 1, 2002, or January 1, 2007, cow inventory or was the main breed of dairy herd (1991).

b. Cow average RHA milk production (lb/cow):

NDHEP 1991		Dairy 1996		Dairy 2002		Dairy 2007	
Cow Avg.	Std. Error	Cow Avg.	Std. Error	Cow Avg.	Std. Error	Cow Avg.	Std. Error
17,532	(81)	18,198	(79)	20,210	(80)	21,483	(115)
Primarily Holsteins*							
Cow Avg.	Std. Error	Cow Avg.	Std. Error	Cow Avg.	Std. Error	Cow Avg.	Std. Error
17,735	(80)	18,442	(78)	20,467	(79)	21,807	(114)

*Operations where Holsteins accounted for 50 percent or more of the January 1, 1998, January 1, 2002, or January 1, 2007, cow inventory or was the main breed of dairy herd (1991).

Operation Average (and Cow Average) RHA Milk Production



2. Age at first calving

The age at first calving at the operation level decreased from 25.9 months in 1991 to 25.2 in 2007. Similarly, the cow average age at first calving decreased from 25.8 to 24.5 months during the same time period.

a. Operation average age at first calving (months):

NDHEP 1991		Dairy 1996		Dairy 2002		Dairy 2007	
Op. Avg.	Std. Error	Op. Avg.	Std. Error	Op. Avg.	Std. Error	Op. Avg.	Std. Error
25.9	(0.1)	25.8	(0.1)	25.4	(0.1)	25.2	(0.1)

b. Cow average age at first calving (months):

NDHEP 1991		Dairy 1996		Dairy 2002		Dairy 2007	
Cow Avg.	Std. Error	Cow Avg.	Std. Error	Cow Avg.	Std. Error	Cow Avg.	Std. Error
25.8	(0.1)	25.5	(0.1)	25.0	(0.1)	24.5	(0.1)

3. Days dry

In 2007, the average days dry at the operation level and cow level was 57.8 and 58.5 days, respectively. These averages represent a decrease of about 3 days since 1991.

a. Operation average days dry:

NDHEP 1991		Dairy 1996		Dairy 2002		Dairy 2007	
Op. Avg.	**Std. Error**	**Op. Avg.**	**Std. Error**	**Op. Avg.**	**Std. Error**	**Op. Avg.**	**Std. Error**
61.1	(0.5)	60.5	(0.3)	60.6	(0.3)	57.8	(0.3)

b. Cow average days dry:

NDHEP 1991		Dairy 1996		Dairy 2002		Dairy 2007	
Cow Avg.	**Std. Error**	**Cow Avg.**	**Std. Error**	**Cow Avg.**	**Std. Error**	**Cow Avg.**	**Std. Error**
61.5	(0.3)	61.7	(0.4)	61.9	(0.2)	58.5	(0.3)

4. Calving interval

Although the operation average calving interval decreased slightly from 2002 to 2007 (13.3 and 13.2 months, respectively), the average increased from 12.8 months in 1991 to 13.2 in 2007.

a. Operation average calving interval for cows (months):

NDHEP 1991		Dairy 1996		Dairy 2002		Dairy 2007	
Op. Avg.	**Std. Error**	**Op. Avg.**	**Std. Error**	**Op. Avg.**	**Std. Error**	**Op. Avg.**	**Std. Error**
12.8	(0.0)	12.9	(0.0)	13.3	(0.0)	13.2	(0.0)

b. Cow average calving interval for cows (months):

NDHEP 1991		Dairy 1996		Dairy 2002		Dairy 2007	
Cow Avg.	Std. Error	Cow Avg.	Std. Error	Cow Avg.	Std. Error	Cow Avg.	Std. Error
12.9	(0.0)	13.0	(0.0)	13.4	(0.0)	13.3	(0.0)

Photo by Dr. Jason Lombard

C. Heifer Management

1. Source of heifers

In 2002 and 2007, the majority of heifers were born and raised on the same operation, and the majority of operations had heifers that were born and raised on the operation. A higher percentage of heifers were raised off the operation in 2007 compared to 2002 (11.5 and 7.2 percent, respectively).

Percentage of operations and percentage of dairy heifers*, by source of heifers:

	Dairy 2002				Dairy 2007			
	Operations		Heifers		Operations		Heifers	
Heifer Source	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Heifers born and raised on same operation	98.1	(0.3)	89.5	(1.0)	96.5	(0.4)	87.4	(1.2)
Heifers born on the operation but raised off the operation	3.6	(0.4)	7.2	(0.8)	4.7	(0.5)	11.5	(1.2)
Heifers were born off the operation	6.7	(0.7)	3.3	(0.8)	6.6	(0.8)	1.1	(0.2)
Total			100.0				100.0	

*As a percentage of January 1 heifer inventory

2. Separation from dam

The practice of separating newborn heifer calves from their dams immediately after birth doubled from 1991 to 2007 (28.0 and 55.9 percent of operations, respectively).

Percentage of operations by age at which newborn heifer calves were separated from their dams:

Percent Operations									
Age (Hours)	NDHEP 1991	Std. Error	**Age** (Hours)	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
0 (before any nursing)	28.0	(1.7)	Immediately (no nursing)	47.9	(1.3)	52.9	(1.3)	55.9	(1.4)
Less than 12	39.6	(1.7)	After nursing, but less than 12 hours	20.8	(1.0)	22.5	(1.1)	22.2	(1.2)
12 to 24	22.0	(1.4)	12 to 24	17.4	(1.1)	15.9	(1.0)	14.6	(1.0)
More than 24	10.4	(1.0)	More than 24	13.9	(1.0)	8.7	(0.8)	7.3	(0.8)
Total	100.0		Total	100.0		100.0		100.0	

Photo by Judy Rodriguez

3. Colostrum

In 1991, 1996, and 2002, about 3 of 10 operations allowed heifer calves to get colostrum during first nursing compared to about 4 of 10 operations in 2007. A smaller percentage of operations hand-fed colostrum from a bucket or bottle in 2007 compared to operations in 1991, 1996, and 2002.

a. Percentage of operations by method normally used for heifer calves' first feeding of colostrum:

	Percent Operations							
Method	**NDHEP 1991**	**Std. Error**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
First nursing	33.7	(1.7)	33.5	(1.2)	30.5	(1.2)	36.3	(1.4)
Hand-fed from bucket or bottle	64.0	(1.7)	62.5	(1.2)	64.8	(1.3)	59.2	(1.4)
Hand-fed using esophageal feeder	2.3	(0.6)	3.6	(0.4)	4.4	(0.5)	4.3	(0.5)
No colostrum	0.0	(0.0)	0.4	(0.2)	0.3	(0.1)	0.2	(0.1)
Total	100.0		100.0		100.0		100.0	

The percentage of operations that estimated immunoglobulin (Ig) levels in colostrum or evaluated its quality increased across all herd sizes from 2002 to 2007.

b. For operations that hand-fed colostrum, percentage of operations that estimated Ig levels of the colostrum or evaluated its quality, by herd size:

	Percent Operations			
Herd Size (Number Dairy Cows)	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Small (fewer than 100)	2.1	(0.6)	7.6	(1.3)
Medium (100 to 499)	10.6	(1.5)	19.8	(2.3)
Large (500 or more)	32.2	(2.8)	45.2	(3.2)
All operations	5.2	(0.5)	13.0	(1.1)

A smaller percentage of medium and large operations pooled colostrum from more than one cow in 2007 than in 2002.

c. For operations that normally hand-fed colostrum, percentage of operations that pooled colostrum from more than one cow, by herd size:

	Percent Operations			
Herd Size (Number Dairy Cows)	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Small (fewer than 100)	22.1	(1.4)	16.0	(1.7)
Medium (100 to 499)	37.4	(2.0)	26.0	(2.4)
Large (500 or more)	70.6	(2.4)	56.9	(3.1)
All operations	27.0	(1.1)	21.0	(1.3)

The percentage of operations by storage methods for colostrum was essentially unchanged between 2002 and 2007, with the largest percentage of operations not storing colostrum. Approximately 6 of 10 operations did not store colostrum in 2002 and 2007.

d. For operations that hand-fed colostrum, percentage of operations by primary method of storing colostrum:

	Percent Operations			
Method	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Stored without refrigeration	4.4	(0.6)	3.9	(0.7)
Stored in refrigerator	7.8	(0.6)	11.1	(0.9)
Stored in freezer	27.7	(1.1)	28.2	(1.6)
Other	0.5	(0.2)	0.0	(--)
Not stored	59.6	(1.3)	56.8	(1.8)
Total	100.0		100.0	

The percentage of operations that pasteurized colostrum did not change from 2002 to 2007.

e. For operations that hand-fed colostrum, percentage of operations that pasteurized colostrum, by herd size:

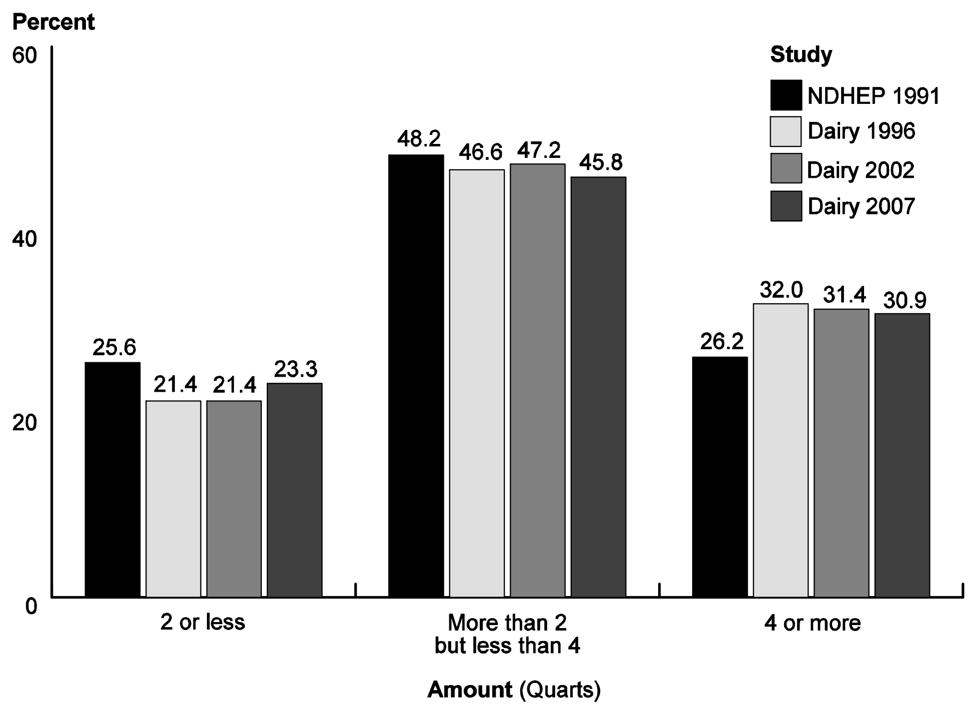
	Percent Operations			
Herd Size (Number Dairy Cows)	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Small (fewer than 100)	0.4	(0.2)	0.2	(0.2)
Medium (100 to 499)	0.8	(0.3)	0.9	(0.4)
Large (500 or more)	3.6	(0.9)	6.4	(1.6)
All operations	0.6	(0.2)	0.8	(0.2)

Operations provided calves approximately the same amount of colostrum during the first 24 hours of life from 1991 to 2007, with approximately one-quarter of operations feeding 2 quarts or less and about one-third feeding 4 or more quarts.

f. For operations that hand-fed colostrum, percentage of operations by amount of colostrum normally fed during the first 24 hours:

	Percent Operations							
Amount (Quarts)	**NDHEP 1991**	**Std. Error**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
2 or less	25.6	(1.8)	21.4	(1.3)	21.4	(1.4)	23.3	(1.6)
More than 2 but less than 4	48.2	(2.1)	46.6	(1.6)	47.2	(1.7)	45.8	(1.9)
4 or more	26.2	(1.9)	32.0	(1.5)	31.4	(1.5)	30.9	(1.7)
Total	100.0		100.0		100.0		100.0	

For Operations that Normally Hand-fed Colostrum, Percentage of Operations by Amount of Colostrum Normally Fed During the First 24 Hours



4. Medicated milk replacer

Approximately 56 percent of operations fed medicated milk replacer in 2002 and 2007.

a. Percentage of operations that fed medicated milk replacer, by herd size:

	Percent Operations			
Herd Size (Number Dairy Cows)	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Small (fewer than 100)	54.4	(1.6)	55.2	(1.8)
Medium (100 to 499)	64.1	(1.9)	68.2	(2.1)
Large (500 or more)	37.7	(2.5)	43.6	(3.1)
All operations	55.7	(1.3)	57.5	(1.4)

Photo by Judy Rodriguez

Although the percentage of operations that fed milk replacer remained unchanged between 2002 and 2007, the percentage of operations that fed each specific medication listed increased from 2002 to 2007.

b. For operations that fed a medicated milk replacer, percentage of operations by medication used:

	Percent Operations			
Medication Used	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Chlortetracycline (CTC)	7.1	(0.7)	12.1	(1.1)
Oxytetracycline (OTC)	13.7	(0.8)	21.9	(1.5)
Oxytetracycline in combination with Neomycin (OxyNEO)	25.6	(1.2)	49.5	(1.9)
Decoquinate	12.8	(0.9)	18.8	(1.4)
Lasalocid	3.2	(0.4)	7.2	(0.9)
Other	3.6	(0.5)	5.4	(0.9)

5. Weaning age

The age at weaning for both the operation and heifer averages has remained relatively steady since 1996.

a. Operation average age of heifers at weaning (weeks):

NDHEP 1991		**Dairy 1996**		**Dairy 2002**		**Dairy 2007**	
Op. Avg.	**Std. Error**	**Op. Avg.**	**Std. Error**	**Op. Avg.**	**Std. Error**	**Op. Avg.**	**Std. Error**
7.9	(0.1)	8.4	(0.1)	8.0	(0.1)	8.2	(0.1)

b. Heifer average age at weaning (weeks):

NDHEP 1991		Dairy 1996		Dairy 2002		Dairy 2007	
Heifer Avg.	Std. Error	Heifer Avg.	Std. Error	Heifer Avg.	Std. Error	Heifer Avg.	Std. Error
8.2	(0.1)	8.7	(0.1)	8.4	(0.1)	8.6	(0.1)

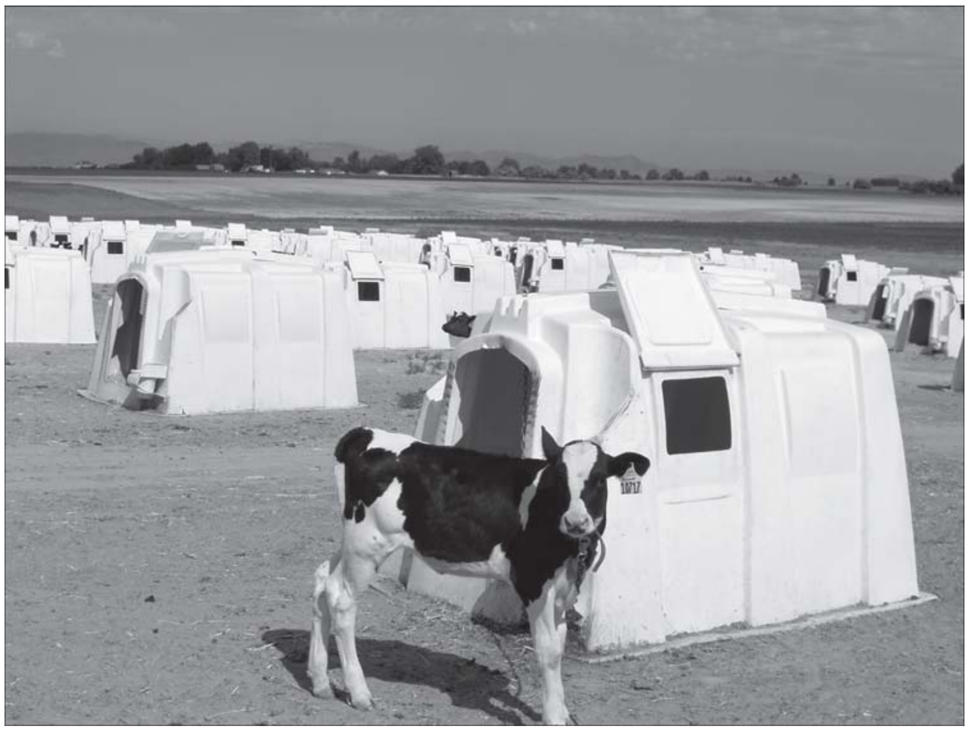


Photo by Dr. Jason Lombard

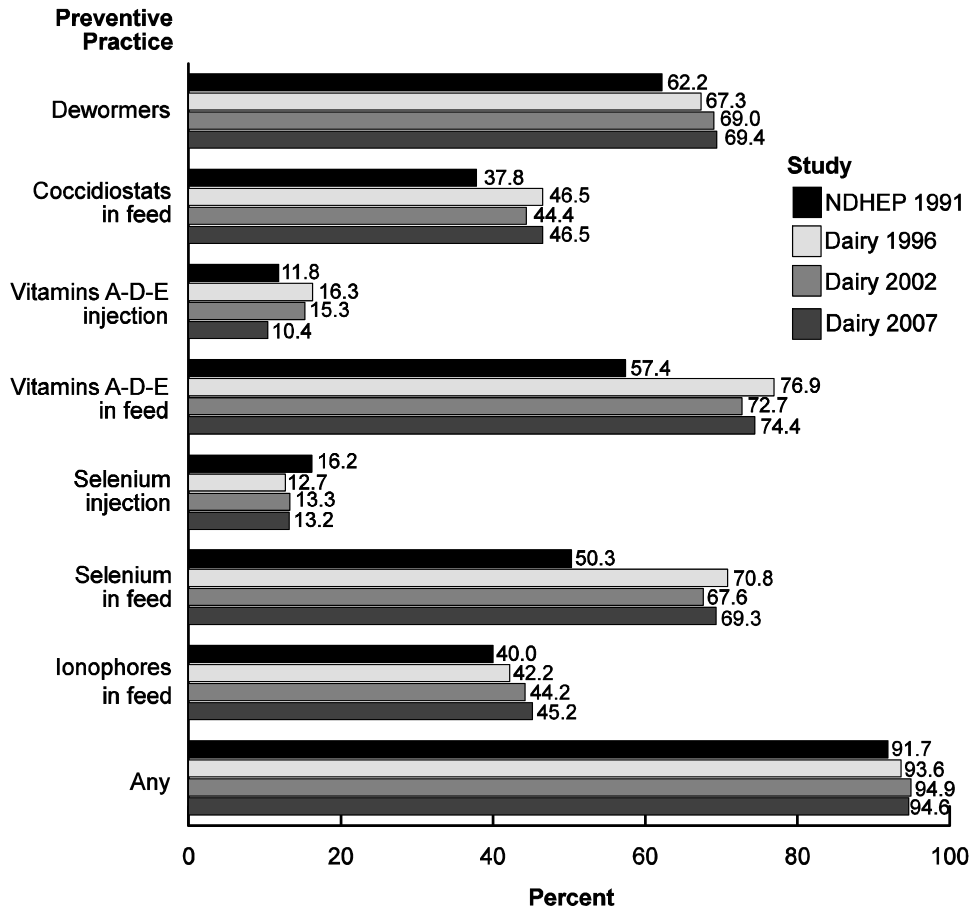
6. Preventive practices

Operation use of specific preventive practices for heifers has remained stable or increased since 1991. The largest increases in the use of preventive practices were observed for vitamins A-D-E in feed and selenium in feed.

Percentage of operations by preventive practices normally used for heifers:

	Percent Operations							
Preventive Practice	**NDHEP 1991**	**Std. Error**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Dewormers	62.2	(2.2)	67.3	(1.3)	69.0	(1.2)	69.4	(1.3)
Coccidiostats in feed	37.8	(2.0)	46.5	(1.2)	44.4	(1.3)	46.5	(1.4)
Vitamins A-D-E injection	11.8	(1.3)	16.3	(1.0)	15.3	(1.0)	10.4	(0.7)
Vitamins A-D-E in feed	57.4	(2.2)	76.9	(1.1)	72.7	(1.2)	74.4	(1.2)
Selenium injection	16.2	(1.8)	12.7	(0.8)	13.3	(0.9)	13.2	(0.9)
Selenium in feed	50.3	(2.2)	70.8	(1.2)	67.6	(1.3)	69.3	(1.3)
Ionophores in feed (e.g., Rumensin®, Bovatec®)	40.0	(2.2)	42.2	(1.2)	44.2	(1.3)	45.2	(1.4)
Probiotics	NA		13.1	(0.9)	14.2	(0.9)	20.0	(1.1)
Anionic salts in feed	NA		NA		20.6	(1.1)	20.9	(1.1)
Other	NA		4.8	(0.6)	3.8	(0.5)	4.6	(0.7)
Any	91.7	(1.1)	93.6	(0.7)	94.9	(0.6)	94.6	(0.7)

Percentage of Operations by Preventive Practices Normally Used for Heifers



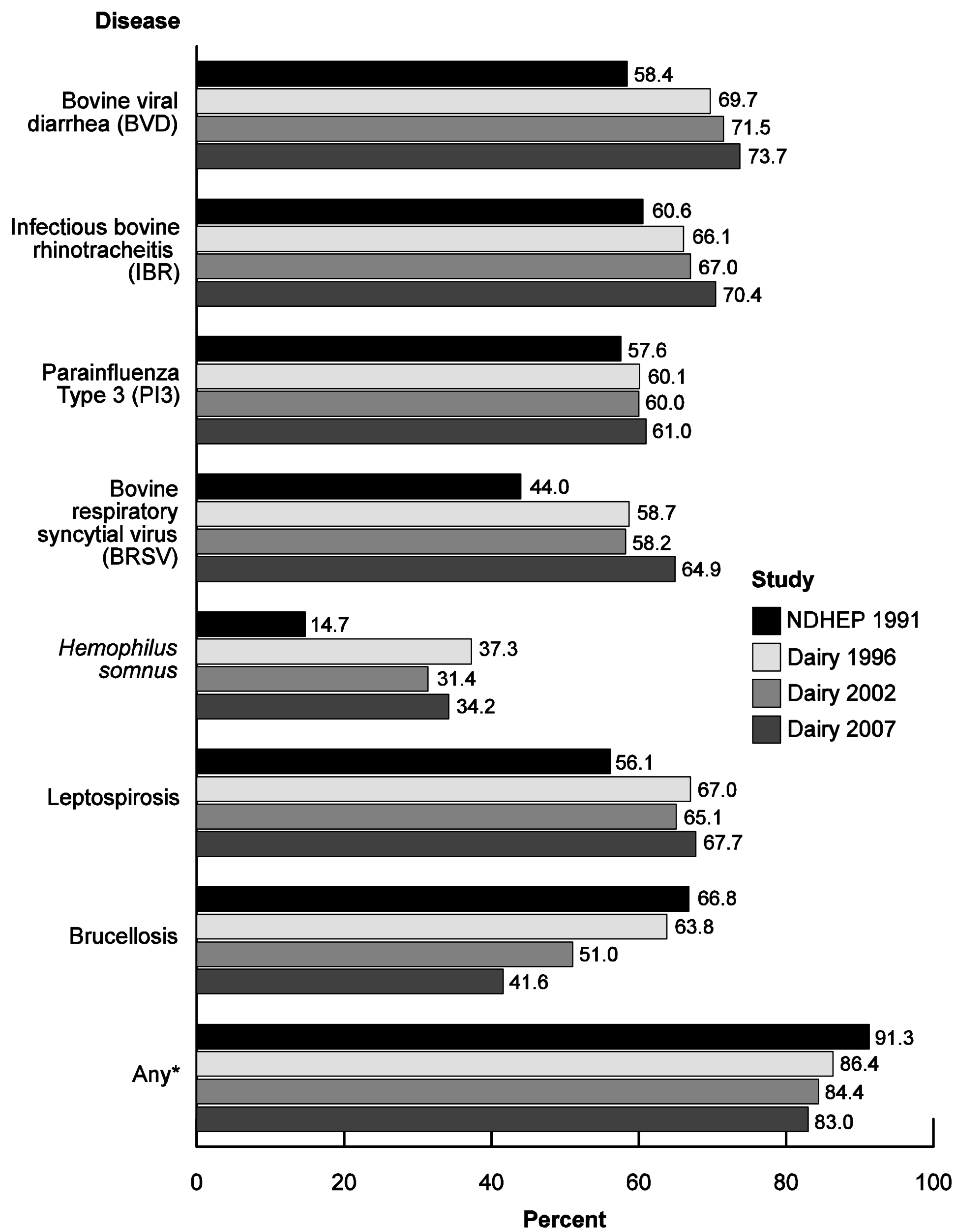
7. Vaccination practices

The percentage of operations administering any vaccine decreased from 91.3 percent in 1991 to 83.0 percent in 2007. With the exceptions of parainfluenza, brucellosis, and Johne's disease vaccines, vaccine use for all other diseases increased. The percentage of operations that vaccinated heifers against brucellosis decreased from 63.8 percent in 1996 to 41.6 percent in 2007. This decease may be due to the fact that many States switched from a mandatory to a voluntary brucellosis vaccination program from 1996 to 2007. In addition, the number of States that were certified brucellosis-free increased from 34 in 1996 to 49 in 2007, which may have impacted how many operations vaccinated against brucellosis.

Percentage of operations that normally vaccinated heifers against the following diseases:

	Percent Operations							
Disease	**NDHEP 1991**	**Std. Error**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Bovine viral diarrhea (BVD)	58.4	(2.1)	69.7	(1.3)	71.5	(1.2)	73.7	(1.3)
Infectious bovine rhinotracheitis (IBR)	60.6	(2.1)	66.1	(1.3)	67.0	(1.3)	70.4	(1.3)
Parainfluenza Type 3 (PI3)	57.6	(2.1)	60.1	(1.3)	60.0	(1.3)	61.0	(1.4)
Bovine respiratory syncytial virus (BRSV)	44.0	(2.1)	58.7	(1.3)	58.2	(1.3)	64.9	(1.4)
Haemophilus somnus	14.7	(1.4)	37.3	(1.3)	31.4	(1.2)	34.2	(1.3)
Leptospirosis	56.1	(2.2)	67.0	(1.3)	65.1	(1.3)	67.7	(1.3)
Salmonella	NA		18.9	(1.0)	16.8	(1.0)	21.5	(1.1)
E. coli mastitis	NA		18.1	(0.9)	21.3	(1.0)	24.1	(1.1)
Clostridia (blackleg/ malignant edema)	20.7	(1.4)	32.3	(1.1)	32.8	(1.1)	34.6	(1.3)
Brucellosis	66.8	(1.9)	63.8	(1.3)	51.0	(1.3)	41.6	(1.3)
Mycobacterium avium subspecies *paratuberculosis* (Johne's disease)	NA		5.4	(0.6)	4.6	(0.5)	5.0	(0.6)
Neospora	NA		NA		3.6	(0.4)	6.3	(0.6)
Other	NA		7.3	(0.6)	6.9	(0.6)	6.8	(0.7)
Any	91.3	(1.3)	86.4	(1.0)	84.4	(1.1)	83.0	(1.1)

Percentage of Operations that Normally Vaccinated Heifers Against the Following Diseases



*Includes vaccines for the diseases listed above plus *Salmonella*, *E. coli* mastitis, clostridia, Johne's disease, *Neospora,* and "Other."

8. Types of BVD vaccine

The majority of operations that administered BVD vaccines to heifers switched from giving killed vaccines in 1996 (58.4 percent of operations) to modified-live vaccines in 2007 (62.2 percent of operations).

For operations that gave BVD vaccinations to heifers, percentage of operations by type of BVD vaccine given:

	Percent Operations					
Type of BVD Vaccine	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Killed	58.4	(1.5)	50.6	(1.6)	43.1	(1.6)
Modified live	40.7	(1.5)	49.2	(1.6)	62.2	(1.5)

D. Heifer Health

1. Calves born alive

The number of calves born alive as a percentage of cow inventory decreased from 93.4 percent in 1996 to 86.0 percent in 2007.

Number of calves born and alive*, as a percentage of January 1 cow inventory:

Dairy 1996		Dairy 2002		Dairy 2007	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
93.4	(0.5)	88.8	(0.5)	86.0	(0.6)

*In Dairy 2007, included "alive at 48 hours."

2. Mortality

The percentages of unweaned and weaned heifer calves that died decreased from 1996 to 2007. The percentage of unweaned calves that died decreased from 10.5 percent in 2002 to 7.8 percent in 2007. Weaned heifer calf deaths increased from 2.2 percent in 1991 to 2.8 percent in 2002 and then decreased to 1.8 percent in 2007.

a. Number of unweaned and weaned heifer deaths, as a percentage of heifers born alive…

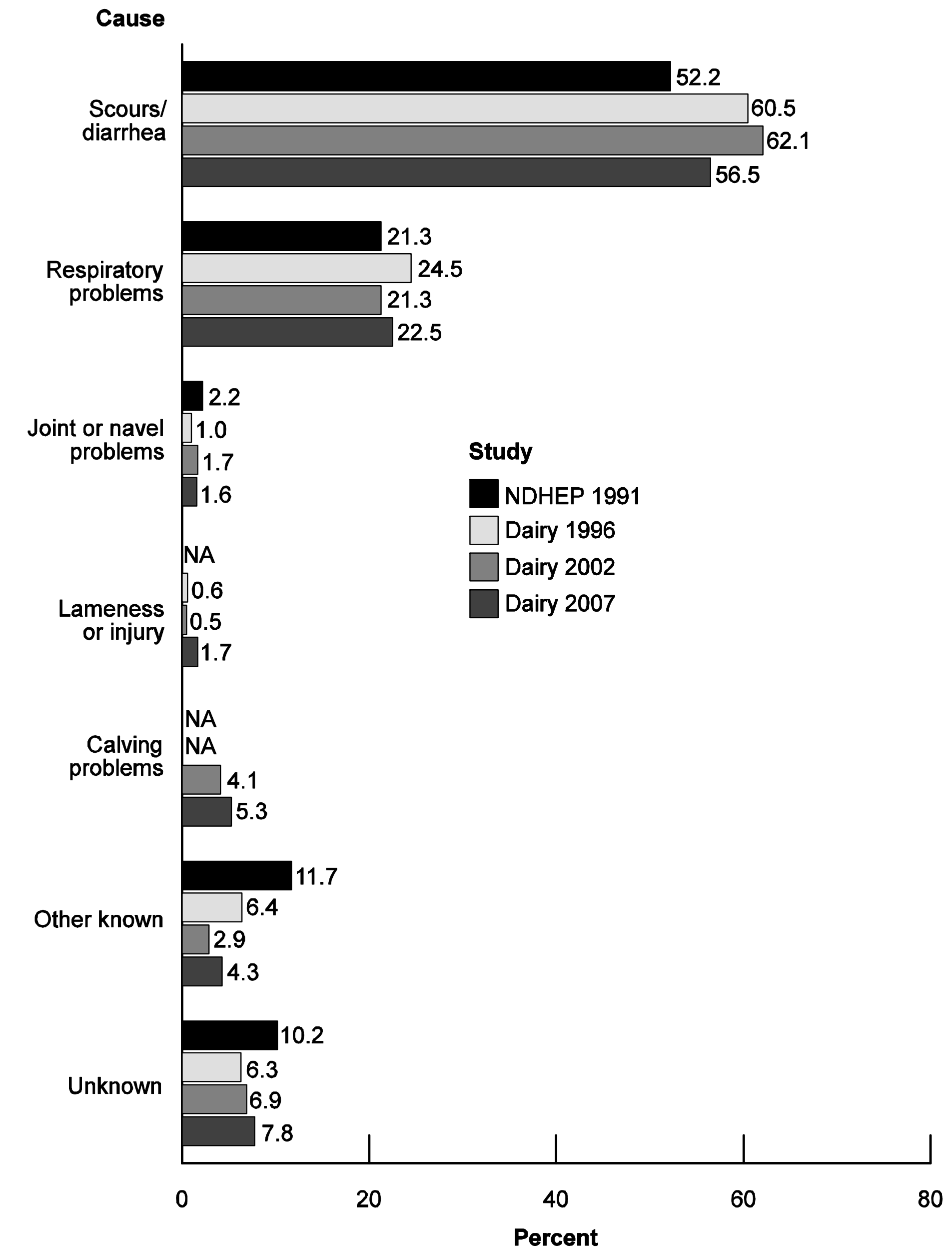
	…or moved onto the operation NDHEP 1991		Dairy 1996		Dairy 2002		Dairy 2007	
Heifer Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Unweaned	8.4	(0.4)	10.8	(0.4)	10.5	(0.3)	7.8	(0.2)
Weaned	2.2	(0.1)	2.4	(0.1)	2.8	(0.1)	1.8	(0.1)

Scours/diarrhea accounted for more than 50 percent of unweaned heifer deaths in each study year since 1991, while respiratory problems accounted for 20 to 25 percent of deaths during the same period.

b. Percentage of ***unweaned heifer*** deaths by cause:

	Percent Deaths							
Cause	**NDHEP 1991**	**Std. Error**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Scours/ diarrhea	52.2	(2.6)	60.5	(1.2)	62.1	(1.1)	56.5	(1.3)
Respiratory problems	21.3	(1.6)	24.5	(1.0)	21.3	(0.9)	22.5	(0.9)
Joint or navel problems	2.2	(0.7)	1.0	(0.1)	1.7	(0.2)	1.6	(0.3)
Lameness or injury	NA		0.6	(0.1)	0.5	(0.1)	1.7	(0.3)
Trauma	2.4	(0.8)	NA		NA		NA	
Lack of coordination/ severe depression	NA		0.4	(0.1)	0.4	(0.1)	0.3	(0.1)
Poison	NA		0.3	(0.1)	0.1	(0.0)	0.0	(0.0)
Calving problems	NA		NA		4.1	(0.6)	5.3	(0.7)
Other known	11.7	(1.8)	6.4	(1.1)	2.9	(0.4)	4.3	(0.7)
Unknown	10.2	(1.4)	6.3	(0.9)	6.9	(0.8)	7.8	(0.9)
Total	100.0		100.0		100.0		100.0	

Percentage of Unweaned Heifer Deaths by Cause

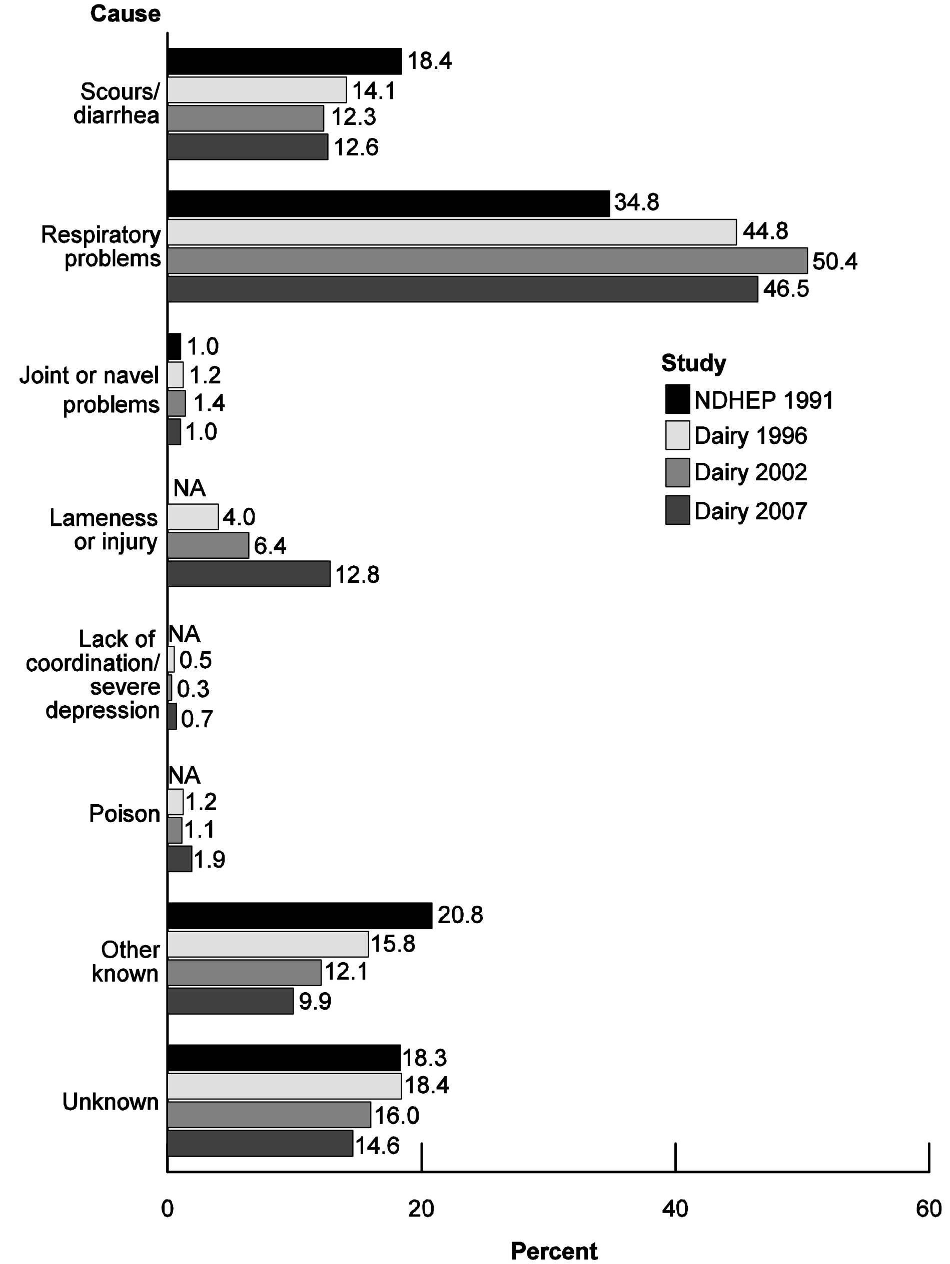


The percentage of weaned heifer deaths caused by respiratory problems increased from 34.8 percent of deaths in 1991 to 46.5 percent in 2007. Weaned heifer deaths caused by lameness or injury increased from 4.0 percent of deaths in 1996 to 12.8 percent in 2007.

c. Percentage of ***weaned heifer*** deaths by cause:

	Percent Deaths							
Cause	**NDHEP 1991**	**Std. Error**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Scours/ diarrhea	18.4	(2.6)	14.1	(1.6)	12.3	(1.0)	12.6	(1.0)
Respiratory problems	34.8	(3.5)	44.8	(2.1)	50.4	(1.6)	46.5	(1.7)
Joint or navel problems	1.0	(0.4)	1.2	(0.5)	1.4	(0.3)	1.0	(0.3)
Lameness or injury	NA		4.0	(0.5)	6.4	(0.6)	12.8	(1.0)
Trauma	6.7	(0.9)	NA		NA		NA	
Lack of coordination/ severe depression	NA		0.5	(0.1)	0.3	(0.1)	0.7	(0.2)
Poison	NA		1.2	(0.3)	1.1	(0.4)	1.9	(0.9)
Other known	20.8	(2.0)	15.8	(2.4)	12.1	(1.2)	9.9	(1.0)
Unknown	18.3	(2.1)	18.4	(1.4)	16.0	(1.1)	14.6	(1.2)
Total	100.0		100.0		100.0		100.0	

Percentage of Weaned Heifer Deaths by Cause



3. Carcass disposal

The percentage of operations that used rendering to dispose of dead calves decreased from 43.8 percent in 2002 to 36.5 percent in 2007, while the percentage of operations that composted dead calves increased from 10.1 to 24.2 percent during the same period.

Percentage of operations by primary method used to dispose of dead calves:

	Percent Operations			
Method of Disposal	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Buried	35.3	(1.3)	32.6	(1.3)
Burned/incinerated	2.8	(0.4)	2.0	(0.4)
Rendered	43.8	(1.3)	36.5	(1.3)
Composted	10.1	(0.8)	24.2	(1.2)
Landfill	2.4	(0.4)	1.7	(0.3)
Other	5.6	(0.6)	3.0	(0.5)
Total	100.0		100.0	

E. Cow Management

1. Home-raised replacements

The percentage of operations that home-raised more than 40 percent of their cow inventory increased threefold from 2002 to 2007 (8.2 and 24.2 percent, respectively).

Percentage of operations by percentage of adult-cow inventory that was home-raised:

	Percent Operations			
Percent of Home-Raised Replacements	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
0	8.4	(0.8)	10.2	(0.8)
0.1 to 10.0	3.9	(0.6)	3.5	(0.6)
10.1 to 20.0	23.2	(1.2)	15.8	(1.1)
20.1 to 30.0	33.1	(1.3)	23.3	(1.2)
30.1 to 40.0	23.2	(1.1)	22.8	(1.2)
40.1 or more	8.2	(0.7)	24.4	(1.3)
Total	100.0		100.0	

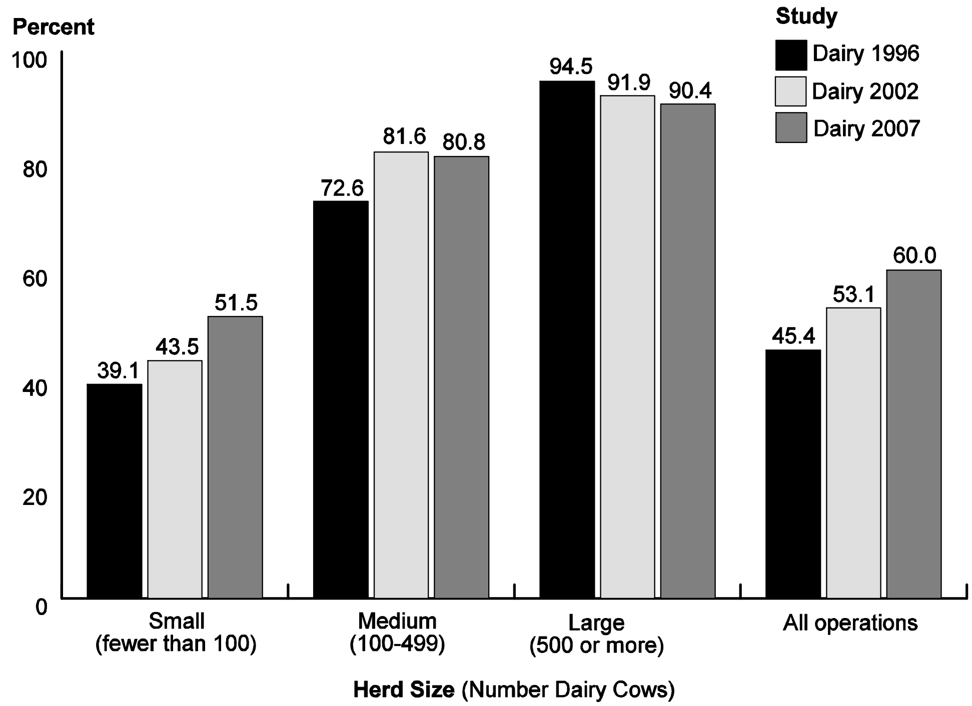
2. Housing

A higher percentage of small and medium operations housed maternity cows separate from lactating cows in 2007 compared with 1996. For all operations, the use of separate maternity housing increased from 45.4 percent in 1996 to 60.0 percent in 2007.

Percentage of operations in which maternity housing was separate from housing used for ***lactating*** cows, by herd size:

	Percent Operations					
Herd Size (Number Dairy Cows)	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Small (fewer than 100)	39.1	(1.3)	43.5	(1.6)	51.5	(1.7)
Medium (100 to 499)	72.6	(2.1)	81.6	(1.7)	80.8	(1.8)
Large (500 or more)	94.5	(1.8)	91.9	(1.5)	90.4	(2.0)
All operations	45.4	(1.2)	53.1	(1.3)	60.0	(1.3)

Percentage of Operations in Which Maternity Housing was Separate from Housing Used for Lactating Cows, by Herd Size



3. Milking facilities

The percentage of operations that used a parlor as a primary milking facility increased from 28.8 percent in 1996 to 39.5 percent in 2007, while the percentage of operations that used a tiestall or stanchion decreased from 69.5 to 60.3 percent during the same period. A larger shift was observed in the percentage of cows, as 54.9 percent of cows were milked in parlors in 1996 compared with 78.2 percent in 2007.

Percentage of operations (and percentage of cows on these operations) by primary milking[1] facility used:

	Percent Operations						Percent Cows[2]					
Facility Type	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Parlor	28.8	(0.9)	37.1	(1.0)	39.5	(1.0)	54.9	(1.0)	70.0	(0.8)	78.2	(0.6)
Tie stall or stanchion	69.5	(0.9)	61.9	(1.0)	60.3	(1.0)	43.9	(1.0)	28.9	(0.8)	21.8	(0.6)
Other	2.9	(0.5)	1.0	(0.2)	0.2	(0.1)	4.3	(0.7)	1.1	(0.2)	0.0	(0.0)

[1]Dairy 1996 did not ask about primary milking facilities; therefore, the column totals for 1996 are greater than 100 percent.
[2]As a percentage of January 1 cow inventory.

Percentage of Operations (and Percentage of Cows on These Operations) by Primary Milking Facility Used

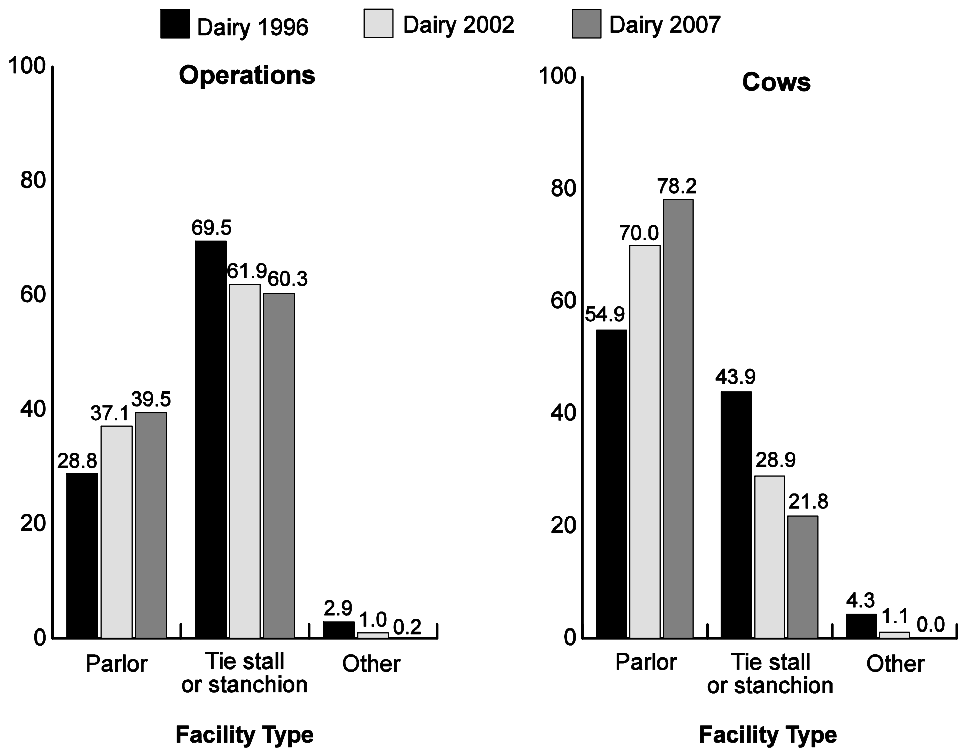


Photo by Dr. Jason Lombard

4. Nutrition

The percentage of operations that fed a total mixed ration increased for all herd sizes from 1996 to 2007.

a. Percentage of operations that fed a total mixed ration, by herd size:

	Percent Operations					
Herd Size (Number Dairy Cows)	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Small (fewer than 100)	28.2	(1.3)	36.6	(1.6)	37.8	(1.6)
Medium (100 to 499)	68.8	(2.0)	78.3	(1.7)	84.7	(1.7)
Large (500 or more)	84.1	(3.0)	90.2	(1.7)	94.1	(1.4)
All operations	35.6	(1.1)	47.0	(1.3)	51.1	(1.3)

The percentage of operations with an RHA milk production of 16,000 pounds or more that fed a total mixed ration increased from 1996 to 2002 but was similar between 2002 and 2007.

b. Percentage of operations that fed a total mixed ration, by RHA milk production:

	Percent Operations					
RHA Milk Production (Pounds)	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Less than 16,000	28.9	(2.0)	25.4	(2.3)	23.5	(2.4)
16,000 to 19,999	33.2	(1.7)	45.0	(2.2)	42.7	(2.3)
20,000 or more	55.4	(2.5)	65.7	(2.1)	70.7	(1.9)

The percentages of operations that used forage test results to balance feed rations were similar for individual herd sizes from 1996 to 2007, although a higher percentage of all operations tested forage in 2007 than in 1996 (75.5 and 67.8 percent, respectively).

c. Percentage of operations that used forage test results to balance feed rations, by herd size:

	Percent Operations					
Herd Size (Number Dairy Cows)	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Small (fewer than 100)	64.1	(1.4)	66.1	(1.6)	70.1	(1.7)
Medium (100 to 499)	84.8	(1.3)	87.1	(1.3)	89.9	(1.4)
Large (500 or more)	89.2	(2.7)	88.8	(1.8)	90.7	(1.8)
All operations	67.8	(1.2)	71.2	(1.2)	75.5	(1.2)

The percentage of operations and percentage of cows on these operations that relied on pasture during the growing season to provide part of the ration forage component has increased since 2002.

d. Percentage of operations (and percentage of cows on these operations) that relied on pasture during the growing season to provide part of the ration forage component for cows:

Percent Operations				Percent Cows			
Dairy 2002	**Std. Error**	**Dairy 2007**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
47.6	(1.3)	58.9	(1.3)	24.7	(0.8)	33.0	(1.3)

5. Number of bulls

The percentage of operations with bulls has remained stable since 1996. Approximately half of dairy operations (48.3 percent) did not house bulls in 2007.

Percentage of operations by the number of bulls in the January 1 inventory used for breeding dairy cows or heifers:

	Percent Operations					
Number Bulls	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
0	45.4	(1.3)	45.1	(1.4)	48.3	(1.4)
1	34.8	(1.3)	31.1	(1.3)	28.5	(1.3)
2 to 4	16.9	(0.8)	19.1	(1.0)	18.6	(1.0)
5 or more	2.9	(0.2)	4.7	(0.3)	4.6	(0.3)
Total	100.0		100.0		100.0	

6. Preventive practices

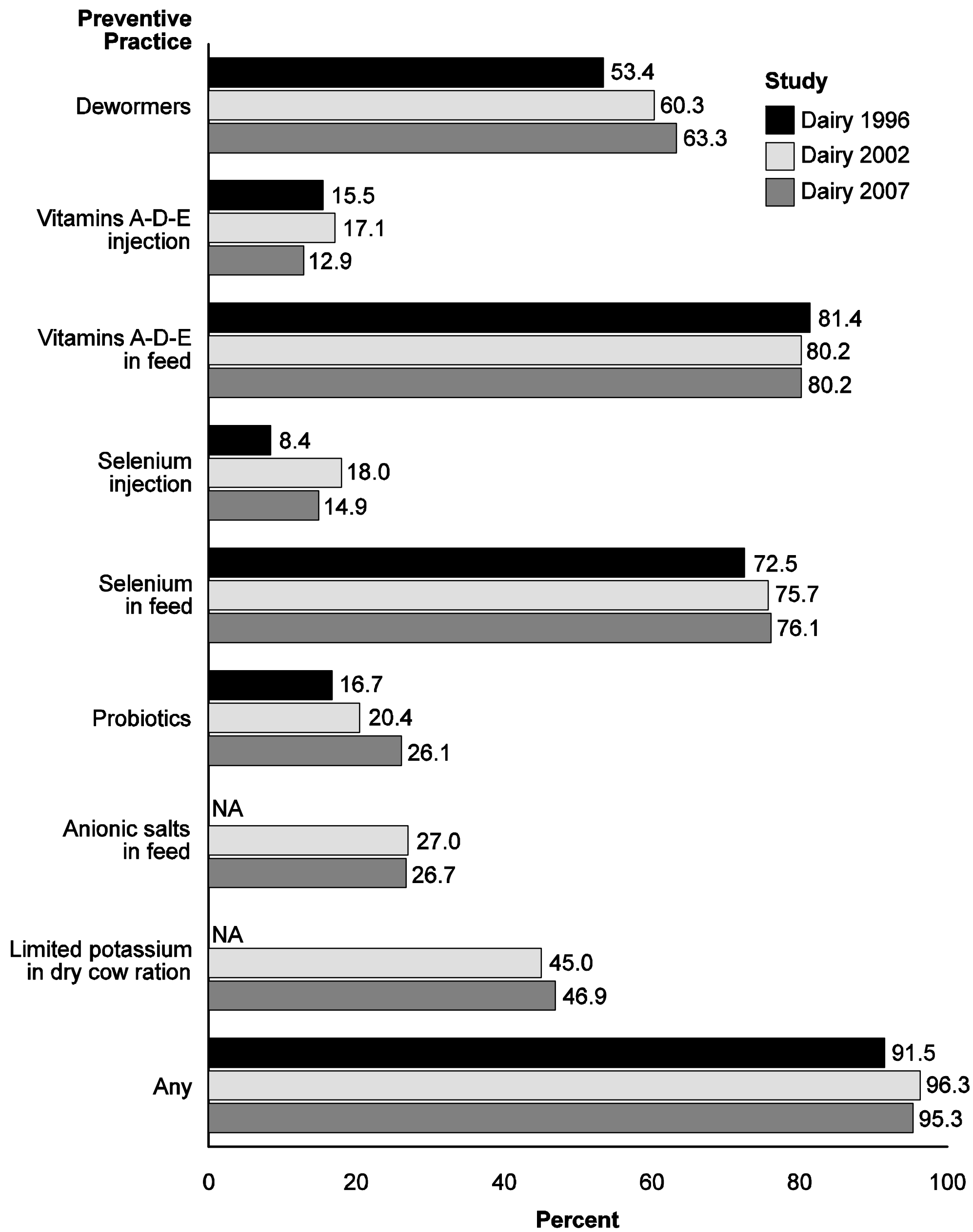
Since 1996, the use of dewormers, selenium injections, and probiotics increased while vitamin A-D-E injections decreased. In 2007, 95.3 percent of operations administered any preventive compared with 91.5 percent in 1996.

Percentage of operations by preventive practices normally used for cows:

	Percent Operations					
Preventive Practice	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Dewormers	53.4	(1.3)	60.3	(1.3)	63.3	(1.4)
Vitamins A-D-E injection	15.5	(0.9)	17.1	(1.0)	12.9	(0.8)
Vitamins A-D-E in feed	81.4	(1.1)	80.2	(1.1)	80.2	(1.2)
Selenium injection	8.4*	(0.6)	18.0	(1.0)	14.9	(0.9)
Selenium in feed	72.5*	(1.2)	75.7	(1.1)	76.1	(1.2)
Probiotics	16.7	(0.9)	20.4	(1.0)	26.1	(1.2)
Anionic salts in feed	NA		27.0	(1.2)	26.7	(1.2)
Limited potassium in dry cow ration	NA		45.0	(1.3)	46.9	(1.4)
Ionophores in feed	NA		NA		26.8	(1.1)
Other	4.4	(0.5)	5.4	(0.6)	3.6	(0.6)
Any	91.5	(0.8)	96.3	(0.6)	95.3	(0.7)

*Lactating cows only.

Percentage of Operations by Preventive Practices Normally Used for Cows



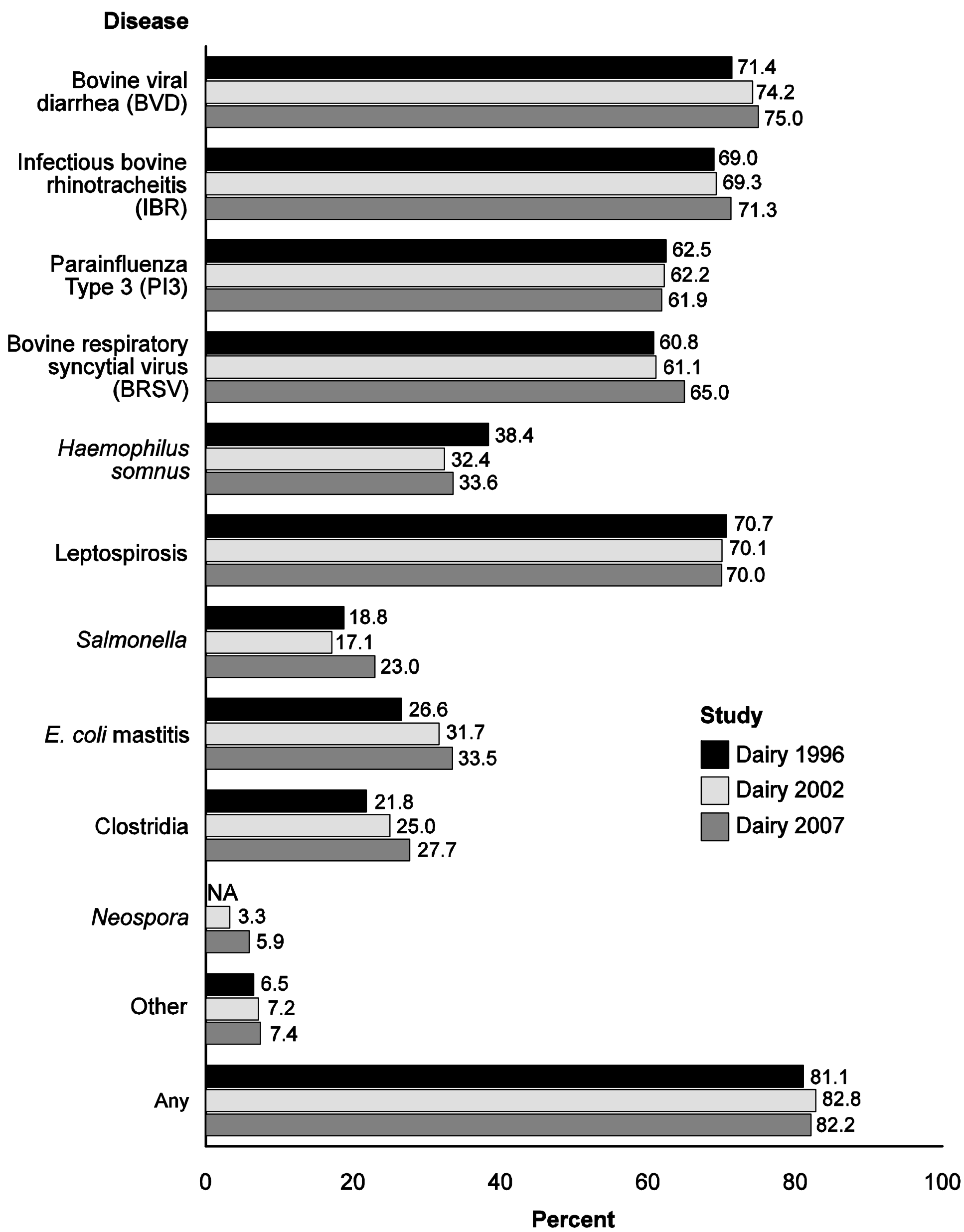
7. Vaccination practices

The use of *Salmonella*, *E coli*, and clostridia vaccines has increased since 1996, while the use of *Haemophilus somnus* vaccine decreased. Use of the most common vaccines (BVD, IBR, PI3, BRSV, and Leptospirosis) has remained steady since 1996.

Percentage of operations that normally vaccinated cows against the following diseases:

	Percent Operations					
Disease	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Bovine viral diarrhea (BVD)	71.4	(1.3)	74.2	(1.2)	75.0	(1.3)
Infectious bovine rhinotracheitis (IBR)	69.0	(1.3)	69.3	(1.3)	71.3	(1.3)
Parainfluenza Type 3 (PI3)	62.5	(1.3)	62.2	(1.3)	61.9	(1.4)
Bovine respiratory syncytial virus (BRSV)	60.8	(1.3)	61.1	(1.3)	65.0	(1.4)
Haemophilus somnus	38.4	(1.3)	32.4	(1.2)	33.6	(1.3)
Leptospirosis	70.7	(1.3)	70.1	(1.3)	70.0	(1.3)
Salmonella	18.8	(1.0)	17.1	(1.0)	23.0	(1.1)
E. coli mastitis	26.6	(1.1)	31.7	(1.2)	33.5	(1.2)
Clostridia	21.8	(1.0)	25.0	(1.1)	27.7	(1.2)
Neospora	NA		3.3	(0.4)	5.9	(0.6)
Other	6.5	(0.6)	7.2	(0.6)	7.4	(0.7)
Any	81.1	(1.1)	82.8	(1.1)	82.2	(1.1)

Percentage of Operations that Normally Vaccinated Cows Against the Following Diseases



8. Types of BVD vaccine

Although the majority of operations administered killed BVD vaccine to cows, the percentage of operations that used modified-live vaccine increased from 29.3 percent in 1991 to 48.9 percent in 2007. The use of killed BVD vaccine decreased slightly during the same period.

a. For operations that gave BVD vaccinations to cows, percentage of operations by type of BVD vaccine given:

	Percent Operations					
Type of BVD	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Killed	65.4	(1.4)	61.9	(1.5)	56.3	(1.6)
Modified live	29.3	(1.3)	36.7	(1.5)	48.9	(1.6)

A higher percentage of operations used a combination of Type 1 and Type II vaccines in 2007 compared to 2002 (60.8 and 39.4 percent, respectively). Producers are becoming more aware of the type of BVD vaccine they used, as the percentage of operations that did not know which vaccine was used decreased from 47.6 percent in 2002 to 27.2 percent in 2007.

b. For operations that gave any BVD vaccinations, percentage of operations by strain of BVD contained in vaccine administered:

	Percent Operations			
BVD Strain	**Dairy 2002**	**Standard Error**	**Dairy 2007**	**Standard Error**
Type I only	5.4	(0.6)	4.3	(0.6)
Type II only	7.6	(0.9)	7.7	(0.8)
Combination (Type I and Type II)	39.4	(1.4)	60.8	(1.5)
Did not know	47.6	(1.5)	27.2	(1.4)
Total	100.0		100.0	

The percentages of operations that gave annual BVD booster injections were similar in 1996, 2002, and 2007, with about 80 percent of operations giving booster injections.

c. For operations that gave BVD vaccinations to cows, percentage of operations that gave annual BVD booster injections:

Percent Operations					
Dairy 1996	**Standard Error**	**Dairy 2002**	**Standard Error**	**Dairy 2007**	**Standard Error**
77.4	(1.3)	82.9	(1.2)	80.2	(1.3)

9. Bovine somatotropin (bST)

With the exception of small operations, the percentage of operations that used bST and the percentage of cows that received bST increased from 1996 to 2002. From 2002 to 2007, the percentage of large operations that used bST decreased from 54.4 percent to 42.7 percent. Overall, the percentage of operations that used bST remained the same in 2002 and 2007 (15.2 percent for both study years). The percentage of cows that received bST on medium and large operations decreased from 24.5 and 34.1 percent, respectively, in 2002 to 17.7 and 22.6 percent, respectively, in 2007. Overall, the percentage of cows that received bST decreased from 22.3 percent in 2002 to 17.2 percent in 2007.

Percentage of operations (and percentage of cows milked on January 1) that used bST in cows during the current lactation (at the time of interview), by herd size:

	Dairy 1996 (All Cows in Inventory January 1)				**Dairy 2002** (Cows Milked January 1)				**Dairy 2007** (Cows Milked January 1)			
Herd Size (Number Dairy Cows)	**Pct. Ops.**	**Std. Error**	**Pct. Cows**	**Std. Error**	**Pct. Ops.**	**Std. Error**	**Pct. Cows**	**Std. Error**	**Pct. Ops.**	**Std. Error**	**Pct. Cows**	**Std. Error**
Small (fewer than 100)	6.5	(0.6)	3.7	(0.4)	8.8	(0.8)	6.2	(0.7)	9.1	(0.9)	6.2	(0.7)
Medium (100 to 499)	21.0	(1.7)	13.2	(1.3)	32.2	(1.9)	24.5	(1.5)	28.8	(2.0)	17.7	(1.4)
Large (500 or more)	38.7	(3.9)	17.9	(2.3)	54.4	(2.6)	34.1	(1.8)	42.7	(2.5)	22.6	(1.5)
All operations	9.4	(0.6)	10.1	(0.7)	15.2	(0.8)	22.3	(0.8)	15.2	(0.8)	17.2	(0.8)

F. Cow Health

1. Abortions

Abortion percentage for cows and heifers combined increased from 3.5 percent in 1996 to 4.5 percent in 2007.

a. Percentage of heifers, cows, and heifers and cows combined that aborted:

	Percent Heifers/Cows					
	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Heifers	NA		NA		3.3[1]	(0.2)
Cows	NA		NA		5.0[2]	(0.2)
Both heifers and cows	3.5	(0.1)	4.0	(0.1)	4.5[3]	(0.2)

[1]Breeding age or older heifers on January 1, 2007
[2]Cow inventory minus breeding age and older heifers on January 1, 2007
[3]Cow inventory on January 1, 2007.

The percentages of operations by abortion percentage were similar across study years.

b. Percentage of operations by reported abortion percentage:

	Percent Operations					
Abortion Percent	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Less than 2.0	42.7	(1.3)	39.3	(1.3)	38.2	(1.4)
2.0 to 4.9	36.2	(1.2)	34.6	(1.2)	34.3	(1.3)
5.0 to 9.9	16.2	(0.9)	20.3	(1.1)	20.6	(1.1)
10.0 to 14.9	3.2	(0.5)	4.7	(0.7)	4.9	(0.6)
15.0 or more	1.7	(0.4)	1.1	(0.3)	2.0	(0.4)
Total	100.0		100.0		100.0	

2. Cow morbidity

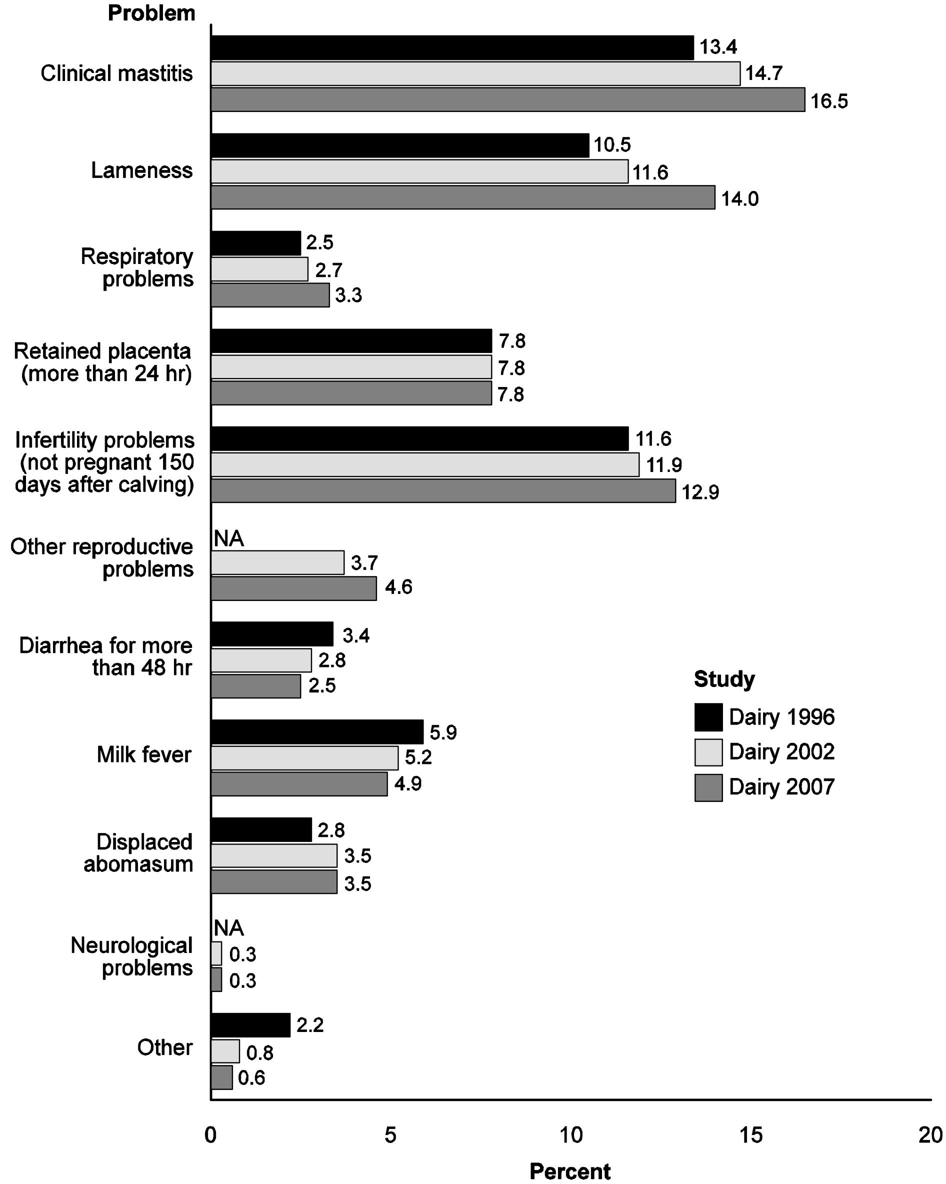
The percentage of cows with clinical mastitis, lameness, respiratory problems, infertility problems, or displaced abomasum increased from 1996 to 2007. The percentage of cows with diarrhea for more than 48 hours or milk fever decreased from 1996 to 2007.

Percentage of cows by health problem:

	Percent Cows*					
	Dairy 1996		Dairy 2002		Dairy 2007	
Problem	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Clinical mastitis	13.4	(0.3)	14.7	(0.3)	16.5	(0.5)
Lameness	10.5	(0.3)	11.6	(0.3)	14.0	(0.4)
Respiratory problems	2.5	(0.1)	2.7	(0.1)	3.3	(0.1)
Retained placenta (more than 24 hours)	7.8	(0.2)	7.8	(0.2)	7.8	(0.2)
Infertility problems (not pregnant 150 days after calving)	11.6	(0.3)	11.9	(0.3)	12.9	(0.3)
Other reproductive problems (e.g., dystocia, metritis)	NA		3.7	(0.2)	4.6	(0.3)
Diarrhea for more than 48 hours	3.4	(0.2)	2.8	(0.2)	2.5	(0.2)
Milk fever	5.9	(0.1)	5.2	(0.1)	4.9	(0.1)
Displaced abomasum	2.8	(0.1)	3.5	(0.1)	3.5	(0.1)
Neurological problems	NA		0.3	(0.0)	0.3	(0.0)
Other health-related problems	2.2	(0.2)	0.8	(0.1)	0.6	(0.1)

*As a percentage of January 1 respective-year cow inventory.

Percentage of Cows* by Health Problem



*As a percentage of January 1 respective-year cow inventory.

3. Permanently removed cows

The percentage of cows removed from medium operations increased from 21.6 percent in 1996 to 23.7 percent in 2007, while the percentage of cows removed from large operations decreased from 27.4 percent in 1996 to 23.4 percent in 2007. For all operations, there were no differences in the percentages of cows permanently removed from operations.

a. Percentage of cows permanently removed* as a percentage of January 1 inventory, by herd size:

	Percent Cows					
Herd Size (Number Dairy Cows)	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Small (fewer than 100)	23.9	(0.7)	24.9	(0.6)	24.1	(0.6)
Medium (100 to 499)	21.6	(0.4)	23.9	(0.5)	23.7	(0.5)
Large (500 or more)	27.4	(0.8)	27.5	(0.6)	23.4	(0.7)
All operations	24.0	(0.4)	25.5	(0.3)	23.6	(0.4)

*Permanently removed cows include those that permanently left the herd but excludes those that died.

There were no changes in the destination of permanently removed cows from 1996 to 2007, with about 75 percent of cows being sent to market, auction, or stockyard in all three study years.

b. For operations that permanently removed* cows, percentage of permanently removed cows by destination:

	Percent Cows					
Destination	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Sent directly to another dairy	4.5	(1.0)	5.7	(0.6)	5.5	(0.7)
Sent to market, auction, or stockyard	74.0	(1.4)	74.0	(1.1)	76.2	(1.1)
Sent directly to packer or slaughter plant	21.0	(1.2)	19.6	(1.0)	17.5	(1.3)
Sent elsewhere	0.5	(0.1)	0.7	(0.1)	0.8	(0.3)
Total	100.0		100.0		100.0	

*Permanently removed cows include those that permanently left the herd but excludes those that died.

The reasons cows were permanently removed remained fairly constant from 1996 to 2007, although a lower percentage of cows were removed due to poor production in 2007 (16.1 percent) than in 1996 (21.4 percent).

c. For operations that permanently removed cows, percentage of cows removed, by reason:

	Percent Removals					
Reason	**Dairy 1996**	**Standard Error**	**Dairy 2002**	**Standard Error**	**Dairy 2007**	**Standard Error**
Udder or mastitis problems	25.3	(0.6)	25.4	(0.5)	23.0	(0.6)
Lameness or injury	14.4	(0.6)	15.5	(0.4)	16.0	(0.4)
Reproductive problems	25.5	(0.8)	25.0	(0.5)	26.3	(0.7)
Poor production not related to above	21.4	(0.8)	18.3	(0.7)	16.1	(0.7)
Aggressiveness or belligerence	1.0	(0.1)	0.9	(0.1)	0.7	(0.1)
Other diseases	4.1	(0.5)	5.6	(0.2)	3.7	(0.2)
Sold as replacements to another dairy	4.4	(1.0)	5.5	(0.6)	5.8	(0.7)
Other	3.9	(0.3)	3.8	(0.4)	8.4	(1.1)
Total	100.0		100.0		100.0	

4. Mortality

The percentage of cows that died increased across herd sizes from 1996 to 2007. The overall percentage of cows that died increased from 3.8 percent in 1996 to 5.7 percent in 2007.

a. Percentage of cows that died as a percentage of January 1 inventory, by herd size:

	Percent Cows					
Herd Size (Number Dairy Cows)	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Small (fewer than 100)	3.6	(0.1)	4.4	(0.1)	4.8	(0.1)
Medium (100 to 499)	3.9	(0.1)	5.0	(0.1)	5.8	(0.2)
Large (500 or more)	4.0	(0.2)	4.9	(0.1)	6.1	(0.2)
All operations	3.8	(0.1)	4.8	(0.1)	5.7	(0.1)

The percentage of cow deaths due to lameness or injury increased from 12.7 percent in 1996 to 20.0 percent in 2007. Conversely, the percentage of cow deaths due to calving problems and other known reasons decreased from 1996 to 2007.

b. Percentage of cow deaths by cause:

	Percent Deaths					
Cause	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Scours, diarrhea, or other digestive problems	9.0	(1.0)	8.6	(0.5)	10.4	(0.5)
Respiratory problems	9.6	(0.7)	10.3	(0.5)	11.3	(0.7)
Poison	0.9	(0.2)	0.4	(0.1)	0.4	(0.1)
Put down due to lameness or injury	12.7	(0.7)	13.9	(0.6)	20.0	(0.8)
Lack of coordination or severe depression	1.4	(0.2)	1.4	(0.2)	1.0	(0.1)
Mastitis	16.3	(0.8)	17.1	(0.6)	16.5	(0.7)
Calving problems	18.3	(0.7)	17.4	(0.7)	15.2	(0.7)
Other known reasons	17.0	(0.9)	11.1	(0.6)	10.2	(0.8)
Unknown reasons	14.8	(0.8)	19.8	(0.9)	15.0	(1.1)
Total	100.0		100.0		100.0	

5. Carcass disposal

Although rendering remained the primary method of dead-cow disposal, the percentage of operations that used this method decreased from 62.4 percent in 2002 to 56.9 percent in 2007. Conversely, use of composting increased from 6.9 percent of operations in 2002 to 16.8 percent in 2007. These changes in dead-cow disposal are similar to those observed in disposing of dead calves,

Percentage of operations by primary method used to dispose of dead cows:

	Percent Operations			
Method of Disposal	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Buried	22.7	(1.1)	20.3	(1.1)
Burned/incinerated	2.2	(0.4)	1.8	(0.4)
Rendered	62.4	(1.2)	56.9	(1.3)
Composted	6.9	(0.7)	16.8	(1.0)
Landfill	1.9	(0.3)	1.7	(0.3)
Other	3.9	(0.5)	2.5	(0.4)
Total	100.0		100.0	

G. Biosecurity

1. Physical contact with unweaned calves

The percentage of unweaned calves not exposed to weaned calves, bred heifers, or adult cattle increased from 1996 to 2007.

Percentage of operations where, after separation from the dam, unweaned heifers did not have physical contact* with the following groups:

	Percent Operations							
Age Group	**NDHEP 1991**	**Std. Error**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Weaned calves less than approximately 4 months of age	68.5	(2.0)	67.0	(1.3)	77.2	(1.2)	76.0	(1.2)
Calves from approximately 4 months of age to breeding	89.6	(1.3)						
Bred heifers not yet calved	95.4	(0.9)	81.2	(1.1)	86.7	(0.9)	86.8	(1.0)
Adult cattle	89.8	(1.3)	79.8	(1.1)	84.6	(1.0)	84.3	(1.1)

*Physical contact = possible nose-to-nose contact or sniffling/touching/licking each other, including through a fence.

2. Physical contact with other animals

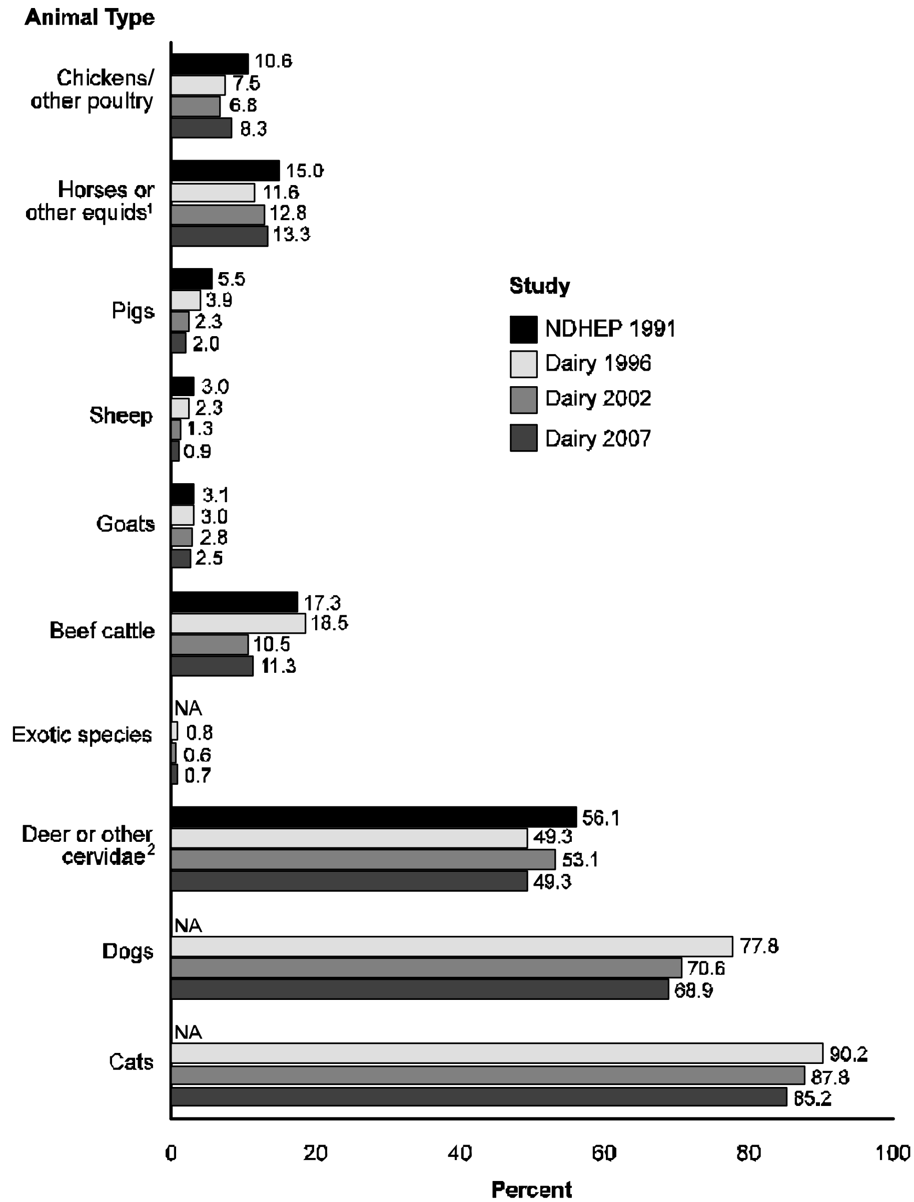
The percentage of operations in which pigs, sheep, or beef cattle had physical contact with dairy cattle and/or their feed, minerals, or water supply was lower in 2007 than in 1991. Dairy-cattle contact with the other listed animals was unchanged between 1991 and 2007.

Percentage of operations in which the following animals had physical contact with dairy cattle and/or their feed, minerals, or water supply:

	Percent Operations							
Animal Type	**NDHEP 1991**	**Std. Error**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Chickens/other poultry	10.6	(1.4)	7.5	(0.8)	6.8	(0.7)	8.3	(0.8)
Horses or other equids[1]	15.0	(1.6)	11.6	(0.9)	12.8	(0.9)	13.3	(1.0)
Pigs	5.5	(1.0)	3.9	(0.6)	2.3	(0.4)	2.0	(0.4)
Sheep	3.0	(0.6)	2.3	(0.5)	1.3	(0.3)	0.9	(0.3)
Goats	3.1	(0.7)	3.0	(0.5)	2.8	(0.5)	2.5	(0.4)
Beef cattle	17.3	(1.7)	18.5	(1.1)	10.5	(0.8)	11.3	(1.0)
Exotic species	NA		0.8	(0.2)	0.6	(0.2)	0.7	(0.2)
Deer or other cervidae[2]	56.1	(2.2)	49.3	(1.1)	53.1	(1.3)	49.3	(1.4)
Dogs	NA		77.8	(1.1)	70.6	(1.2)	68.9	(1.3)
Cats	NA		90.2	(0.8)	87.8	(0.8)	85.2	(0.9)

[1]In 1991, "horses" was the animal type; "other equids" was not listed.
[2]In 1991, "deer" was the animal type; "other cervidae" was not listed.

Percentage of Operations in Which the Following Animals had Physical Contact with Dairy Cattle and/or Their Feed, Minerals, or Water Supply



[1] In 1991, "horses" was the animal type; "other equids" was not listed.
[2] In 1991, "deer" was the animal type; "other cervidae" was not listed.

3. Biosecurity for new arrivals

From 1996 to 2007, about 4 of 10 operations brought cattle onto the operation.

Percentage of operations that brought the following classes of cattle onto the operation:

Percent Operations								
Cattle Class	**Dairy 1996**	**Std. Error**	**Cattle Class**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Calves not yet weaned	5.0	(0.7)	Calves not yet weaned	5.1	(0.7)	3.4	(0.6)
Heifers weaned but not yet bred	7.3	(0.7)	Heifers weaned but not yet bred	6.7	(0.7)	6.4	(0.7)
Bred heifers not yet calved	18.5	(0.9)	Bred heifers not yet calved	15.8	(0.9)	12.2	(0.9)
Lactating cows	19.9	(1.0)	Lactating cows	16.4	(1.0)	13.8	(1.0)
Dry cows	7.1	(0.8)	Dry cows	5.9	(0.6)	4.3	(0.6)
Bulls	8.7	(0.7)	Dairy bulls	13.7	(0.9)	12.5	(0.9)
			Beef bulls	2.3	(0.4)	1.7	(0.3)
Other cattle	1.9	(0.4)	Beef heifers and cows	1.5	(0.3)	1.3	(0.3)
	2.0	(0.3)	Steers	1.1	(0.3)	1.8	(0.4)
Any cattle	43.9	(1.3)	Any cattle	45.7	(1.4)	38.9	(1.4)

4. Quarantine

There were no differences in the percentages of operations that quarantined new arrivals between 1996 and 2007 or in the number of days that new additions were quarantined.

a. For operations that brought the following classes of cattle onto the operation, percentage of operations that quarantined the following cattle classes upon arrival*:

			Percent Operations					
Cattle Class	Dairy 1996	Std. Error	Cattle Class	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Calves not yet weaned	26.9	(5.2)	Calves not yet weaned	37.0	(7.3)	44.2	(8.3)
Heifers weaned but not yet bred	24.9	(4.7)	Heifers weaned but not yet bred	23.9	(3.9)	23.0	(4.7)
Bred heifers not yet calved	16.0	(2.0)	Bred heifers not yet calved	19.6	(2.3)	14.5	(2.3)
Lactating cows	6.2	(1.7)	Lactating cows	9.5	(1.6)	12.1	(2.4)
Dry cows	17.9	(4.8)	Dry cows	7.1	(2.2)	15.9	(4.8)
Bulls	11.2	(2.4)	Dairy bulls	15.9	(2.4)	17.1	(2.9)
			Beef bulls	23.6	(6.5)	20.3	(6.5)
Other heifers/cows	15.7	(6.0)	Beef heifers and cows	24.0	(8.5)	30.1	(9.8)
Steers	21.0	(6.6)	Steers	40.0	(11.4)	30.0	(9.6)

*Producers were asked for the number of head brought on and number of head quarantined.

b. For operations that quarantined new arrivals, average number of days new arrivals were quarantined, by cattle class:

			Average Number of Days				
Cattle Class	Dairy 1996	Std. Error	Cattle Class	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Calves not yet weaned	40.8	(5.7)	Calves not yet weaned	49.2	(9.3)	42.4	(4.8)
Heifers weaned but not yet bred	21.5	(4.2)	Heifers weaned but not yet bred	28.2	(6.0)	20.0	(3.6)
Bred heifers not yet calved	16.8	(2.3)	Bred heifers not yet calved	23.7	(4.0)	22.0	(3.1)
Lactating cows	11.7	(2.3)	Lactating cows	20.1	(4.1)	15.6	(2.5)
Dry cows	8.9	(2.1)	Dry cows	21.4	(4.3)	16.5	(4.3)
Bulls	21.0	(3.1)	Dairy bulls	19.0	(2.5)	25.3	(3.5)
			Beef bulls	32.0	(12.9)	31.9	(12.6)
Other heifers/cows	24.3	(9.1)	Beef heifers and cows	31.1	(6.6)	33.3	(12.1)
Steers	41.5	(22.0)	Steers	41.3	(14.0)	40.7	(18.7)

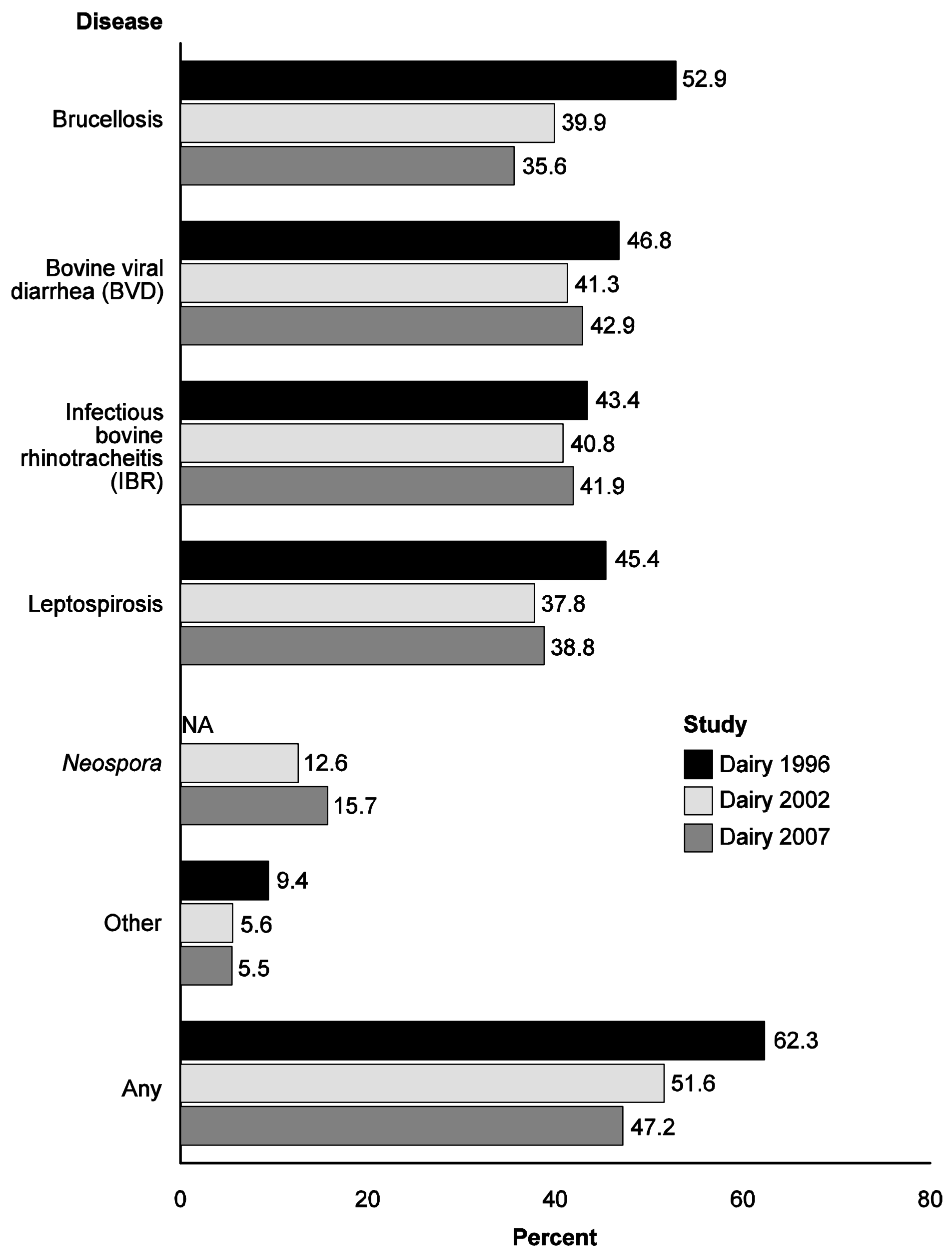
5. Vaccine requirements

No changes occurred from 1996 to 2007 in the percentage of operations that vaccinated new additions for BVD, IBR, and leptospirosis before the cattle were brought onto the operation. Approximately one-third to one-half of operations vaccinated for the diseases mentioned above. The percentages of operations that vaccinated for brucellosis decreased for each herd size from 1996 to 2007. Since many different ages of cattle are brought onto operations, the lower brucellosis vaccination percentages may be due partially to cattle too old or already vaccinated for brucellosis at the time of purchase. *Neospora* vaccination has remained unchanged in purchased cattle since 2002. The percentages of operations vaccinating for any disease decreased for small, large, and all operations.

For operations that brought any dairy cattle onto the operation, percentage of operations that normally required vaccination against the following diseases before bringing animals onto the operation, by herd size:

	Percent Operations											
	Herd Size (Number Dairy Cows)											
	Small (Fewer than 100)			Medium (100-499)			Large (500 or More)			All Operations		
Disease	**Dairy 1996**	**Dairy 2002**	**Dairy 2007**	**Dairy 1996**	**Dairy 2002**	**Dairy 2007**	**Dairy 1996**	**Dairy 2002**	**Dairy 2007**	**Dairy 1996**	**Dairy 2002**	**Dairy 2007**
Brucellosis	48.9 (2.5)	33.4 (2.5)	28.0 (2.6)	63.6 (2.9)	51.3 (2.7)	50.2 (3.5)	85.2 (3.0)	60.0 (3.1)	52.2 (3.9)	52.9 (2.0)	39.9 (1.9)	35.6 (2.0)
Bovine viral diarrhea (BVD)	43.1 (2.4)	36.2 (2.5)	34.8 (2.8)	59.4 (2.9)	51.2 (2.7)	59.9 (3.4)	58.8 (4.8)	53.9 (3.2)	56.7 (3.7)	46.8 (2.0)	41.3 (1.9)	42.9 (2.1)
Infectious bovine rhinotracheitis (IBR)	39.2 (2.3)	35.8 (2.6)	34.2 (2.8)	57.9 (2.9)	50.5 (2.7)	57.3 (3.4)	57.4 (4.8)	51.2 (3.2)	57.1 (3.7)	43.4 (1.9)	40.8 (1.9)	41.9 (2.1)
Leptospirosis	41.9 (2.4)	32.5 (2.5)	32.0 (2.7)	57.7 (2.9)	48.5 (2.7)	53.6 (3.4)	54.3 (4.8)	47.5 (3.2)	48.4 (3.8)	45.4 (2.0)	37.8 (1.8)	38.8 (2.1)
Neospora	NA	11.1 (1.6)	10.8 (1.7)	NA	15.5 (1.8)	26.6 (3.1)	NA	16.1 (2.3)	22.4 (3.3)	NA	12.6 (1.2)	15.7 (1.5)
Other	8.2 (1.1)	4.3 (0.8)	4.2 (1.1)	12.8 (2.2)	8.4 (1.4)	8.7 (1.8)	16.5 (3.6)	7.7 (1.5)	6.5 (1.6)	9.4 (1.0)	5.6 (0.7)	5.5 (0.9)
Any	58.0 (2.5)	44.6 (2.7)	37.7 (2.9)	74.8 (2.6)	64.0 (2.7)	65.2 (3.3)	88.8 (2.9)	71.9 (3.0)	68.5 (3.2)	62.3 (2.0)	51.6 (2.0)	47.2 (2.2)

For Operations that Brought any Dairy Cattle onto the Operation, Percentage of Operations that Normally Required Vaccination Against the Following Diseases Before Bringing Animals onto the Operation



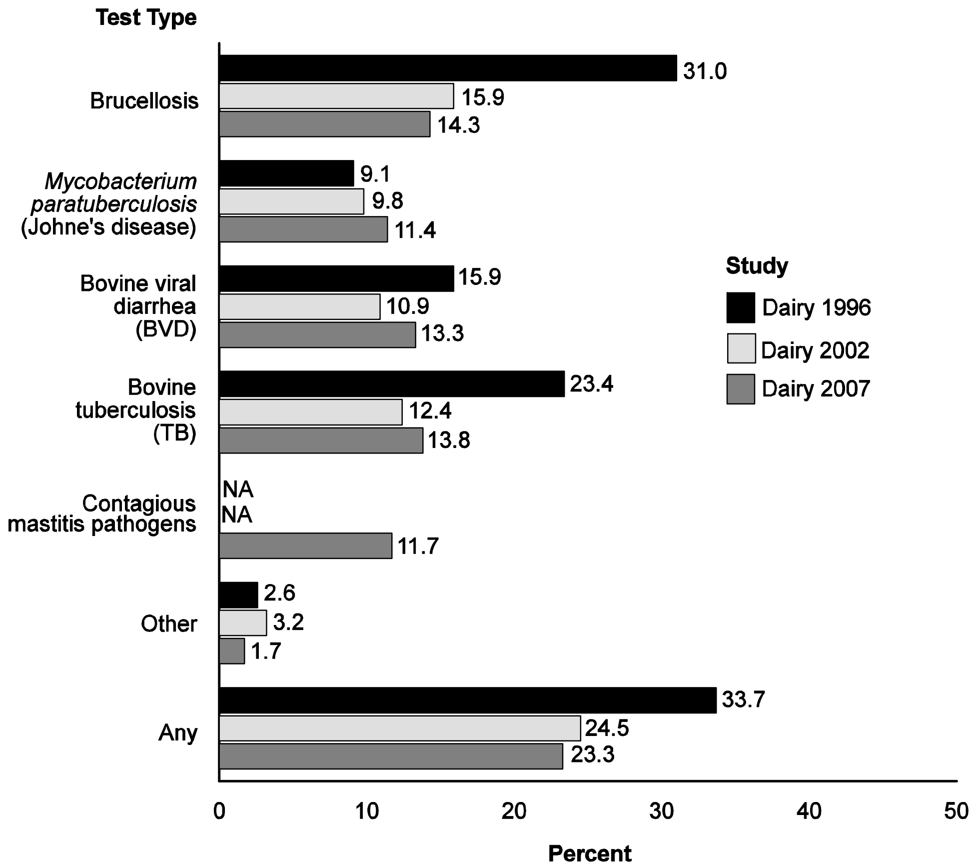
6. Testing requirements

Brucellosis testing for new additions decreased across herd sizes between 1996 and 2007. Tuberculosis testing has also decreased for small, large, and all operations since 1996. Testing for *Mycobacterium avium* subspecies *paratuberculosis* and BVD remained unchanged from 1996 to 2007. The percentage of operations that performed any testing decreased for small, large, and all operations since 1996, with less than 1 in 4 operations that purchased new additions (23.3 percent) performing any testing during 2007.

a. For operations that brought any dairy cattle onto the operation, percentage of operations that tested individual animals brought onto the operation, by testing normally required and by herd size:

	Percent Operations											
	Herd Size (Number Dairy Cows)											
	Small (Fewer than 100)			**Medium** (100-499)			**Large** (500 or More)			**All Operations**		
Test Type	**Dairy 1996**	**Dairy 2002**	**Dairy 2007**	**Dairy 1996**	**Dairy 2002**	**Dairy 2007**	**Dairy 1996**	**Dairy 2002**	**Dairy 2007**	**Dairy 1996**	**Dairy 2002**	**Dairy 2007**
Brucellosis	28.5 (2.1)	13.1 (1.8)	11.6 (1.9)	38.3 (2.9)	19.5 (2.1)	19.8 (2.8)	50.6 (4.4)	29.9 (2.7)	19.0 (3.0)	31.0 (1.7)	15.9 (1.3)	14.3 (1.5)
Mycobacterium avium subspecies *paratuberculosis* (Johne's disease)	8.5 (1.3)	8.3 (1.4)	9.9 (1.8)	11.0 (2.3)	12.7 (1.9)	16.6 (2.7)	9.6 (2.9)	12.2 (1.9)	7.2 (1.8)	9.1 (1.1)	9.8 (1.1)	11.4 (1.4)
Bovine viral diarrhea (BVD)	15.1 (1.6)	8.6 (1.4)	10.7 (1.8)	18.4 (2.5)	15.6 (2.1)	19.4 (2.8)	19.4 (3.9)	15.0 (2.1)	15.8 (2.7)	15.9 (1.3)	10.9 (1.1)	13.3 (1.4)
Bovine tuberculosis (TB)	22.3 (1.9)	10.8 (1.5)	12.0 (1.8)	26.8 (2.7)	14.3 (1.7)	17.8 (2.7)	31.4 (4.2)	20.7 (2.3)	15.8 (2.3)	23.4 (1.6)	12.4 (1.1)	13.8 (1.4)
Contagious mastitis pathogens	NA	NA	10.5 (1.8)	NA	NA	13.1 (2.3)	NA	NA	16.3 (3.3)	NA	NA	11.7 (1.4)
Other	2.3 (0.5)	2.8 (0.8)	1.6 (0.6)	3.6 (1.4)	4.3 (1.3)	2.2 (1.0)	3.9 (2.1)	3.5 (1.1)	0.4 (0.2)	2.6 (0.5)	3.2 (0.6)	1.7 (0.5)
Any	31.3 (2.1)	21.2 (2.2)	20.2 (2.4)	40.0 (2.9)	29.4 (2.5)	28.2 (3.2)	54.3 (4.5)	38.8 (2.9)	34.7 (3.8)	33.7 (1.8)	24.5 (1.6)	23.3 (1.8)

For Operations that Brought any Dairy Cattle Onto the Operation, Percentage of Operations that Tested Individual Animals Brought Onto the Operation, by Testing Normally Required



A higher percentage of operations in 2007 (13.0 percent) required a bulk-tank milk culture before bringing animals onto the operation than did operations in 1996 (5.8 percent). While the percentage of all operations that required proof of bulk-tank somatic cell count was unchanged from 1996 to 2007, the percentage of large operations that required a count decreased from 45.7 percent in 1996 to 19.8 percent in 2007.

b. For operations that brought any dairy cows onto the farm, percentage of operations that normally required testing or proof of udder health before bringing animals onto the farm, by herd size:

	Percent Operations											
	Herd Size (Number Dairy Cows)											
	Small (Fewer than 100)			**Medium** (100-499)			**Large** (500 or More)			**All Operations**		
Type of Proof	**1996**	**2002**	**2007**	**1996**	**2002**	**2007**	**1996**	**2002**	**2007**	**1996**	**2002**	**2007**
Individual-cow milk somatic cell count	24.7 (2.7)	26.7 (3.7)	NA	30.1 (4.1)	26.7 (4.0)	NA	27.9 (8.7)	29.5 (5.2)	NA	25.7 (2.3)	26.8 (2.8)	NA
Bulk-tank milk somatic cell count	13.4 (2.0)	14.3 (2.9)	18.8 (2.4)	21.3 (3.1)	19.2 (3.4)	24.4 (3.1)	45.7 (9.0)	34.1 (5.9)	19.8 (2.9)	15.3 (1.7)	16.6 (2.2)	20.3 (1.8)
Individual-cow milk culture	9.1 (1.7)	10.7 (2.5)	NA	8.4 (1.8)	10.6 (2.6)	NA	9.4 (4.1)	18.8 (4.8)	NA	9.0 (1.4)	11.0 (1.8)	NA
Bulk-tank milk culture	3.9 (0.9)	9.5 (2.4)	10.1 (1.7)	11.8 (2.4)	10.0 (2.6)	17.8 (2.8)	35.7 (8.4)	31.0 (6.0)	20.9 (2.9)	5.8 (0.9)	10.6 (1.8)	13.0 (1.4)

Appendix I: Methodology Overview

	NAHMS Dairy Studies			
	1991	**1996**	**2002**	**2007**
Data collection dates	4/1991-7/1992	1/1-1/26 1996	12/31/2001-2/12/2002	1/1-1/31 2007
Minimum number of dairy cattle	30	1	1	1
Number of States	28	20	21	17
Data collectors	National Agricultural Statistics Service enumerators			
States as a percentage of U.S. population coverage				
Operations	76.3	80.4	83.0	79.5
Cows	81.3	83.1	85.7	82.5
Respondent Sample profile (herd size)				
Small (fewer than 100 cows)	931	1,480	1,131	1,028
Medium (100-499 cows)	705	873	820	691
Large (500 or more cows)	175	189	510	475
Response category				
Survey complete	1,811	2,542	2,461	2,194
Percent of total	54.1	56.3	63.5	61.7
No milk cows	NA	646	227	214
Out of business/ no milk sold in 1995		179	183	111
Out of scope		16	45	6
Refused		969	821	785
Did not contact		NA	2	126
Inaccessible		164	137	118
Total	3346	4,516	3,876	3,554

Appendix II: Study Objectives and Related Outputs

1. Describe trends in dairy cattle health and management practices
- **Part II: Changes in the U.S. Dairy Cattle Industry 1991-2007, February 2008**
- Part V: Changes in Dairy Cattle Health and Management in the United States, 1991-2007, expected summer 2008

2. Evaluate management factors related to cow comfort and removal rates
- Dairy Facilities and Cow Comfort on U.S Dairy Operations, 2007 interpretive report, expected spring 2008
- Info sheets, expected spring 2008

3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices
- Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
- Off-Site Heifer Raising info sheet, November 2007
- Colostrum Management info sheet, February 2008
- Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, expected spring 2008
- Calf Health and Management Practices on U.S. Dairy Operations, 2007 interpretive report, expected spring 2008
- Additional info sheets, expected spring 2008

4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVD)
- Info sheets, expected spring 2008.

5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens
- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, expected spring 2008.
- Info sheets, expected spring 2008.

6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis*
- Info sheets, expected spring 2008.

7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices
- Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, expected spring 2008

United States
Department of
Agriculture

Animal and
Plant Health
Inspection
Service

Veterinary
Services

National
Animal Health
Monitoring
System

September 2008

Dairy 2007

Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007

USDA-APHIS-VS-CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

#N482.0908

Cover photo courtesy of
Judy Rodriguez

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- USDA-APHIS, National Veterinary Services Laboratories
- USDA-ARS, Beltsville Agricultural Research Center
- USDA-ARS, Russell Research Center
- Antel BioSystems, Inc.
- Cornell University Animal Health Diagnostic Laboratory
- Quality Milk Production Services
- Tetracore, Inc.
- University of Pennsylvania, New Bolton Center
- University of Wisconsin, Madison
- Wisconsin Veterinary Diagnostic Laboratory

All participants are to be commended, particularly the producers whose voluntary efforts made the Dairy 2007 study possible.

Larry M. Granger
Director
Centers for Epidemiology and Animal Health

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Contacts for further information:
Questions or comments on data analysis: Dr. Jason Lombard 970.494.7000
Information on reprints or other reports: Ms. Kathy Snover 970.494.7000
E-mail: NAHMS@aphis.usda.gov

Table of Contents

Introduction

The National Animal Health Monitoring System (NAHMS) is a nonregulatory program of the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service. NAHMS is designed to help meet the Nation's animal-health information needs and has collected data on dairy health and management practices through three previous studies.

The NAHMS 1991-92 National Dairy Heifer Evaluation Project (NDHEP) provided the dairy industry's first national baseline information on the health and management of dairy cattle in the United States. Just months after the study's first results were released in 1993, cases of acute bovine viral diarrhea (BVD) surfaced in the United States following a 1993 outbreak in Canada. NDHEP information on producer vaccination and biosecurity practices helped officials address the risk of disease spread and target educational efforts on vaccination protocols. An outbreak of human illness was reported in 1993 in the Pacific Northwest, this time related to *Escherichia coli* 0157:H7. NDHEP data on the bacteria's prevalence in dairy cattle helped officials define public risks as well as research needs. This baseline picture of the industry also helped identify additional research and educational efforts in various production areas, such as feed management and weaning age.

Information from the NAHMS Dairy 1996 study helped the U.S. dairy industry identify educational needs and prioritize research efforts on such timely topics as antibiotic usage and Johne's disease, as well as digital dermatitis, bovine leukosis virus, and potential foodborne pathogens, including *E. coli*, *Salmonella*, and *Campylobacter.*

A major focus of the Dairy 2002 study was to describe management strategies that prevent and reduce Johne's disease and to determine management factors associated with *Mycoplasma* and *Listeria* in bulk-tank milk. Additionally, levels of participation in quality assurance programs, the incidence of digital dermatitis, a profile of animal-waste handling systems used on U.S. dairy operations, and industry changes since the NDHEP in 1991 and Dairy 1996 were examined.

The Dairy 2007 study was conducted in 17 of the Nation's major dairy States (see map on next page) and provides participants, stakeholders, and the industry as a whole with valuable information representing 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows.

Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007 (October 2007) was the first in a series of reports containing national information from the NAHMS Dairy 2007 study. This report contains information collected from 2,194 dairy operations.

Part II: Changes in the United States Dairy Industry, 1991-2007 (March 2008) provides national estimates of animal health management practices for comparable populations from the NAHMS 1991 NDHEP, Dairy 1996, Dairy 2002, and Dairy 2007.

Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007 is the third in a series of reports containing national information from the NAHMS Dairy 2007 study. Data from this report were collected from 582 operations with 30 or more dairy cows. State and Federal veterinary medical officers (VMOs) and animal health technicians (AHTs) collected the data between February 26 and August 3, 2007.

All Dairy 2007 study reports as well as reports from previous NAHMS dairy studies are available online at http://nahms.aphis.usda.gov.

Dairy 2007 Participating States and Number of Respondents by State

The methods used and number of respondents in the study can be found in Section II and Appendix I of this report, respectively.

Further information on NAHMS studies and reports is available at: http://nahms.aphis.usda.gov.

For questions about this report or additional copies, please contact:

USDA-APHIS-VS-CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000

Terms Used In This Report

Antibiotics: Substances produced by microorganisms that kill or inhibit the growth of other microorganisms. For the purpose of this report, antibiotics are synonymous with antimicrobials.

Antimicrobial: Any substance that kills or inhibits the growth of microorganisms.

Cow: Female dairy bovine that has calved at least once.

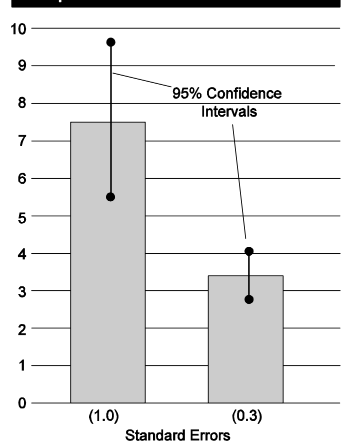
Heifer: Female dairy bovine that has not yet calved.

Herd size: Herd size is based on January 1, 2007, dairy cow inventory. Small herds are those with fewer than 100 head; medium herds are those with 100 to 499 head; and large herds are those with 500 or more head.

Operation: Premises with at least 30 dairy cows on January 1, 2007.

Operation average: The average value for all operations. A single value for each operation is summed over all operations reporting divided by the number of operations reporting. For example, the operation average number of employees (see table 4b on p 11) is calculated by dividing the total number of employees by the total number of operations.

Examples of a 95% Confidence Interval



Population estimates: Estimates in this report are provided with a measure of precision called the standard error. A 95-percent confidence interval can be created with bounds equal to the estimate, plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean 95 out of 100 times. In the example to the left, an estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). The second estimate of 3.4 shows a standard error of 0.3 and results in limits of 2.8 and 4.0. Alternatively, the 90-percent confidence interval would be created by multiplying the standard error by 1.65 instead of 2. Most estimates in this report are rounded to the nearest tenth. If rounded to 0, the standard error was reported (0.0). If there were no reports of the event, no standard error was reported (—).

Regions:
West: California, Idaho, New Mexico, Texas, and Washington
East: Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

Sample profile: Information that describes characteristics of the operations from which Dairy 2007 data were collected.

Usual calving area: An area separate from housing for lactating cows designated specifically for calving.

Section I: Population Estimates

A. Disease Familiarity and Biosecurity Practices

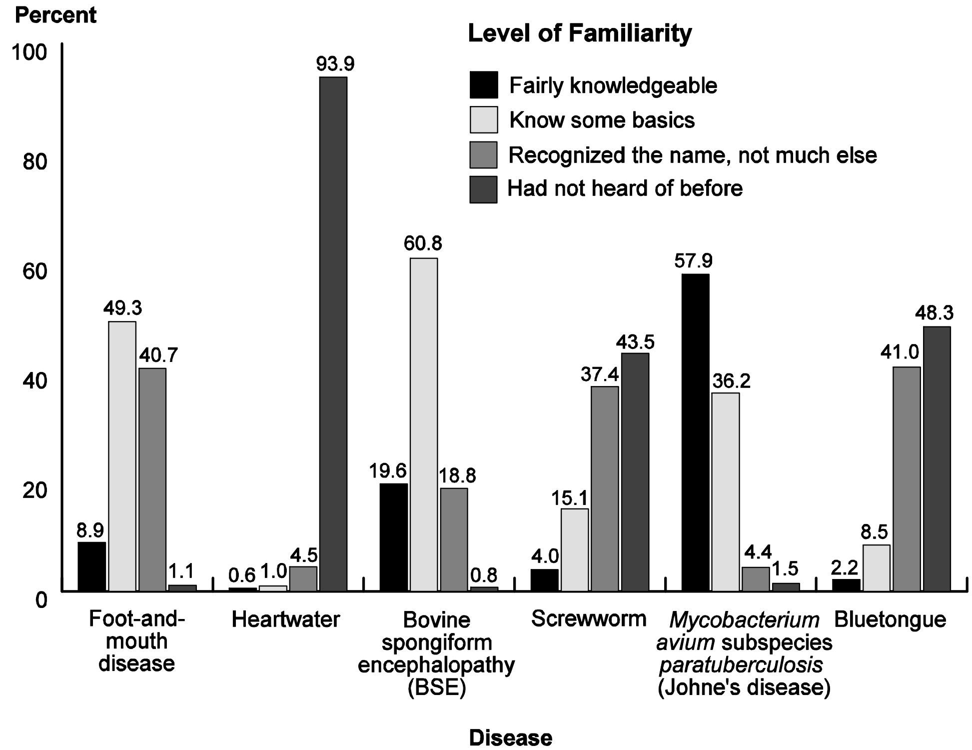
1. Producer familiarity with disease

Almost half of producers (49.3 percent) knew some basics about foot-and-mouth disease, while an additional 8.9 percent were fairly knowledgeable about the disease. More than 8 of 10 producers (80.4 percent) knew some basics or were fairly knowledgeable about bovine spongiform encephalopathy (BSE). Almost 60 percent of producers (57.9 percent) were fairly knowledgeable about Johne's disease, while an additional 36.2 percent knew some basics about the disease. Additionally, more than 50 percent of producers at least knew some basics about *Mycoplasma* mastitis, bovine viral diarrhea (BVD), and *Leptospira hardjo bovis*. Almost all producers (93.9 percent) had not heard of heartwater, which is a ruminant disease not present in the United States. More than 8 of 10 producers (80.9 percent) either only recognized the name screwworm or had not heard of it before. The United States has been free of screwworm since 1966.

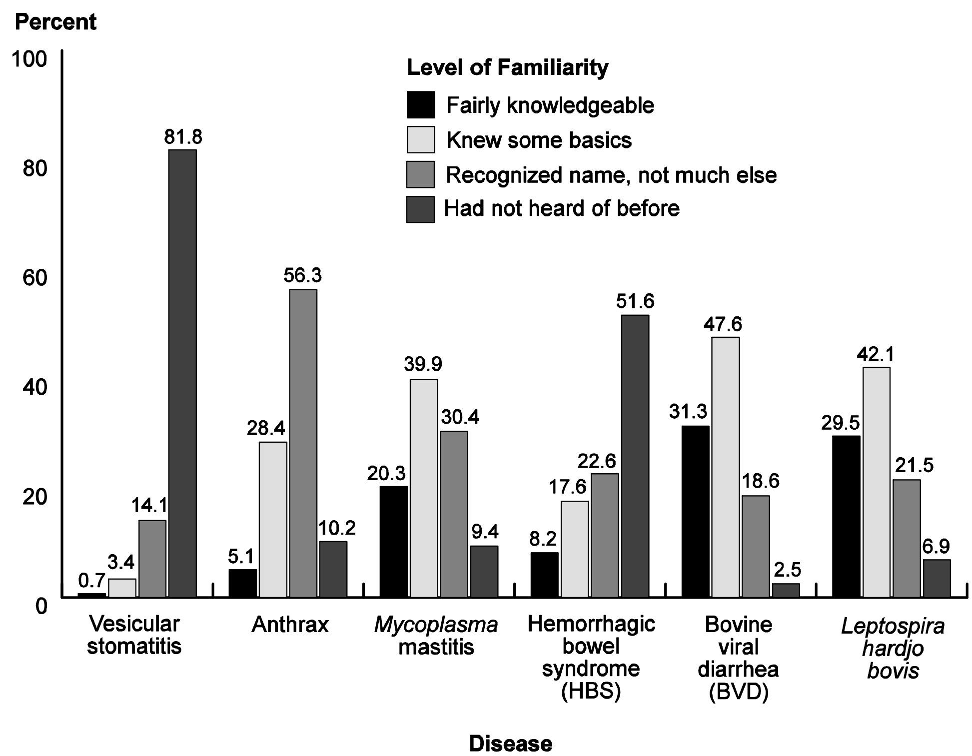
a. Percentage of operations by level of familiarity with specific cattle diseases:

	Percent Operations								
	Level of Familiarity								
	Fairly Knowledge-able		Knew Some Basics		Recognized Name, Not Much Else		Had Not Heard of Before		
Disease	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Total**
Foot-and-mouth disease	8.9	(1.2)	49.3	(2.9)	40.7	(2.9)	1.1	(0.7)	100.0
Heartwater	0.6	(0.3)	1.0	(0.4)	4.5	(1.0)	93.9	(1.1)	100.0
Bovine spongiform encephalopathy (BSE)	19.6	(2.0)	60.8	(2.7)	18.8	(2.2)	0.8	(0.6)	100.0
Screwworm	4.0	(0.8)	15.1	(1.9)	37.4	(2.6)	43.5	(2.7)	100.0
Mycobacterium avium subspecies *paratuberculosis* (Johne's disease)	57.9	(2.9)	36.2	(2.8)	4.4	(1.2)	1.5	(0.6)	100.0
Bluetongue	2.2	(0.9)	8.5	(1.2)	41.0	(2.8)	48.3	(2.8)	100.0
Vesicular stomatitis	0.7	(0.3)	3.4	(0.8)	14.1	(1.7)	81.8	(1.9)	100.0
Anthrax	5.1	(1.2)	28.4	(2.6)	56.3	(2.8)	10.2	(1.8)	100.0
Mycoplasma mastitis	20.3	(1.8)	39.9	(2.8)	30.4	(2.8)	9.4	(1.8)	100.0
Hemorrhagic bowel syndrome (HBS)	8.2	(1.1)	17.6	(1.9)	22.6	(2.3)	51.6	(2.7)	100.0
Bovine viral diarrhea (BVD)	31.3	(2.5)	47.6	(2.9)	18.6	(2.4)	2.5	(1.1)	100.0
Leptospira hardjo bovis	29.5	(2.4)	42.1	(2.9)	21.5	(2.4)	6.9	(1.5)	100.0

Percentage of Operations by Level of Familiarity with Specific Cattle Diseases



Percentage of Operations by Level of Familiarity with Specific Cattle Diseases



When producers that were fairly knowledgeable or knew some basics about each disease were combined and evaluated by region, differences in familiarity were observed for screwworm, bluetongue, vesicular stomatitis, and *Mycoplasma*. Producers in the West region were more familiar with the above diseases than producers in the East region. A higher percentage of producers in the West region (17.9 percent) at least knew some basics about vesicular stomatitis than operations in the East region (2.7 percent). Almost 9 of 10 producers in the West region (90.2 percent) at least knew some basics about *Mycoplasma* mastitis compared with producers in the East region (57.3 percent).

b. Percentage of operations that were fairly knowledgeable or knew some basics about specific cattle diseases:

	Percent Operations					
	Region					
	West		**East**		**All Operations**	
Disease	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Foot-and-mouth disease	71.0	(4.7)	57.0	(3.1)	58.2	(2.8)
Heartwater	4.7	(2.1)	1.3	(0.6)	1.6	(0.5)
Bovine spongiform encephalopathy (BSE)	82.6	(4.1)	80.1	(2.5)	80.4	(2.3)
Screwworm	34.5	(5.5)	17.6	(2.2)	19.1	(2.0)
Mycobacterium avium subspecies *paratuberculosis* (Johne's disease)	85.9	(3.9)	94.9	(1.4)	94.1	(1.3)
Bluetongue	25.2	(4.5)	9.3	(1.5)	10.7	(1.4)
Vesicular stomatitis	17.9	(4.0)	2.7	(0.8)	4.1	(0.8)
Anthrax	41.7	(5.9)	32.7	(2.9)	33.5	(2.7)
Mycoplasma mastitis	90.2	(3.8)	57.3	(3.1)	60.2	(2.9)
Hemorrhagic bowel syndrome (HBS)	38.5	(5.4)	24.5	(2.2)	25.8	(2.1)
Bovine viral diarrhea (BVD)	85.7	(4.5)	78.2	(2.7)	78.9	(2.5)
Leptospira hardjo bovis	77.8	(5.1)	71.0	(2.9)	71.6	(2.7)

2. Information sources in case of a foreign animal disease outbreak

Almost all operations (93.6 percent) would very likely use a private veterinarian for information regarding a foreign animal disease outbreak in the United States. Approximately 4 of 10 operations would very likely seek information from other dairy producers or magazines (41.4 and 39.0 percent, respectively). The Internet was not a likely source of information for 48.1 percent of operations.

Percentage of operations by likelihood of using the following information sources if an outbreak of foreign animal disease occurred in the United States (e.g., foot-and-mouth disease):

	Percent Operations						
	Likelihood						
	Very Likely		Somewhat Likely		Not Likely		
Information Source	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Total
Other dairy producers	41.4	(2.8)	37.8	(2.7)	20.8	(2.3)	100.0
Private veterinarian	93.6	(1.3)	5.4	(1.3)	1.0	(0.5)	100.0
Extension agent	32.5	(2.7)	38.9	(2.9)	28.6	(2.5)	100.0
Dairy organization or cooperative	30.7	(2.6)	42.3	(2.8)	27.0	(2.6)	100.0
Magazines	39.0	(2.8)	49.4	(2.8)	11.6	(1.5)	100.0
Internet	23.1	(2.2)	28.8	(2.6)	48.1	(2.8)	100.0
State Veterinarian’s office	26.7	(2.4)	37.4	(2.8)	35.9	(2.9)	100.0
USDA	22.6	(2.4)	42.5	(2.8)	34.9	(2.7)	100.0
Television/ newspapers	25.8	(2.5)	38.8	(2.8)	35.4	(2.6)	100.0
Other	4.7	(1.2)	2.4	(1.0)	92.9	(1.6)	100.0

3. Resource contacts

If a foreign animal disease was introduced into the United States, infected animals would need to be identified and diagnosed quickly to stop the spread of disease. Most operations (98.6 percent) would contact a private veterinarian if an animal on the operation was suspected of having a foreign animal disease.

a. Percentage of operations that would contact the following resources if an animal on the operation was suspected of having foot-and-mouth disease or another foreign animal disease:

Resource	Percent Operations	Standard Error
Extension agent/university	20.8	(2.3)
State Veterinarian's office	35.7	(2.6)
USDA	21.8	(2.3)
Private veterinarian	98.6	(0.5)
Feed company or milk cooperative representative	25.7	(2.3)
Other	4.1	(1.3)

Photo courtesy of Chuck Greiner, Agricultural Research Service

Decreased milk production, cows with fever, deaths, and/or abortions could indicate that a new disease has been introduced into the herd. On average, an operation would have to have a 20.6 percent decrease in milk production before a veterinarian would be contacted for assistance or consultation. Large operations had a lower threshold (12.9 percent reduction) compared with small operations (22.3 percent reduction). Operations reported that a veterinarian would be contacted if 9.6 percent of cows exhibited a fever, 5.8 percent of cows died within a short period, or 6.8 percent of cows aborted.

b. Operation average percentage change at which a veterinarian would be contacted for assistance, by potential problem sign and by herd size:

	Operation Average Percent Change							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Potential Problem Sign	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Decline in total daily milk production	22.3	(1.2)	18.0	(1.1)	12.9	(1.2)	20.6	(0.9)
Milk cows exhibiting fever within a short time period	10.7	(1.2)	7.3	(0.9)	6.0	(1.8)	9.6	(0.9)
Milk cows dying within a short time period	6.8	(1.1)	3.2	(0.7)	4.2	(1.9)	5.8	(0.8)
Milk cows aborting within a short time period	8.1	(1.1)	3.9	(0.7)	4.6	(1.8)	6.8	(0.8)

Operations in the West region would seek veterinary assistance if daily milk production declined by 14.1 percent, while operations in the East region would do so at a 21.3 percent decline. For the other three potential problem signs, there were no regional differences in the average percentage change at which operations would seek assistance from a veterinarian.

c. Operation average percentage change at which a veterinarian would be contacted for assistance, by potential problem sign and by region:

	Operation Average Percent Change			
	Region			
	West		**East**	
Potential Problem Sign	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Decline in total daily milk production	14.1	(1.1)	21.3	(1.0)
Milk cows exhibiting fever within a short time period	5.7	(1.3)	10.0	(0.9)
Milk cows dying within a short time period	3.8	(1.3)	5.9	(0.9)
Milk cows aborting within a short time period	4.5	(1.3)	7.0	(0.9)

4. Employees and visitors

Not surprisingly, a lower percentage of small operations (65.6 percent) had employees compared with medium and large operations (95.0 and 98.0 percent, respectively).

a. Percentage of operations that had employees* during the previous 12 months, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
65.6	(4.1)	95.0	(2.0)	98.0	(1.9)	75.7	(2.8)

*Excludes owners and family members.

The number of full-time employees increased as herd size increased. Small operations averaged 2.0 full-time employees, compared with 3.8 and 12.9 full-time employees on medium and large operations, respectively. Medium operations employed more part-time people on average than large operations (2.4 and 1.2, respectively).

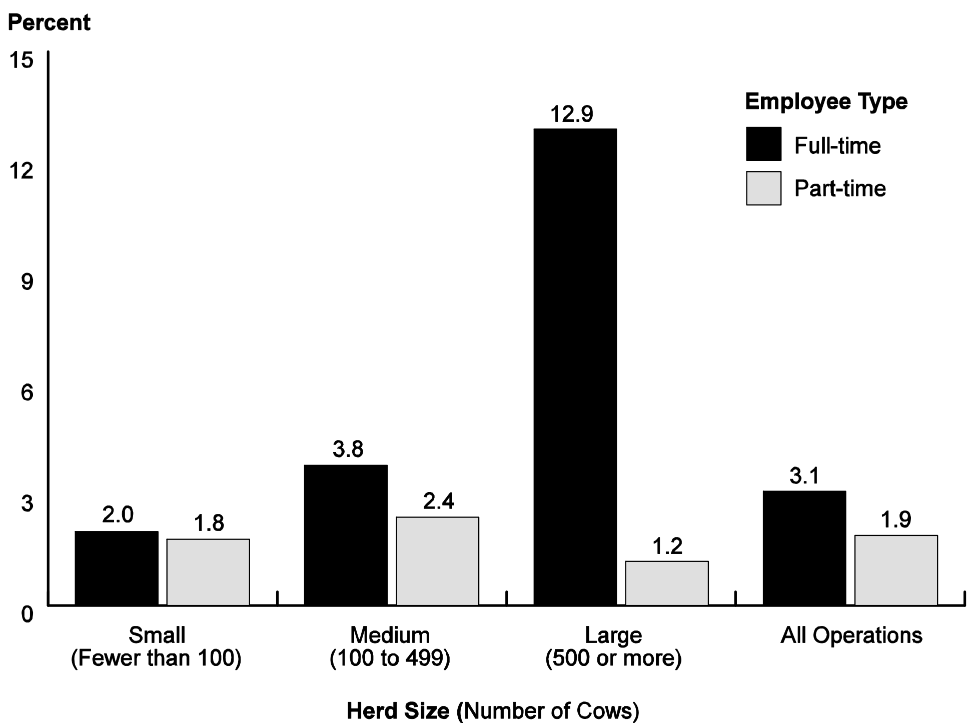
b. Operation average number of employees, by employee type and by herd size:

Operation Average Number Employees*

	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Employee Type	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
Full-time	2.0	(0.1)	3.8	(0.1)	12.9	(0.8)	3.1	(0.1)
Part-time	1.8	(0.1)	2.4	(0.2)	1.2	(0.2)	1.9	(0.1)

*Paid and unpaid, including owners and family members assigned work duties directly related to the dairy's operation.

Operation Average Number of Employees*, by Employee Type and by Herd Size



*Paid and unpaid, including owners and family members assigned work duties directly related to the dairy's operation.

Operations in the West region averaged more full-time employees (7.8) compared with operations in the East region (2.7). Operations in the East region averaged more part-time employees. These differences were likely related to the larger herd sizes in the West region.

c. Operation average number of employees, by employee type and by region:

	Operation Average Number Employees*			
	Region			
	West		East	
Employee Type	Average	Std. Error	Average	Std. Error
Full-time	7.8	(0.7)	2.7	(0.1)
Part-time	1.0	(0.1)	2.0	(0.1)

*Paid and unpaid, including owners and family members assigned work duties directly related to the dairy's operation.

Photo courtesy of Keith Weller, Agricultural Research Service

Implementing biosecurity practices reduces the introduction of disease. Employees and visitors are potential sources of disease, and operations should have restrictions and guidelines—for both employees and visitors—designed to limit the introduction of disease.

A higher percentage of large operations (47.3 percent) trained employees in performing biosecurity practices compared with small and medium operations (17.8 and 23.7 percent, respectively). Other than employee training, less than 20 percent of all operations implemented the other biosecurity practices listed.

d. For operations with employees, percentage of operations by biosecurity practices used and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Biosecurity Practice	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Restrictions on employee livestock ownership outside this operation	17.4	(3.7)	18.6	(3.5)	20.1	(4.7)	18.1	(2.5)
Guidelines regarding foreign travel by employees	9.7	(2.7)	16.0	(3.6)	14.7	(3.7)	12.0	(2.0)
Written standard operating procedures (other than milking procedures)	10.9	(2.7)	13.2	(2.9)	23.0	(4.8)	12.2	(2.0)
Training for employees in performing biosecurity practices	17.8	(3.4)	23.7	(3.6)	47.3	(6.2)	21.9	(2.5)

Nearly all operations, regardless of herd size, allowed visitors in the animal area.

e. Percentage of operations in which visitors were allowed in the animal area:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
98.6	(0.8)	95.9	(1.8)	97.9	(1.6)	97.9	(0.7)

About one of three operations (30.4 percent) had guidelines regarding which visitors were allowed in animal areas, and 51.3 percent of operations had restrictions on vehicles entering animal areas. A lower percentage of small operations (22.7 percent) provided disposable or clean boots for visitors entering animal areas compared with medium operations (42.1 percent).

f. For operations that allowed visitors in the animal area, percentage of operations by biosecurity practices used and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Biosecurity Practice	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Guidelines regarding which visitors are allowed in animal areas	28.0	(3.4)	35.2	(4.3)	39.9	(5.9)	30.4	(2.6)
Footbaths for visitors entering animal areas	6.3	(1.7)	7.2	(1.9)	12.1	(3.5)	6.9	(1.3)
Disposable or clean boots for visitors entering animal areas	22.7	(3.3)	42.1	(4.2)	36.3	(5.5)	28.3	(2.6)
Restrictions on vehicles entering animal areas	51.0	(3.8)	54.5	(4.1)	41.9	(6.1)	51.3	(2.9)

Employees, veterinarians, nutritionists, and milk and cattle haulers routinely come onto dairy operations. Employees and visitors, who may or may not have contact with cattle on the operation, are potential sources of disease introduction. As expected, the number of visits per week increased as herd size increased; 72.2 percent of large operations had 29 or more visits per week compared with 47.6 and 20.0 percent of medium and small operations, respectively.

g. Percentage of operations by number of visits* to the operation per week and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Number of Visits (Per Week)	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1 to 7	35.6	(3.7)	13.7	(3.0)	1.2	(0.7)	28.0	(2.7)
8 to 14	28.4	(3.6)	16.5	(3.3)	0.8	(0.5)	23.6	(2.6)
15 to 21	9.0	(2.0)	12.5	(2.8)	13.7	(4.8)	10.2	(1.6)
22 to 28	7.0	(1.7)	9.7	(2.6)	12.1	(4.0)	8.0	(1.4)
29 or more	20.0	(3.1)	47.6	(4.1)	72.2	(5.3)	30.2	(2.4)
Total	100.0		100.0		100.0		100.0	

*Includes employees, veterinarians, neighbors, nutritionists, milk haulers, etc.

Of operations that had visits, more than 9 of 10 (93.6 percent) had visits that involved contact with animals on the operation.

h. For operations that had visits, percentage of operations in which visits involved contact with animals on the operation:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Percent	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
91.3	(1.9)	98.5	(0.7)	100.0	(0.0)	93.6	(1.3)

For operations in which any visits to the operation involved contact with animals on the operation, about half of operations (54.2 percent) reported one to seven visits per week that involved contact with animals on the operation. About 1 of 6 operations (17.1 percent) had 29 or more visits that resulted in contact with animals. The number of visits that involved animal contact increased as herd size increased.

i. For operations in which any visits to the operation involved contact with animals on the operation, percentage of operations by number of visits per week that involved animal contact, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Number of Visits (Per Week)	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1 to 7	67.1	(3.8)	31.4	(3.9)	10.3	(3.7)	54.2	(2.8)
8 to 14	7.9	(2.0)	13.3	(2.9)	10.9	(3.8)	9.5	(1.6)
15 to 21	11.5	(2.6)	13.8	(3.2)	7.9	(3.4)	11.8	(1.9)
22 to 28	6.5	(2.0)	9.9	(2.3)	6.2	(3.1)	7.4	(1.5)
29 or more	7.0	(1.9)	31.6	(3.7)	64.7	(5.4)	17.1	(1.7)
Total	100.0		100.0		100.0		100.0	

For Operations in Which Any Visits to the Operation Involved Contact with Animals on the Operation, Percentage of Operations by Number of Visits Per Week that Involved Animal Contact, and by Herd Size

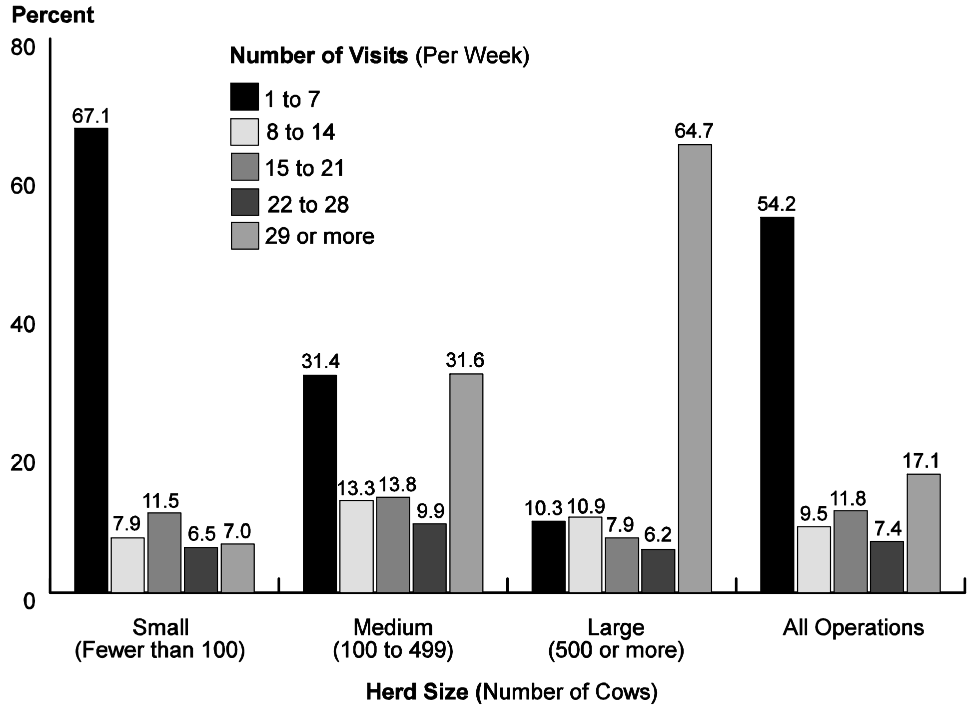


Photo courtesy of Keith Weller, Agricultural Research Service

5. Specific animal exclusion practices

In order to effectively exclude specific diseases from an operation, all potential disease sources should be considered. Many diseases are initially introduced into a herd through the purchase of an infected animal. Knowing the source of purchased cattle may provide the buyer the opportunity to inquire directly about any diseases on the source operation or any testing that may have been done. About 6 of 10 operations (64.2 percent) did not introduce cattle into their herds during the previous 12 months. Only 2.6 percent of operations did not know the source of any new cattle, while 24.2 percent knew the source of all cattle introduced. The percentage of operations that had no incoming cattle decreased as herd size increased.

a. Percentage of operations in which the producer was aware of the source and geographic origin of all, some, or none of the incoming cattle during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Knew the Source and Geographic Origin of . . .	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
All	22.0	(3.3)	28.0	(3.8)	32.0	(5.2)	24.2	(2.4)
Some	8.6	(2.3)	7.8	(2.3)	19.1	(3.7)	9.0	(1.7)
None	2.0	(1.2)	3.6	(1.6)	5.4	(2.9)	2.6	(0.9)
No incoming cattle*	67.4	(3.7)	60.6	(4.2)	43.5	(5.7)	64.2	(2.8)
Total	100.0		100.0		100.0		100.0	

*If the operation sent heifers off-site but cattle were not commingled with cattle from other operations, these operations were considered to have had no incoming cattle.

There were no regional differences in the percentage of operations by producer knowledge of the source and geographic origin of incoming cattle.

b. Percentage of operations in which the producer was aware of the source and geographic origin of all, some, or none of the incoming cattle during the previous 12 months, by region:

	Percent Operations			
	Region			
	West		**East**	
Knew the Source and Geographic Origin of . . .	**Percent**	**Std. Error**	**Percent**	**Std. Error**
All incoming cattle	16.5	(3.6)	24.9	(2.7)
Some incoming cattle	10.9	(3.0)	8.9	(1.9)
None	7.3	(2.8)	2.1	(1.0)
No incoming cattle*	65.3	(4.7)	64.1	(3.0)
Total	100.0		100.0	

*If the operation sent heifers off-site but cattle were not commingled with cattle from other operations, these operations were considered to have had no incoming cattle.

The majority of operations used insect and rodent control practices, and maintained a closed herd. There were no differences across herd sizes in the percentages of operations that implemented specific biosecurity practices.

c. Percentage of operations that used the following biosecurity practices to prevent disease during the previous 12 months, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Biosecurity Practice	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Insect control	86.5	(2.7)	88.3	(2.7)	93.6	(3.0)	87.4	(2.0)
Rodent control	95.7	(1.4)	91.8	(2.0)	90.3	(3.4)	94.4	(1.1)
Bird control	29.4	(3.6)	44.3	(4.2)	41.4	(5.6)	33.8	(2.7)
Limit cattle contact with other livestock, elk, and deer	44.8	(3.8)	55.7	(4.2)	59.6	(5.6)	48.5	(2.8)
Control access to cattle feed by other livestock and wildlife	52.0	(3.9)	46.8	(4.2)	40.1	(5.4)	49.9	(2.9)
Closed herd*	60.1	(3.9)	49.5	(4.2)	40.6	(5.6)	56.2	(2.9)

*All replacements are from the operation; no contact with cattle from other operations.

6. Equipment handling for manure and feeding

Manure is a source of bacteria that can cause disease in animals if feedstuffs are contaminated. It is generally recommended that equipment used for manure handling not be used for handling feed. If the equipment is used to handle manure, it should be cleaned and disinfected before handling feed. Approximately the same percentages of operations (one-third) routinely, rarely, or never used the same equipment for manure and feed, and no differences were observed across herd sizes.

a. Percentage of operations by frequency that the same equipment was used to handle manure and feed cattle during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Frequency	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Routinely	34.1	(3.6)	29.8	(3.9)	20.3	(4.7)	32.2	(2.7)
Rarely	34.4	(3.6)	36.4	(4.0)	46.0	(5.6)	35.6	(2.7)
Never	31.5	(3.6)	33.8	(3.9)	33.7	(5.5)	32.2	(2.7)
Total	100.0		100.0		100.0		100.0	

For operations that used the same equipment to handle manure and feed cattle, the majority (61.0 percent) washed equipment with water or steam after handling manure and before handling feed. The majority of the approximately one of four operations (23.2 percent) that used “other” procedures reported using separate loader buckets.

b. For operations that used the same equipment to handle manure and feed cattle, percentage of operations by procedure that best describes what is usually done with equipment after handling manure:

Procedure	Percent Operations	Standard Error
Wash equipment with water or steam only	61.0	(3.4)
Chemically disinfect only	0.1	(0.1)
Wash equipment and chemically disinfect	4.6	(1.5)
Other	23.2	(3.1)
No procedures done	11.1	(2.3)
Total	100.0	

7. Equipment sharing with other livestock operations

Sharing equipment between operations can spread disease from one operation to another. Ideally, equipment should be disinfected before it is transported and used on another operation. A lower percentage of operations in the West region (13.6 percent) shared equipment compared with operations in the East region (38.4 percent).

a. Percentage of operations that shared any heavy equipment (tractors, feeding equipment, manure spreaders, trailers, etc.) with other livestock operations during the previous 12 months, by region:

Percent Operations					
Region					
West		East		All Operations	
Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
13.6	(3.5)	38.4	(3.0)	36.2	(2.8)

The majority of operations, regardless of herd size, had not shared any heavy equipment with other livestock operations during the previous 12 months. Overall, 63.8 percent of operations had not shared equipment. More than 12 percent of operations across all herd sizes shared equipment at least six times during the previous 12 months.

b. Percentage of operations by number of times heavy equipment was shared during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Number of Times	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
0	64.1	(3.7)	59.0	(4.1)	78.7	(4.3)	63.8	(2.8)
1 to 2	11.1	(2.6)	15.5	(3.1)	5.3	(2.3)	11.8	(2.0)
3 to 5	12.6	(2.5)	7.0	(2.4)	3.1	(1.1)	10.6	(1.8)
6 or more	12.2	(2.3)	18.5	(3.4)	12.9	(3.8)	13.8	(1.8)
Total	100.0		100.0		100.0		100.0	

Photo courtesy of Keith Weller, Agricultural Research Service

The majority of producers that shared equipment with other operations (63.0 percent) performed no cleaning procedures prior to using the equipment on their own operations, while 26.6 percent washed equipment with water or steam.

c. For operations that shared equipment with other livestock operations, percentage of operations by cleaning procedure usually performed on equipment shared with other operations prior to use on the operation:

Procedure	Percent Operations	Standard Error
Wash equipment with water or steam only	26.6	(3.9)
Chemically disinfect only	0.0	(--)
Wash equipment and chemically disinfect	0.5	(0.3)
Other	9.9	(3.2)
No procedures done	63.0	(4.6)
Total	100.0	

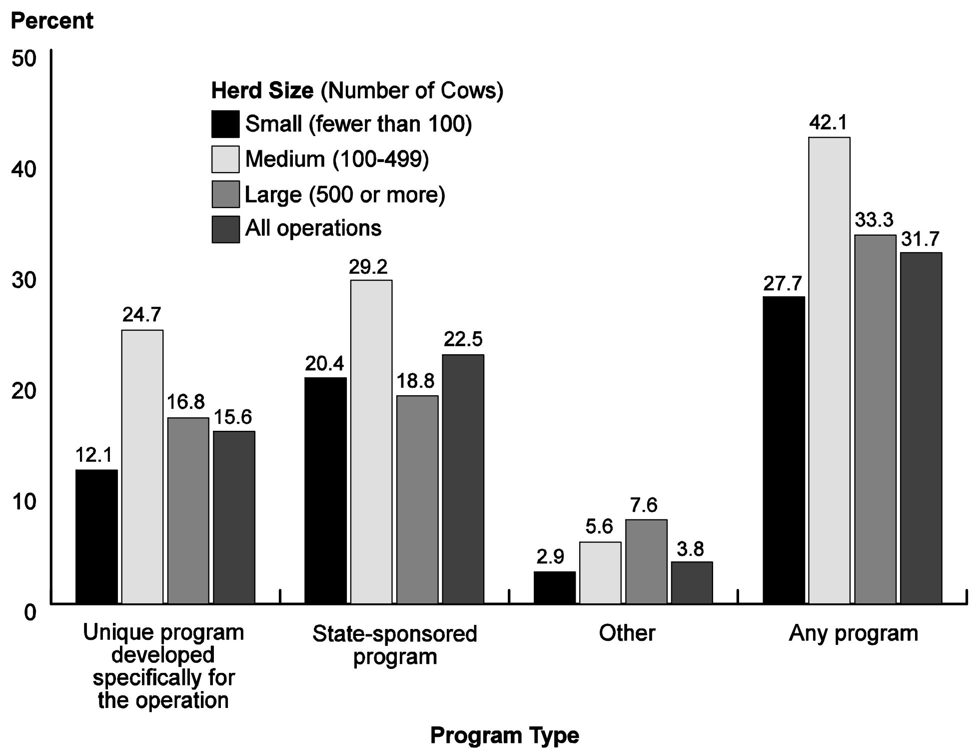
8. Johne's disease

Herd-level control programs on operations infected with *Mycobacterium avium* subspecies *paratuberculosis* (the causative agent of Johne's disease) are critical in controlling the disease. Almost one of three operations (31.7 percent) participated in some type of Johne's disease control program. A higher percentage of medium operations (24.7 percent) had a unique Johne's disease program developed specifically for the operation compared with small operations (12.1 percent). There were no differences across herd sizes in the percentage of operations that used the other program types.

a. Percentage of operations that participated in Johne's disease control or certification programs, by type of program and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Program Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Unique program developed specifically for the operation	12.1	(2.4)	24.7	(3.6)	16.8	(3.8)	15.6	(1.9)
State-sponsored program	20.4	(3.0)	29.2	(3.8)	18.8	(2.9)	22.5	(2.2)
Other	2.9	(1.1)	5.6	(2.0)	7.6	(2.8)	3.8	(0.9)
Any program	27.7	(3.3)	42.1	(4.1)	33.3	(4.5)	31.7	(2.5)

Percentage of Operations that Participated in Johne's Disease Control or Certification Programs, by Type of Program and by Herd Size



A higher percentage of operations in the East region (33.0 percent) participated in any Johne's disease control program compared with operations in the West region (18.3 percent).

b. Percentage of operations that participated in a Johne's disease control or certification program, by type of program and by region:

	Percent Operations			
	Region			
	West		East	
Program Type	Percent	Std. Error	Percent	Std. Error
Unique program developed specifically for this operation	11.0	(3.3)	16.0	(2.1)
State-sponsored program	8.0	(2.1)	23.9	(2.5)
Other	2.6	(1.6)	4.0	(1.0)
Any	18.3	(3.8)	33.0	(2.7)

A Johne's disease control program may include testing individual animals in order to identify those that are shedding *Mycobacterium avium* subspecies *paratuberculosis* and are, therefore, presenting a risk to noninfected animals on the operation. More than one-third of operations (35.3 percent) tested for Johne's disease. A higher percentage of medium operations tested for Johne's disease compared with small operations (47.6 and 30.7 percent, respectively).

c. Percentage of operations that tested for Johne's disease, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
30.7	(3.4)	47.6	(4.1)	37.5	(5.7)	35.3	(2.6)

9. Calving areas

Ideally, calving areas are clean, dry, quiet, and provide enough room for a cow to comfortably lie down and deliver a calf. The majority of operations (70.0 percent) used a multiple-animal calving area/pen. A lower percentage of small operations (65.6 percent) used a multiple-animal calving area compared with medium operations (79.8 percent). Approximately one-quarter of operations used an individual calving area that was either cleaned between each calving or cleaned after two or more calvings (25.5 and 26.2 percent, respectively). A higher percentage of small operations (30.6 percent) used an individual-animal pen that was cleaned between each calving compared with medium and large operations (14.6 and 13.5 percent, respectively).

a. Percentage of operations by area usually used for calving and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Calving Area	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Multiple animal area/pen	65.6	(3.5)	79.8	(3.5)	78.5	(4.3)	70.0	(2.6)
Individual animal area/pen cleaned between each calving	30.6	(3.4)	14.6	(3.3)	13.5	(3.9)	25.5	(2.5)
Individual animal area/pen cleaned after two or more calvings	25.4	(3.3)	27.4	(3.7)	30.3	(5.6)	26.2	(2.5)
Other	5.1	(1.7)	3.6	(1.4)	3.1	(1.7)	4.6	(1.2)

The percentage of operations with a usual calving area ranged from 62.5 percent of small operations to 98.2 percent of large operations.

b. Percentage of operations that had a usual calving area:

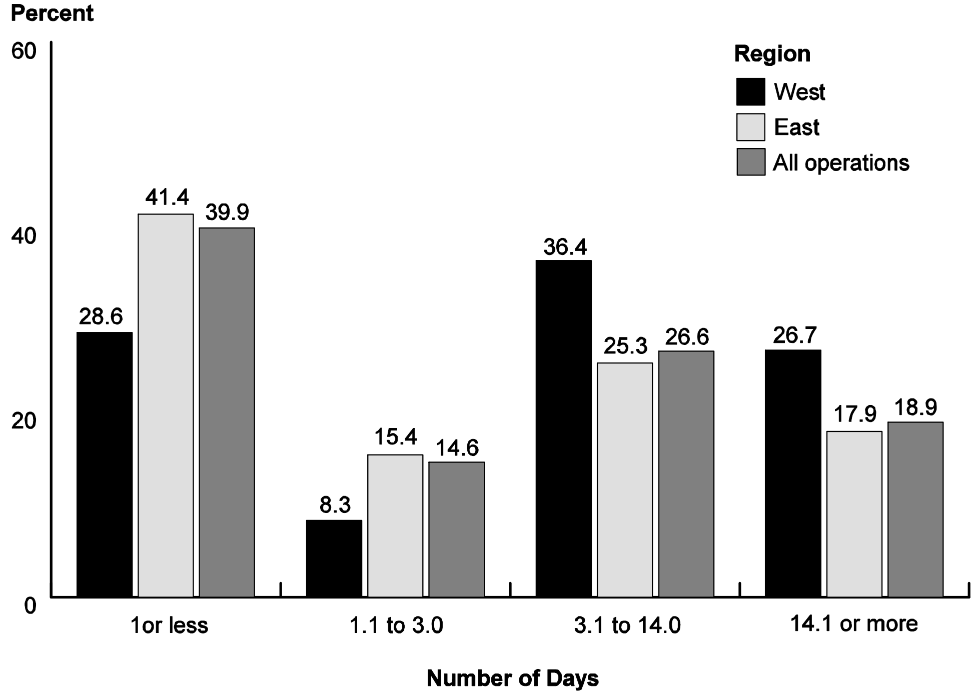
Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Percent	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
62.5	(3.8)	83.7	(3.3)	98.2	(1.2)	70.1	(2.7)

For operations with a usual calving area, 4 of 10 operations (39.9 percent) moved cows into the calving area within a day prior to calving. There were no regional differences. Cows were kept in the calving area prior to calving for 3.1 to 14.0 days on 26.6 percent of operations and for 14.1 or more days on 18.9 percent of operations.

c. For operations with a usual calving area, percentage of operations by number of days cows remained in the usual calving area/pen ***prior*** to calving, and by region:

	Percent Operations					
	Region					
	West		East		All Operations	
Number of Days	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1 or less	28.6	(4.9)	41.4	(3.6)	39.9	(3.2)
1.1 to 3.0	8.3	(2.9)	15.4	(2.6)	14.6	(2.3)
3.1 to 14.0	36.4	(5.6)	25.3	(3.1)	26.6	(2.8)
14.1 or more	26.7	(4.9)	17.9	(2.5)	18.9	(2.3)
Total	100.0		100.0		100.0	

For Operations with a Usual Calving Area, Percentage of Operations by Number of Days Cows were in the Usual Calving Area/Pen *Prior* to Calving, and by Region



For operations with a usual calving area, few operations (12.9 percent) removed cows from the calving area in the first hour after calving. A lower percentage of large operations (6.2 percent) allowed cows to remain in the usual calving area for 14.1 or more hours compared with small operations (25.0 percent).

d. For operations with a usual calving area, percentage of operations by number of hours cows remained in the usual calving area/pen ***after*** calving, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Number of Hours	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Removed immediately	4.4	(1.8)	2.7	(1.3)	7.2	(3.0)	4.2	(1.2)
.25 to 1.0	8.0	(2.3)	7.8	(2.1)	16.5	(3.8)	8.7	(1.6)
1.1 to 3.0	22.5	(4.0)	26.1	(4.0)	28.0	(5.4)	24.1	(2.8)
3.1 to 14.0	40.1	(4.6)	44.0	(4.4)	42.1	(5.5)	41.4	(3.2)
14.1 or more	25.0	(4.2)	19.4	(3.9)	6.2	(3.2)	21.6	(2.8)
Total	100.0		100.0		100.0		100.0	

There were no regional differences by length of time that cows remained in the usual calving area after calving.

e. For operations with a usual calving area, percentage of operations by number of hours cows remained in the usual calving area/pen ***after*** calving, and by region:

	Percent Operations			
	Region			
	West		**East**	
Number of Hours	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Removed immediately	6.7	(2.7)	3.9	(1.3)
.25 to 1.0	7.3	(2.7)	8.9	(1.7)
1.1 to 3.0	22.6	(4.9)	24.3	(3.1)
3.1 to 14.0	44.6	(5.8)	41.0	(3.5)
14.1 or more	18.8	(4.9)	21.9	(3.2)
Total	100.0		100.0	

Allowing sick cows into the calving area is a potential source of disease for other cows and newborn calves. A higher percentage of small and medium operations (37.3 and 33.0 percent, respectively) allowed sick cows in calving areas than large operations (16.5 percent). Approximately half of operations (51.6 percent) allowed lame cows into the calving area. A lower percentage of large operations (28.6 percent) allowed lame cows into the calving area than medium and small operations (57.9 and 51.8 percent, respectively).

f. For operations with a usual calving area, percentage of operations that allowed sick/lame cows in the usual calving area, by cattle class and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Sick cows	37.3	(4.6)	33.0	(4.5)	16.5	(4.4)	34.2	(3.2)
Lame cows	51.8	(4.6)	57.9	(4.4)	28.6	(4.5)	51.6	(3.1)
Other	5.4	(2.0)	5.8	(2.3)	4.1	(2.2)	5.4	(1.4)
Any of the above	56.4	(4.6)	62.3	(4.2)	30.7	(4.6)	55.8	(3.1)

Cows that test positive for Johne’s disease present a risk of contaminating the usual calving area and transmitting the disease to newborn calves. To prevent calving-area contamination and the potential for infecting calves, test-positive animals should not be allowed in the calving area or other calf areas. There were no differences by operation size in the percentage of operations that allowed Johne’s disease test-positive animals in the calving area; 15.5 percent of operations that tested for Johne’s disease allowed test-positive cows in the calving area.

g. For operations with a usual calving area and that tested for Johne’s disease, percentage of operations that allowed Johne’s test-positive cows in the usual calving area, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
12.0	(4.5)	18.0	(5.0)	30.2	(8.3)	15.5	(3.2)

The percentage of calves born in the usual calving area increased as herd size increased. Overall, 89.8 percent of calves were born in the usual calving area.

h. For operations with a usual calving area, percentage of calves born in the usual calving area, by herd size:

Percent Calves							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
79.9	(2.0)	89.0	(1.3)	93.6	(1.3)	89.8	(0.9)

Photo courtesy of Judy Rodriguez

A higher percentage of small operations than large operations reported that less than three-fourths of their calves were born in the usual calving area. A higher percentage of large operations (45.8 percent) reported that 91 to 99 percent of calves were born in the calving area compared to 16.6 percent of small operations.

i. Percentage of operations by percentage of calves born in the usual calving area/pen, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Percent Calves	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
0 to 50	19.3	(3.8)	8.4	(2.5)	3.7	(2.0)	14.7	(2.5)
51 to 75	18.3	(3.9)	6.5	(2.3)	3.6	(2.0)	13.5	(2.5)
76 to 90	28.6	(4.3)	29.0	(4.2)	24.0	(4.5)	28.3	(3.0)
91 to 99	16.6	(3.2)	38.4	(4.5)	45.8	(5.7)	25.6	(2.5)
100	17.2	(3.3)	17.7	(3.3)	22.9	(5.5)	17.9	(2.3)
Total	100.0		100.0		100.0		100.0	

Colostrum from Johne's test-positive cows could transmit the disease to calves. Studies suggest that colostrum is approximately three times as likely as milk to contain *Mycobacterium avium* subspecies *paratuberculosis*. Operations should either use colostrum from a test-negative cow or pasteurize colostrum prior to feeding. Approximately 1 of 20 operations (4.9 percent) fed colostrum from test-positive cows to calves. There were no differences by herd size.

j. For operations that tested for Johne's disease, percentage of operations in which calves were fed colostrum from cows that tested positive for Johne's disease, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
6.0	(2.9)	3.8	(2.8)	0.6	(0.4)	4.9	(2.0)

B. Source of Replacements

NOTE: Estimates for sources of cow replacements were published in NAHMS Dairy 2007 Part I, p 62. Cow-replacement estimates in this report (Part III) are similar, with the exception of the percentage of operations that had cow replacements born on the operation and raised off-site—which is higher in this report than in Part I.

1. Cow replacements in the milking herd

Approximately one-third of the dairy cow inventory (36.2 percent) was replaced (primarily by heifers that calved) during the previous 12 months. There were no differences by herd size.

a. Cow replacements that entered the milking herd during the previous 12 months, as a percentage of cow inventory on the day of interview, by herd size:

Percent Cow Inventory							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
33.0	(1.1)	34.5	(1.1)	39.0	(2.6)	36.2	(1.2)

Almost 9 of 10 operations (88.0 percent) had cow replacements enter the milking herd that were born and raised on the operation. A lower percentage of large operations (50.7 percent) raised cow replacements on their operations compared with medium and small operations (84.7 and 92.6 percent, respectively). Off-site heifer raising of cow replacements was practiced by 13.9 percent of all operations and was highest for large operations (50.9 percent). Cow replacements were purchased directly from other dairies by 15.3 percent of operations. A higher percentage of large operations (20.2 percent) purchased cow replacements from a dealer compared with medium and small operations (8.9 and 1.7 percent, respectively). Purchasing cow replacements from auction markets was practiced by 7.0 percent of operations.

b. Percentage of operations by source of cow replacements that entered the milking herd during the previous 12 months:

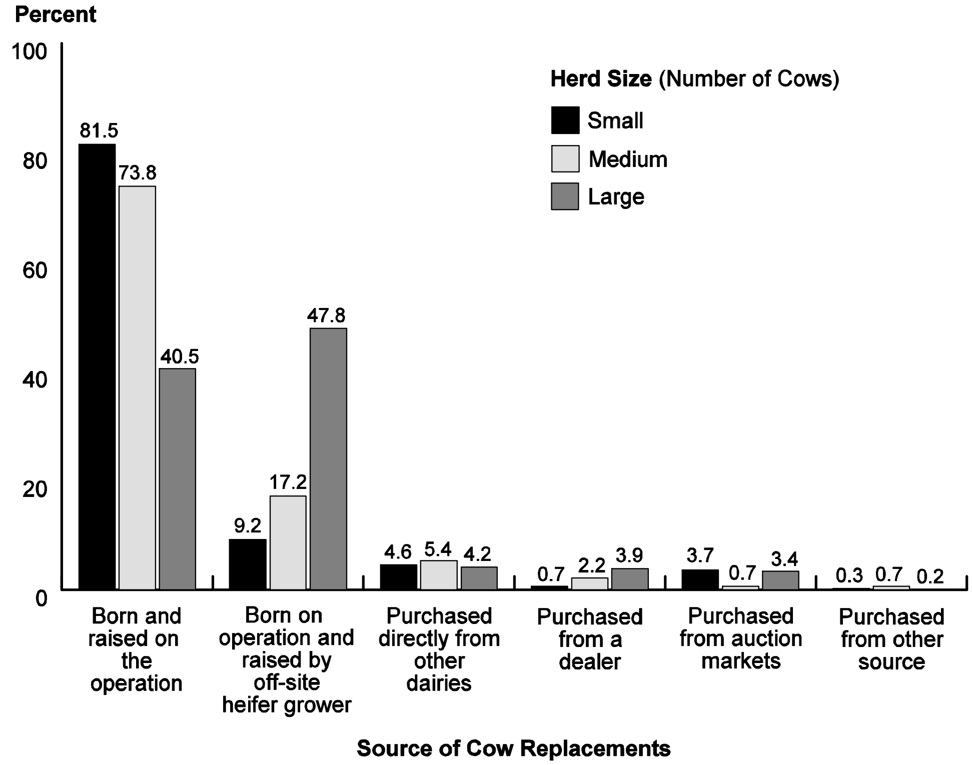
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Source of Cow Replacements	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Born and raised on the operation	92.6	(1.9)	84.7	(3.2)	50.7	(6.2)	88.0	(1.6)
Born on operation, raised off-site	9.3	(2.2)	17.2	(3.3)	50.9	(5.7)	13.9	(1.8)
Purchased directly from other dairies	12.6	(2.7)	21.5	(3.5)	20.7	(4.5)	15.3	(2.1)
Purchased from a dealer	1.7	(0.7)	8.9	(2.6)	20.2	(4.3)	4.6	(0.9)
Purchased from auction markets	7.3	(2.4)	4.3	(1.6)	14.3	(4.0)	7.0	(1.7)
Purchased from other source	2.7	(1.4)	1.6	(0.7)	6.1	(2.6)	2.6	(1.0)

All operations had cow replacements enter the milking herd during the previous 12 months. The majority of cow replacements for small and medium operations were born and raised on the operation (81.5 and 73.8 percent of replacements, respectively). Cow replacements for large operations were either “home-raised” or born on the operation and raised off-site (40.5 and 47.8 percent of replacements, respectively). Less than 15 percent of all cow replacements were purchased from other dairies, a dealer, auction market, or other source.

c. Percentage of cow replacements that entered the milking herd during the previous 12 months, by source and by herd size:

	Percent Cow Replacements							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Source of Cow Replacements	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Born and raised on the operation	81.5	(3.3)	73.8	(3.5)	40.5	(6.3)	58.8	(3.5)
Born on operation, raised off-site	9.2	(2.2)	17.2	(3.4)	47.8	(6.0)	30.8	(3.3)
Purchased directly from other dairies	4.6	(1.6)	5.4	(1.1)	4.2	(1.2)	4.6	(0.8)
Purchased from a dealer	0.7	(0.4)	2.2	(0.6)	3.9	(1.0)	2.7	(0.5)
Purchased from auction markets	3.7	(1.4)	0.7	(0.3)	3.4	(1.9)	2.7	(1.0)
Purchased from other source	0.3	(0.2)	0.7	(0.5)	0.2	(0.1)	0.4	(0.1)
Total	100.0		100.0		100.0		100.0	

Percentage of Cow Replacements that Entered the Milking Herd During the Previous 12 Months, by Source and by Herd Size



There were no regional differences in source of cow replacements.

d. Percentage of cow replacements that entered the milking herd during the previous 12 months, by source and by region:

	Percent Cow Replacements			
	Region			
	West		**East**	
Source of Cow Replacements	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Born and raised on the operation	50.6	(7.4)	64.3	(3.1)
Born on operation and raised by off-site heifer grower	40.4	(7.1)	24.3	(2.8)
Purchased directly from other dairies	2.3	(1.2)	6.2	(1.0)
Purchased from a dealer	2.2	(0.7)	3.1	(0.7)
Purchased from auction markets	4.2	(2.4)	1.7	(0.6)
Purchased from other source	0.3	(0.2)	0.4	(0.2)
Total	100.0		100.0	

2. Replacement shipments

The number of shipments of cow replacements from off-site heifer growers to the operation increased as herd size increased. During the previous 12 months, large operations received an average of 55.9 shipments from off-site heifer growers compared with an average of 5.5 shipments for small operations.

a. Operation average number of shipments by source of cow replacements during the previous 12 months, and by herd size:

Operation Average Number of Shipments

	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Source of Cow Replacements	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
Born on operation and raised by off-site heifer grower	5.5	(1.6)	11.1	(1.3)	55.9	(16.2)	20.9	(5.1)
Purchased directly from other dairies	1.5	(0.2)	2.3	(0.3)	5.3	(1.0)	2.1	(0.2)
Purchased from a dealer	1.4	(0.3)	2.9	(0.5)	6.0	(1.0)	3.3	(0.5)
Purchased from auction markets	3.0	(1.0)	2.0	(0.7)	28.3	(17.1)	7.8	(3.9)
Purchased from other source	4.0	(0.0)	3.0	(1.1)	2.8	(0.8)	3.3	(0.5)
All sources	2.6	(0.6)	6.0	(0.8)	48.1	(12.3)	9.7	(1.9)

Photo courtesy of Peggy Greb, Agricultural Research Service

Operations in the West region had more shipments from off-site heifer growers during the previous 12 months (65.8) compared to operations in the East region (10.9). Shipments from other sources were similar for both the West and East regions. Although the average number of shipments from auction markets was higher in the West region than in the East region, the standard error for the West region is large and suggests variability in the number of shipments among operations in the West region.

b. Operations average number of shipments by source of cow replacements during the previous 12 months, and by region:

	Operation Average Number of Shipments			
	Region			
	West		**East**	
Source of Cow Replacement	**Average**	**Std. Error**	**Average**	**Std. Error**
Born on operation and raised by off-site heifer grower	65.8	(24.0)	10.9	(1.3)
Purchased directly from other dairies	5.9	(1.8)	1.9	(0.2)
Purchased from a dealer	5.5	(1.1)	2.7	(0.4)
Purchased from auction markets	28.3	(17.3)	2.9	(0.9)
Purchased from other source	3.7	(1.3)	3.2	(0.6)
All sources	45.5	(14.4)	5.0	(0.5)

C. Disease Confirmation

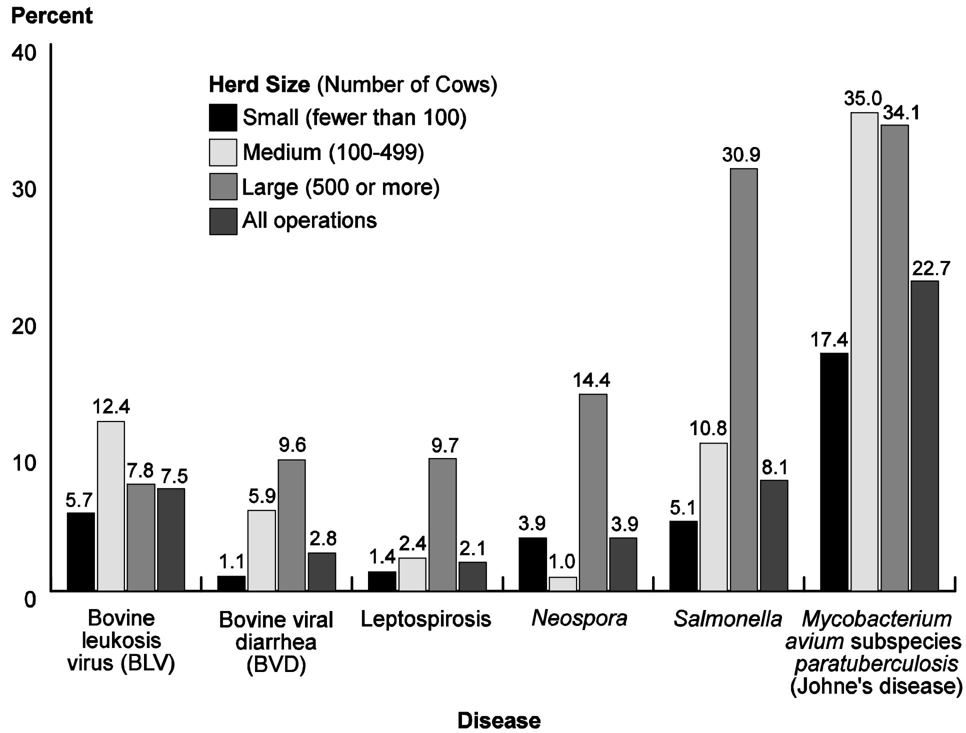
1. Laboratory testing

Laboratory testing is essential in determining the cause of many diseases and allows the implementation of appropriate preventive or control measures. More than 20 percent of operations (22.7 percent) reported that Johne's disease was confirmed via laboratory testing during the previous 12 months. A lower percentage of small operations received a laboratory diagnosis for Johne's disease (17.4 percent) compared with medium and large operations (35.0 and 34.1 percent, respectively). Less than 10 percent of all operations reported a laboratory confirmation for the other listed diseases. *Neospora* and *Salmonella* were more frequently diagnosed on large operations via laboratory testing than on medium and small operations.

a. Percentage of operations in which the following diseases in cattle on the operation were confirmed via laboratory testing during the previous 12 months, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Disease	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Bovine leukosis virus (BLV)	5.7	(1.9)	12.4	(2.9)	7.8	(2.9)	7.5	(1.5)
Bovine viral diarrhea (BVD)	1.1	(0.7)	5.9	(2.0)	9.6	(3.3)	2.8	(0.7)
Leptospirosis	1.4	(0.8)	2.4	(1.1)	9.7	(3.8)	2.1	(0.7)
Neospora	3.9	(1.6)	1.0	(0.6)	14.4	(4.4)	3.9	(1.1)
Salmonella	5.1	(1.8)	10.8	(2.3)	30.9	(5.9)	8.1	(1.4)
Mycobacterium avium subspecies *paratuberculosis* (Johne's disease)	17.4	(3.0)	35.0	(3.9)	34.1	(4.8)	22.7	(2.3)

Percentage of Operations in which the Following Diseases in Cattle on the Operation were Confirmed Via Laboratory Testing During the Previous 12 Months, by Herd Size



During the previous 12 months, a higher percentage of operations in the East region received a laboratory confirmation of Johne's disease (23.6 percent) than in the West region (12.8 percent). There were no differences by region in the percentages of operations reporting laboratory confirmation for the other listed diseases.

b. Percentage of operations in which the following diseases in cattle on the operation were confirmed via laboratory testing during the previous 12 months, by region:

	Percent Operations			
	Region			
	West		**East**	
Disease	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Bovine leukosis virus (BLV)	4.3	(2.0)	7.8	(1.7)
Bovine viral diarrhea (BVD)	5.3	(2.3)	2.5	(0.7)
Leptospirosis	5.2	(2.4)	1.9	(0.7)
Neospora	10.8	(3.5)	3.2	(1.2)
Salmonella	17.2	(4.2)	7.3	(1.5)
Mycobacterium avium subspecies *paratuberculosis* (Johne's disease)	12.8	(3.2)	23.6	(2.5)

BLV was most frequently diagnosed via blood samples (88.5 percent of operations). Blood, ear notches, tissues at necropsy, and aborted fetuses were the most frequently used samples for diagnosing BVD. Leptospirosis and Johne's disease were most frequently diagnosed via blood samples (69.6 and 70.3 percent, respectively). *Neospora* was confirmed using aborted fetuses, blood, and tissues at necropsy. *Salmonella* was most frequently confirmed using fecal samples (49.3 percent).

c. For operations in which disease was confirmed via laboratory testing, percentage of operations by diagnostic samples used to confirm disease, and by confirmed disease:

	Percent Operations											
	Confirmed Disease											
	Bovine Leukosis Virus (BLV)		Bovine Viral Diarrhea (BVD)		Lepto-spirosis		*Neospora*		*Salmonella*		Johne's disease	
Diagnostic Sample	**Pct.**	**Std. Err.**	**Pct.**	**Std. Err.**	**Pct.**	**Std. Err.**	**Pct.**	**Std. Err.**	**Pct.**	**Std. Err.**	**Pct.**	**Std. Err.**
Aborted fetus			13.9	(6.7)	22.8	(11.2)	59.0	(14.2)	7.9	(4.9)		
Blood	88.5	(4.8)	47.5	(12.9)	69.6	(12.5)	40.6	(14.2)	16.9	(5.5)	70.3	(5.3)
Ear notch			41.3	(12.5)								
Feces			7.5	(4.4)					49.3	(9.1)	36.4	(5.5)
Milk			0.6	(0.4)					20.0	(9.9)	12.4	(3.5)
Tissues at necropsy	6.3	(3.5)	15.7	(7.9)	10.3	(7.4)	18.5	(10.1)	15.4	(4.7)	0.1	(0.1)
Urine					8.8	(5.4)						
Other	15.5	(6.3)	3.0	(2.9)	0.0	(--)	9.0	(8.5)	5.0	(4.2)	1.7	(1.6)

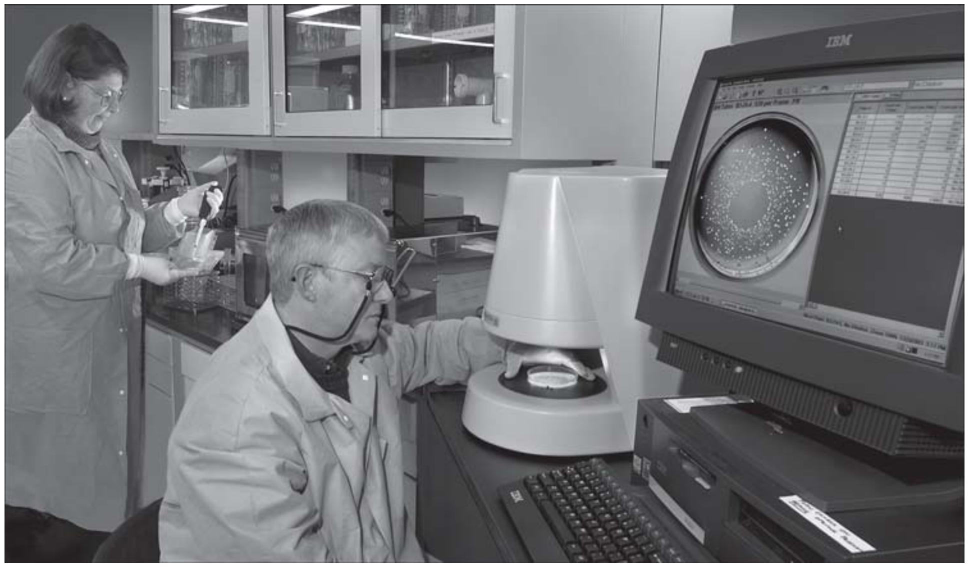


Photo courtesy of Paul Pierlott, Agricultural Research Service

2. Abortions

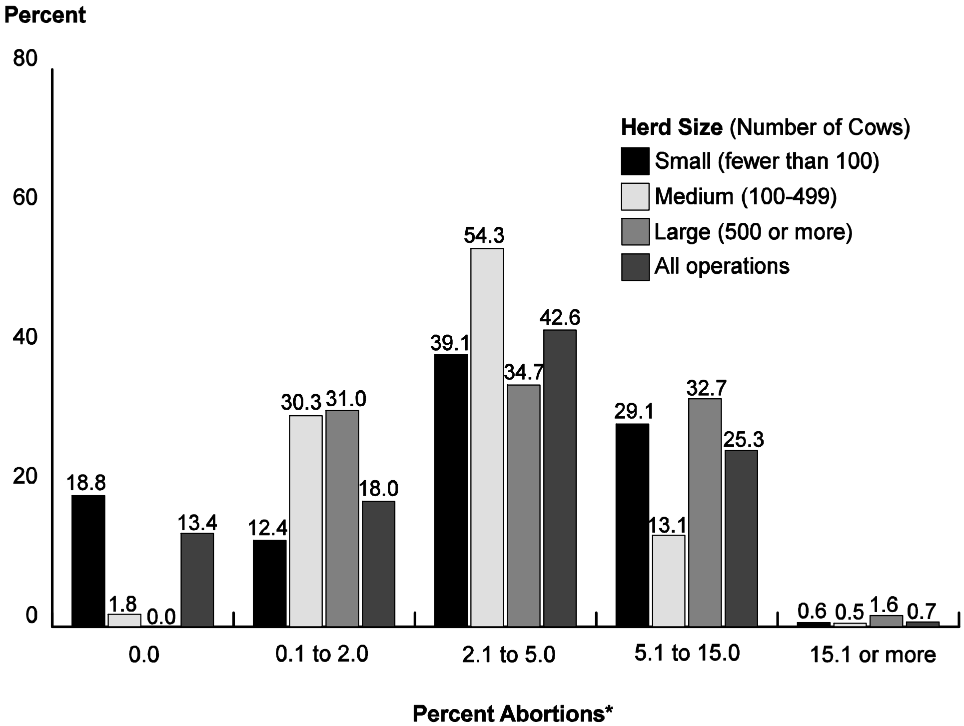
Abortion generally describes the expulsion of a dead fetus at 45 to 265 days of gestation. A goal is to have less than 2 percent of cows and heifers abort each year, although up to 5 percent is considered normal. Across herd sizes, approximately 30 percent of operations reported that 2 percent or less of cows aborted (as a percentage of cow inventory). Few operations (0.7 percent) reported that more than 15.1 percent of cows aborted. No operations had more than 25 percent of cows abort.

a. Percentage of operations by percentage of abortions during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Percent Abortions*	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
0.0	18.8	(3.1)	1.8	(1.0)	0.0	(--)	13.4	(2.2)
0.1 to 2.0	12.4	(2.3)	30.3	(3.8)	31.0	(4.9)	18.0	(1.9)
2.1 to 5.0	39.1	(3.8)	54.3	(4.2)	34.7	(5.5)	42.6	(2.9)
5.1 to 15.0	29.1	(3.6)	13.1	(2.9)	32.7	(5.1)	25.3	(2.6)
15.1 or more	0.6	(0.5)	0.5	(0.5)	1.6	(1.5)	0.7	(0.4)
Total	100.0		100.0		100.0		100.0	

*As a percentage of cow inventory at time of interview.

Percentage of Operations by Percentage of Abortions During the Previous 12 Months, and by Herd Size



*As a percentage of cow inventory on day of interview.

Almost 9 of 10 operations (86.6 percent) had at least one cow or heifer abort during the previous 12 months.

b. Percentage of operations that had any abortions:

Percent Operations	Standard Error
86.6	(2.2)

Determining the cause of abortion can be difficult. In many cases, the event that caused the fetus to die occurs days to weeks before the actual abortion. Frequently, the cause of an abortion is no longer detectable, or the fetus is too decomposed to evaluate or never found at all. Generally, a diagnosis is determined in less than 40 percent of samples from abortions submitted to diagnostic laboratories. To improve the chances of diagnosing the cause of abortion, a detailed history and the proper diagnostic specimens should be submitted to the laboratory. Specific samples recommended for submission include sera from the dam, the entire fetus, or specific tissues and placenta. Approximately one of eight operations (12.4 percent) submitted samples to determine the cause of abortion.

c. For operations that had any abortions, percentage of operations that submitted any samples for diagnosis:

Percent Operations	Standard Error
12.4	(1.7)

For operations that submitted samples, 70.2 percent submitted serum from the dam and 32.7 percent submitted the placenta.

d. For operations that submitted samples to determine cause of abortion, percentage of operations by type of sample:

Sample Type	Percent Operations	Standard Error
Placenta	32.7	(6.9)
Entire fetus	53.8	(7.6)
Serum of dam	70.2	(6.6)
Other	4.0	(3.2)

Of the total abortions reported, the placenta was submitted for testing for 1.3 percent of abortions. The entire fetus was submitted for 1.7 percent of abortions, and serum from the dam experiencing the abortion was submitted for 3.1 percent of abortions.

e. For operations that had at least one abortion during the previous 12 months, percentage of abortions by type of sample submitted for laboratory diagnosis:

Sample Type	Percent Abortions Submitted	Standard Error
Placenta	1.3	(0.3)
Entire fetus	1.7	(0.3)
Serum of dam	3.1	(0.6)
Other	0.1	(0.1)

The majority of operations that had any abortions but did not submit samples for diagnosis (69.6 percent) did not perceive abortion as a problem on their operations.

f. For any aborted fetuses that were not submitted for diagnosis, percentage of operations by reason for not submitting fetus:

Reason	Percent Operations	Standard Error
Cost	2.5	(1.0)
Lack of information obtained from previous abortion submissions	6.6	(1.3)
Inconvenience	7.0	(1.7)
Abortion not perceived as a problem on the operation	69.6	(2.7)
Other	14.3	(2.0)
Total	100.0	

Although only 12.4 percent of operations that had abortions submitted samples for diagnosis, more than 8 of 10 operations (82.0 percent) would submit aborted fetuses for diagnosis if testing was performed at no cost, and 48.5 percent of aborted fetuses would be submitted for diagnosis.

g. Percentage of operations that would submit aborted fetuses to a diagnostic laboratory if testing was performed at no cost, and percentage of aborted fetuses that would be submitted:

Percent Operations	Standard Error	Operation Average Percent Aborted Fetuses	Standard Error
82.0	(2.3)	48.5	(4.9)

D. General Management

1. Primary outside access areas

Operations most frequently allowed lactating cows access to pasture (50.9 percent of operations) during summer. No outside access was allowed on 13.1 percent of operations in summer. In winter, the highest percentages of operations allowed lactating cows access to a concrete alley way or pen, dry lot, or allowed no outside access (35.0, 28.9, and 25.2 percent, respectively).

a. Percentage of operations by primary outside area that ***lactating*** cows had routine access to during summer and winter:

	Percent Operations			
	Summer		Winter	
Primary Outside Area	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Pasture	50.9	(2.7)	9.4	(1.5)
Concrete alleyway or pen	12.8	(1.6)	35.0	(2.8)
Dry lot	20.8	(2.2)	28.9	(2.7)
Other	2.4	(0.8)	1.5	(0.6)
None	13.1	(1.7)	25.2	(2.3)
Total	100.0		100.0	

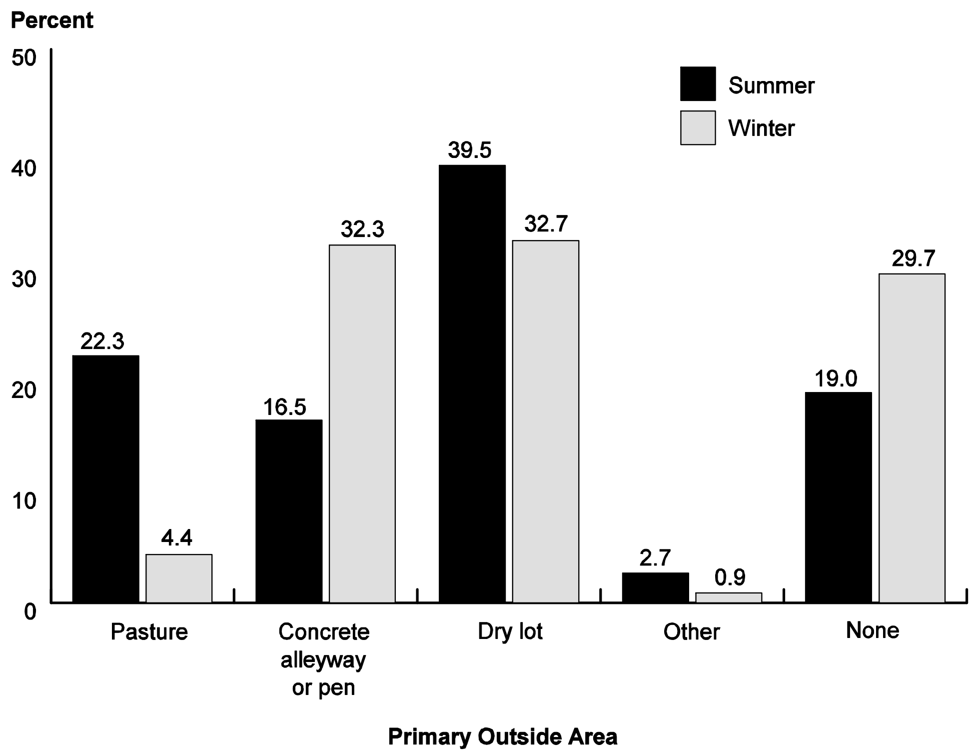
During summer, 39.5 percent of lactating cows were on operations in which the primary outside area was a dry lot, 22.3 percent were on operations in which the primary outside area was pasture, and 19.0 percent were on operations with no outside access. In winter, similar percentages of lactating cows were on operations in which primary outside access was a concrete alleyway or pen, dry lot, or allowed no outside access (32.3, 32.7, and 29.7 percent, respectively).

b. Percentage of cow inventory by primary outside area that ***lactating*** cows had routine access to during summer and winter:*

	Percent Cows			
	Summer		Winter	
Primary Outside Area	Percent	Std. Error	Percent	Std. Error
Pasture	22.3	(1.6)	4.4	(0.7)
Concrete alleyway or pen	16.5	(2.1)	32.3	(3.3)
Dry lot	39.5	(3.0)	32.7	(3.5)
Other	2.7	(1.4)	0.9	(0.3)
None	19.0	(2.0)	29.7	(2.9)
Total	100.0		100.0	

*It was presumed that all lactating cows had access to the operation's primary outside area.

Percentage of Cow Inventory by Primary Outside Area that *Lactating* Cows had Routine Access to During Summer and Winter*



*It was presumed that all lactating cows had access to the operation's primary outside area

The majority of operations (67.2 percent) allowed dry cows access to pasture during summer. In winter, operations allowed access to pasture, concrete alleyway or pen, dry lot, or allowed no outside access (18.4, 24.1, 34.2, and 18.5 percent, respectively).

c. Percentage of operations by primary outside area that ***dry*** cows had routine access to during summer and winter:

	Percent Operations			
	Summer		Winter	
Primary Outside Area	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Pasture	67.2	(2.5)	18.4	(2.2)
Concrete alleyway or pen	5.7	(1.1)	24.1	(2.4)
Dry lot	18.5	(2.0)	34.2	(2.7)
Other	2.1	(0.8)	4.8	(1.3)
None	6.5	(1.2)	18.5	(2.1)
Total	100.0		100.0	

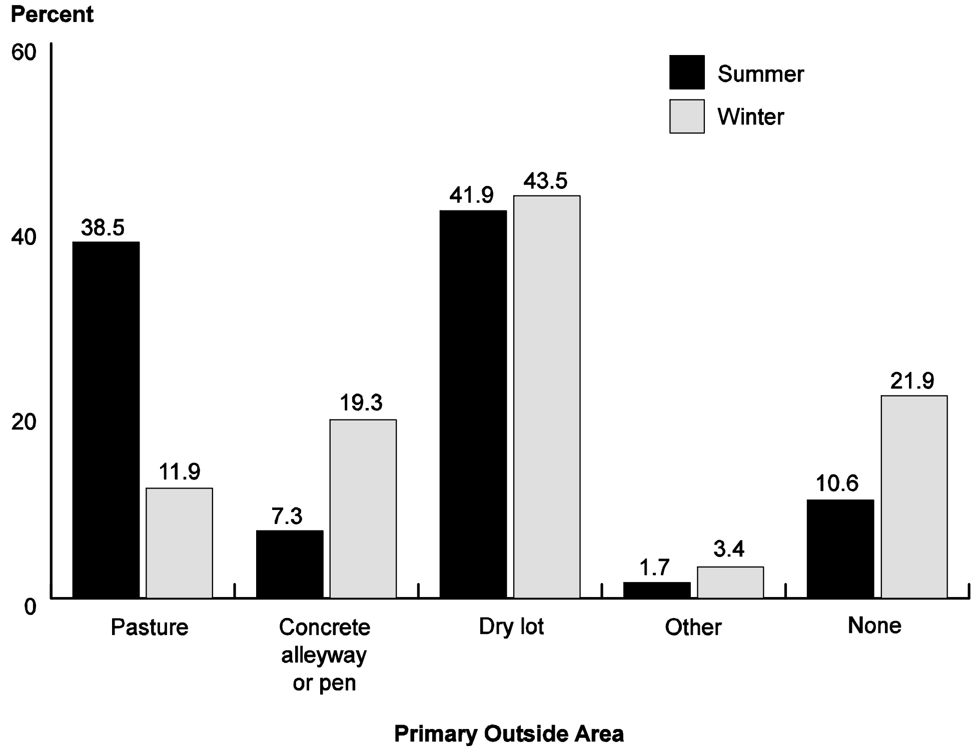
The majority of dry cows were on operations in which pasture (38.5 percent) or dry lot (41.9 percent) were the primary outside access during summer. Dry lot was the most common outside access for dry cows in winter (43.5 percent).

d. Percentage of cow inventory by primary outside area that ***dry*** cows had routine access to during summer and winter:

	Percent Cows			
	Summer		Winter	
Primary Outside Area	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Pasture	38.5	(2.4)	11.9	(1.5)
Concrete alleyway or pen	7.3	(1.3)	19.3	(2.3)
Dry lot	41.9	(2.6)	43.5	(3.2)
Other	1.7	(0.5)	3.4	(0.8)
None	10.6	(1.7)	21.9	(2.5)
Total	100.0		100.0	

*It was presumed that all dry cows had access to the operation's primary outside area.

Percentage of Cow Inventory by Primary Outside Area that *Dry* Cows had Routine Access to During Summer and Winter*



*It was presumed that all dry cows had access to the operation's primary outside area.

2. Flooring type

Flooring surfaces are important to cow health and longevity. When given an option, cows select flooring that compresses and provides cushion, such as rubber mats, pasture, or dirt. Concrete flooring is associated with increased lameness, injuries, and decreased expression of estrus. On approximately half of operations (51.1 percent), flooring for lactating cows was predominately concrete, representing 55.6 percent of cows. Pasture was the predominant flooring on 10.1 percent of operations but for only 5.1 percent of cows. Dirt was the predominate flooring on 5.4 percent of operations, representing 20.0 percent of cows, which probably reflects the use of dry lots on large operations.

a. Percentage of operations (and percentage of cows on these operations) by predominant flooring type that lactating cows stood or walked on when not being milked:

Flooring Type	Percent Operations	Standard Error	Percent Cows	Standard Error
Concrete–grooved/textured	34.3	(2.4)	48.7	(3.5)
Concrete–slatted	1.3	(0.5)	1.1	(0.5)
Concrete–smooth	15.5	(2.3)	5.8	(0.8)
Rubber mats over concrete	22.9	(2.5)	13.9	(2.2)
Pasture	10.1	(1.7)	5.1	(0.9)
Dirt	5.4	(1.1)	20.0	(3.5)
Other	10.5	(1.8)	5.4	(1.1)
Total	100.0		100.0	

Photo courtesy of Judy Rodriguez

For operations with concrete flooring, the use of rubber belting or a similar material in cow areas reduces the amount of time cows spend on concrete and may decrease lameness and injuries as well as increase time spent at the feed bunk. Any rubber belting was present on 21.2 percent of operations and was accessible to 44.4 percent of cows.

b. For operations that used parlors and in which concrete was the predominant flooring, percentage of operations (and percentage of cows on these operations) that had rubber belting or similar flooring, by location of rubber belting:

Location	Percent Operations	Standard Error	Percent Cows	Standard Error
Immediately in front of feed bunk	11.9	(2.3)	29.2	(5.1)
Walkway to parlor	6.2	(1.4)	18.9	(4.7)
Holding pen	8.1	(1.9)	14.2	(3.1)
Other	7.5	(1.7)	11.1	(1.8)
Any	21.2	(2.8)	44.4	(4.8)

3. Surface moisture

Wet flooring can be detrimental to hoof health. Cows on wet surfaces have increased hoof horn moisture and are more prone to infectious hoof diseases. The ground or flooring surface for lactating cows was usually dry on 60.3 percent of operations during summer and 49.5 percent in winter. Lactating cows usually stood in water or slurry on less than 1 percent of operations (0.6 percent).

Percentage of operations by category that best characterizes the surface moisture of the ground or flooring that lactating cows stood on most during summer and winter:

	Percent Operations			
	Summer		Winter	
Flooring Surface Moisture	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Usually dry	60.3	(2.7)	49.5	(2.6)
Wet about half the time	22.8	(2.4)	21.8	(2.2)
Almost always wet, but no standing water	16.3	(1.7)	28.1	(2.1)
Usually standing water or slurry	0.6	(0.3)	0.6	(0.3)
Total	100.0		100.0	

4. Barn type

The type of freestall barn affects ventilation, feedbunk space, and square footage per cow. Two- and four-row barns require less wind to properly ventilate and provide more feedbunk space per cow and more square footage per cow than three- or six-row barns. Approximately 8 of 10 large and medium operations (83.2 and 81.9 and percent, respectively) housed cows in freestalls, compared with about 3 of 10 small operations (27.2 percent). Less than half of all operations (44.3 percent) housed cows in freestall barns.

a. Percentage of operations that used freestall barns:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
27.2	(3.0)	81.9	(3.2)	83.2	(4.2)	44.3	(2.5)

Two-row freestall barns were the predominant setup for small and large freestall operations (48.1 and 49.5 percent, respectively). The percentage of operations with six-row barns increased as herd size increased.

b. For operations that used covered freestall barns to house lactating cows, percentage of operations by type of barn setup that housed the majority of cows, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Freestall Barn Setup	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Two-row	48.1	(6.6)	19.5	(3.5)	49.5	(5.3)	35.2	(3.4)
Three-row	20.7	(5.7)	22.2	(3.8)	8.3	(3.3)	19.9	(3.0)
Four-row	22.7	(5.0)	31.7	(4.4)	22.2	(4.8)	26.7	(3.0)
Six-row	1.1	(0.8)	17.9	(3.7)	19.8	(3.4)	11.0	(1.9)
Other	7.4	(3.7)	8.7	(2.6)	0.2	(0.1)	7.2	(2.0)
Total	100.0		100.0		100.0		100.0	

5. Heat abatement

Using methods to cool cows, such as shade, water sprinklers, or increased air circulation is important during summer in almost all areas of the United States. Heat has many deleterious effects on dairy cattle, including decreased feed intake and milk production, reduced estrous behavior, altered formation and ovulation of follicles, and increased susceptibility to mastitis. In most areas of the United States, a combination of sprinklers and fans is recommended. Fans were the most common method of heat abatement provided on small and medium operations (74.3 and 77.7 of operations, respectively), while a similar percentage of large operations provided shade, sprinklers or misters, or fans (55.6, 61.6, and 61.0 percent, respectively). Overall, 94.0 percent of operations provided some form of heat abatement for lactating cows.

a. Percentage of operations that provided heat abatement during summer for ***lactating*** cows, by herd size:

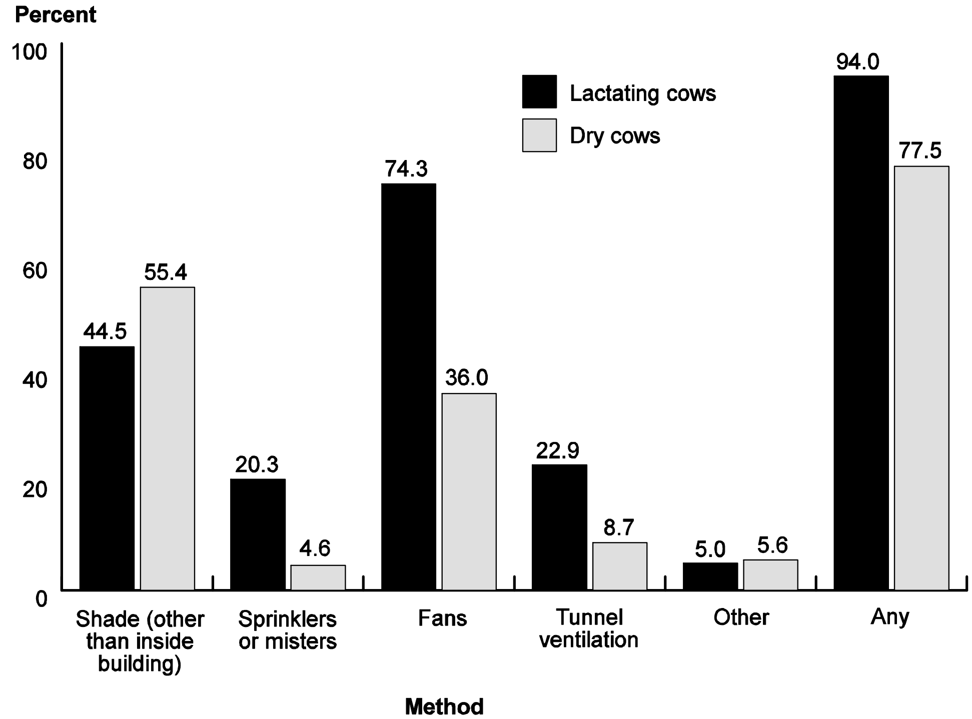
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Shade (other than inside building)	49.2	(3.8)	28.7	(3.4)	55.6	(5.6)	44.5	(2.8)
Sprinklers or misters	12.0	(2.4)	32.9	(3.7)	61.6	(5.8)	20.3	(1.9)
Fans	74.3	(3.2)	77.7	(3.3)	61.0	(5.3)	74.3	(2.4)
Tunnel ventilation	28.3	(3.6)	12.7	(3.0)	3.8	(2.2)	22.9	(2.6)
Other	4.9	(1.8)	6.1	(2.3)	2.5	(1.6)	5.0	(1.3)
Any	96.3	(1.2)	89.1	(2.7)	88.5	(3.7)	94.0	(1.1)

Dry cows were most frequently provided shade on small and large operations (61.0 and 49.8 percent of operations, respectively). Shade and fans were the most common heat abatement methods for dry cows on medium operations (41.0 and 37.8 percent of operations, respectively). More than three of four operations (77.5 percent) provided some method of heat abatement for dry cows.

b. Percentage of operations that provided heat abatement during summer for ***dry*** cows, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Shade (other than inside building)	61.0	(3.6)	41.0	(3.9)	49.8	(5.4)	55.4	(2.7)
Sprinklers or misters	3.8	(1.6)	3.8	(1.7)	16.2	(4.5)	4.6	(1.2)
Fans	36.2	(3.8)	37.8	(4.0)	27.2	(4.3)	36.0	(2.8)
Tunnel ventilation	11.8	(2.7)	1.7	(0.9)	2.0	(1.3)	8.7	(1.9)
Other	6.3	(2.0)	4.7	(2.1)	1.8	(1.6)	5.6	(1.5)
Any	81.4	(2.8)	68.9	(3.9)	69.2	(5.9)	77.5	(2.2)

Percentage of Operations that Provided Heat Abatement During Summer for Lactating and Dry Cows



6. Bedding types

The ideal bedding for lactating cows is dry and clean, provides cushion, and does not support bacterial growth. Sand has these characteristics and is one of the best bedding options for cows, although sand can lead to excessive wear of manure-handling equipment. Straw and/or hay were used on 54.1 percent of operations, representing 33.4 percent of cows. Sawdust/wood products and rubber mats were used on similar percentages of operations (35.0 and 30.2 percent, respectively), although sawdust/wood products were used for a higher percentage of cows (31.2 percent) than were rubber mats (18.5 percent). Sand was used on 21.9 percent of operations and for 30.3 percent of cows.

Straw and/or hay was used as bedding for dry cows by more than 6 of 10 operations (62.2 percent), representing 47.2 percent of cows. Most operations (92.5 percent) provided bedding to dry cows, and most dry cows (92.7 percent) had access to bedding.

a. Percentage of operations (and percentage of cows on these operations) by type of bedding used for ***lactating*** and ***dry*** cows during the previous 90 days:

	Percent Operations				Percent Cows			
	Lactating Cows		Dry Cows		Lactating Cows		Dry Cows	
Bedding Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Straw and/or hay	54.1	(2.7)	62.2	(2.7)	33.4	(2.8)	47.2	(3.2)
Sand	21.9	(2.0)	14.4	(1.7)	30.3	(2.6)	19.0	(2.0)
Sawdust/wood products	35.0	(2.6)	25.2	(2.3)	31.2	(2.8)	28.2	(2.6)
Composted/dried manure	3.9	(0.5)	4.8	(0.8)	24.2	(2.6)	23.5	(2.9)
Rubber mats	30.2	(2.7)	15.2	(2.2)	18.5	(2.1)	11.8	(2.3)
Rubber tires	1.6	(0.6)	1.0	(0.5)	1.1	(0.4)	0.7	(0.3)
Shredded newspaper	5.2	(1.2)	3.6	(1.1)	3.1	(0.7)	2.5	(0.8)
Mattresses	23.7	(2.4)	10.6	(1.8)	20.1	(1.9)	9.5	(1.4)
Corn cobs and stalks	11.0	(1.9)	18.5	(2.2)	5.7	(1.0)	10.7	(1.3)
Waterbeds	1.7	(0.8)	0.3	(0.3)	2.3	(1.0)	0.4	(0.3)
Other	11.7	(1.9)	9.5	(1.7)	13.3	(2.5)	12.4	(2.5)
Any	97.0	(0.8)	92.5	(1.4)	94.9	(1.9)	92.7	(1.9)

Photo courtesy of Judy Rodriguez

The primary bedding types used in the last 90 days for lactating and dry cows were straw and/or hay, sand, sawdust/wood products, or composted/dried manure. Composed/dried manure was used on less than 5 percent of operations but represented almost 25 percent of cows, suggesting that primarily large operations were using this bedding type.

b. For operations that used bedding during the previous 90 days, percentage of operations (and percentage of cows on these operations) by bedding type primarily used for ***lactating*** and ***dry*** cows:

	Percent Operations				Percent Cows			
	Lactating Cows		Dry Cows		Lactating Cows		Dry Cows	
Bedding Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Straw and/or hay	37.3	(2.9)	43.1	(3.0)	21.1	(2.6)	27.3	(2.6)
Sand	18.0	(2.0)	13.2	(1.8)	25.8	(2.7)	17.5	(2.1)
Sawdust/wood products	21.1	(2.2)	15.9	(2.1)	16.4	(1.7)	15.6	(2.3)
Composted/dried manure	3.8	(0.5)	4.0	(0.7)	24.9	(2.5)	23.7	(3.0)
Rubber mats	1.7	(0.7)	2.3	(1.0)	0.8	(0.4)	1.8	(0.9)
Rubber tires	0.0	(--)	0.0	(--)	0.0	(--)	0.0	(--)
Shredded newspaper	1.0	(0.4)	1.0	(0.8)	0.5	(0.2)	0.4	(0.3)
Mattresses	5.6	(1.6)	3.8	(1.5)	2.6	(0.7)	1.8	(0.6)
Corn cobs and stalks	2.7	(1.1)	9.3	(1.6)	1.1	(0.4)	5.1	(0.9)
Waterbeds	0.6	(0.4)	0.4	(0.3)	1.2	(0.8)	0.3	(0.3)
Other	8.2	(1.6)	7.0	(1.6)	5.6	(1.3)	6.5	(1.7)
Total	100.0		100.0		100.0		100.0	

7. Feedstuffs

Dairy operations use a variety of feedstuffs based on factors such as nutrient content, availability, and cost. More than half of operations fed lactating or dry cows alfalfa hay/haylage, corn silage, whole soybeans or soybean meal, or corn.

Percentage of operations by type of feedstuff fed to ***lactating*** and ***dry*** cows during the previous 90 days:

	Percent Operations			
	Cow Type			
	Lactating		Dry	
Feedstuffs	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Alfalfa hay/haylage	92.3	(1.6)	75.9	(2.3)
Corn silage	87.6	(1.8)	80.4	(2.3)
Clover as forage or pasture	23.1	(2.4)	24.1	(2.4)
Whole cottonseed	33.0	(2.5)	8.0	(1.5)
Cottonseed meal or hulls	9.3	(1.5)	3.4	(1.0)
Whole soybeans or soybean meal	84.4	(2.1)	45.7	(2.8)
Bakery byproducts	6.6	(1.0)	1.9	(0.6)
Brewery byproducts	37.1	(2.7)	19.7	(2.3)
Corn	94.2	(1.4)	67.1	(2.7)
Barley	14.1	(1.9)	8.6	(1.6)
Wheat (not silage)	6.7	(1.1)	5.0	(1.0)
Oats (not silage)	17.5	(2.4)	20.4	(2.5)
Green chop	4.9	(1.4)	3.4	(1.1)
Feather/poultry meal	3.2	(0.7)	1.0	(0.3)
Fish meal	4.4	(0.9)	0.8	(0.4)
Fat/tallow	32.7	(2.5)	7.9	(1.4)
Porcine meat and bone meal	8.3	(1.3)	0.8	(0.4)
Blood meal	13.2	(1.7)	2.8	(0.7)

8. Feedline and feeding practices

The configuration of the feedline can impact the feeding behavior of dairy cattle. An increased amount of feedbunk space per cow as well as some form of physical separation between cows—such as the use of headlocks—reduce competition and have the greatest positive impact on subordinate cows. The most common feedline for small operations was a tie stall (46.2 percent of operations) while post and rail was the single most common feedline on medium operations (37.1 percent of operations). The majority of large operations (79.6 percent) used headlocks at the feedline.

a. Percentage of operations by feedline used for the majority of lactating cows, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Feedline	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall	46.2	(3.8)	9.2	(2.8)	0.0	(--)	34.1	(2.8)
Stanchion	14.2	(2.8)	3.9	(1.5)	0.0	(--)	10.7	(1.9)
Post and rail	11.3	(2.2)	37.1	(4.0)	15.7	(4.1)	18.0	(1.9)
Headlocks	3.8	(1.2)	22.2	(3.2)	79.6	(4.7)	13.2	(1.3)
Elevated feed bunk in pen	17.8	(2.7)	20.3	(3.2)	0.1	(0.1)	17.3	(2.0)
Other	6.7	(1.8)	7.3	(2.0)	4.6	(2.5)	6.7	(1.3)
Total	100.0		100.0		100.0		100.0	

Photo courtesy of Judy Rodriguez

Feeding cows based on production or state of lactation can decrease feed costs while providing optimal nutrition. Some operations are limited in their ability to provide separate rations due to facilities or cost constraints. The majority of small and medium operations fed lactating cows the same ration (65.6 and 62.2 percent of operations, respectively), while large operations most frequently fed individuals or groups based on production or stage of lactation (70.5 percent of operations).

b. Percentage of operations by feeding practice used to feed lactating cows, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Feeding Practice	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Feed all cows the same ration	65.6	(3.7)	62.2	(4.0)	27.2	(4.6)	62.3	(2.7)
Feed individuals or groups based on production/stage of lactation	32.9	(3.6)	34.0	(4.0)	70.5	(4.5)	35.6	(2.7)
Feed individuals or groups based on lactation number	1.5	(0.8)	1.6	(0.7)	2.2	(1.2)	1.6	(0.6)
Feed individuals or groups based on criteria other than production/stage of lactation or lactation number	0.0	(--)	2.2	(1.1)	0.1	(0.1)	0.5	(0.3)
Total	100.0		100.0		100.0		100.0	

A higher percentage of operations in the West region (52.9 percent) fed individual cows or groups of cows based on production or stage of lactation compared with operations in the East region (33.9 percent). A higher percentage of operations in the East region (63.8 percent) fed all cows the same ration compared with operations in the West region (45.8 percent).

c. Percentage of operations by feeding practice used to feed lactating cows, and by region:

	Percent Operations			
	Region			
	West		East	
Feeding Practice	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Feed all cows the same ration	45.8	(4.7)	63.8	(2.9)
Feed individuals or groups based on production/stage of lactation	52.9	(4.6)	33.9	(2.9)
Feed individuals or groups based on lactation number	0.8	(0.8)	1.7	(0.7)
Feed individuals or groups based on criteria other than production/stage of lactation or lactation number	0.5	(0.5)	0.6	(0.3)
Total	100.0		100.0	

Feeding anionic salts reduces the incidence of milk fever, although accurate delivery and palatability are issues associated with feeding anionic salts. Since heifers are at very low risk for milk fever, feeding them anionic salts is generally not recommended. The percentage of operations feeding anionic salts to close-up cows increased as herd size increased. A lower percentage of operations fed anionic salts to springing heifers compared to close-up cows (15.7 and 22.9 percent, respectively). A lower percentage of small operations (11.1 percent) fed anionic salts to heifers compared with medium and large operations (23.1 and 36.1 percent, respectively).

d. Percentage of operations that fed anionic salts (e.g., BioChlor™, SoyChlor®, ammonium chloride, etc.) to prevent milk fever, by cattle class and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Close-up cows[1]	16.7	(2.8)	31.4	(3.8)	56.7	(5.5)	22.9	(2.2)
Springing heifers[2]	11.1	(2.4)	23.1	(3.3)	36.1	(5.7)	15.7	(1.9)

[1]Cows 2 to 4 weeks prior to calving.
[2]Springing heifers 2 to 4 weeks prior to calving.

A higher percentage of operations in the West region fed anionic salts to close-up cows or springing heifers compared with operations in the East region.

e. Percentage of operations that fed anionic salts (e.g., BioChlor, SoyChlor, ammonium chloride, etc.) to prevent milk fever, by cattle class and by region:

	Percent Operations			
	Region			
	West		East	
Cattle Class	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Close-up cows[1]	49.7	(5.2)	20.3	(2.4)
Springing heifers[2]	33.5	(5.2)	14.0	(2.0)

[1]Cows 2 to 4 weeks prior to calving.
[2]Springing heifers 2 to 4 weeks prior to calving.

Separating close-up cows makes it possible to change feeding strategies, such as increasing energy levels or adding anionic salts to the diet. The percentage of operations that separated close-up cows increased as herd size increased; 57.1 percent of all operations separated close-up cows from other dry cows.

f. Percentage of operations that separated close-up cows from other dry cows, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
47.1	(3.9)	74.9	(3.7)	96.0	(2.1)	57.1	(2.9)

Milk urea nitrogen (MUN) testing provides a measure of energy and protein balance in rations fed to cows. The majority of small operations (58.3 percent) never tested MUN, while 48.6 percent of medium operations tested it routinely. A similar percentage of large operations either tested MUN routinely, only tested if there was a problem, or never tested MUN. Half of operations (49.8 percent) tested MUN.

g. Percentage of operations by frequency of milk urea nitrogen testing to determine ration composition, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Frequency	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Used routinely	24.0	(3.0)	48.6	(4.2)	37.2	(5.7)	30.9	(2.4)
Use only if had a problem	17.7	(2.8)	20.6	(3.4)	24.8	(5.1)	18.9	(2.2)
Never used	58.3	(3.6)	30.8	(3.8)	38.0	(5.6)	50.2	(2.7)
Total	100.0		100.0		100.0		100.0	

9. Water sources

Water is one of the most important nutrients for cows. Lactating cows consume, either directly or in feed, between 20 and 35 gallons of water per day. In addition to providing clean water, cattle water sources should be easy to clean, readily accessible, and always available. The most common water source across all operation sizes was a water tank or trough (93.2 percent of operations).

a. Percentage of operations by source of drinking water for any cows during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Water Source	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Single cup/bowl waterer used by one cow only	13.3	(2.8)	8.6	(2.6)	2.4	(1.9)	11.4	(2.0)
Single cup/bowl waterer used by multiple cows	74.5	(3.1)	47.7	(4.2)	15.0	(4.4)	64.1	(2.4)
Water tank or trough (covered or uncovered)	91.8	(2.1)	97.4	(1.6)	92.9	(3.4)	93.2	(1.5)
Lake, pond, stream, river, etc.	37.2	(3.7)	29.2	(3.7)	8.7	(2.9)	33.4	(2.7)
Other source	4.4	(1.7)	3.5	(1.5)	0.6	(0.5)	3.9	(1.3)

Photo courtesy of Judy Rodriguez

A higher percentage of operations in the East region used single cup/bowl waterers used by one or multiple cows compared with operations in the West region.

b. Percentage of operations by source of drinking water for any cows during the previous 12 months, by region:

	Percent Operations			
	Region			
	West		East	
Water Source	Percent	Std. Error	Percent	Std. Error
Single cup/bowl waterer used by one cow only	2.2	(1.6)	12.3	(2.2)
Single cup/bowl waterer used by multiple cows	12.9	(3.5)	69.0	(2.6)
Water tank or trough (covered or uncovered)	94.8	(2.5)	93.1	(1.6)
Lake, pond, stream, river, etc.	21.7	(4.7)	34.6	(2.9)
Other source	2.1	(1.1)	4.1	(1.4)

Cleaning water sources may reduce cattle's exposure to pathogens such as *E. coli* and *Salmonella*. The average number of times per year that dairy operations cleaned water sources varied. About one of three operations cleaned single cup/bowl for one cow or water tank/trough 13 or more times per year. No cleaning was reported on 14.2 percent of operations using a single cup/bowl for one cow, 24.2 percent of operations using single cup/bowl for multiple cows, and 4.6 percent of operations using a water tank/trough.

c. Percentage of operations by average number of times per year water sources are drained ***and*** cleaned, by water source:

	Percent Operations					
	Water Source					
	Single Cup, One Cow		**Single Cup, Multiple Cows**		**Water Tank/ Trough**	
Number of Times	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
0	14.2	(7.3)	24.2	(3.9)	4.6	(1.4)
1 to 4	27.0	(10.4)	37.0	(4.3)	37.1	(3.2)
5 to 12	26.2	(10.4)	18.7	(3.4)	24.1	(2.8)
13 or more	32.6	(10.2)	20.1	(3.1)	34.2	(2.8)
Total	100.0		100.0		100.0	

Chlorinated water sources may reduce bacteria counts. Few operations (8.7 percent) reported using chlorinated water for cows. A higher percentage of medium operations (14.9 percent) used chlorinated water compared with small operations (6.0 percent).

d. Percentage of operations by whether usual water source for cows was chlorinated, and by herd size (table revised 3-12-09):

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Chlorinated Water	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Yes	6.0	(1.4)	14.9	(2.9)	13.8	(3.8)	8.7	(1.2)
Don't know	0.9	(0.7)	1.8	(1.0)	0.6	(0.3)	1.1	(0.5)
No	93.1	(1.5)	83.3	(3.0)	85.6	(3.8)	90.2	(1.3)
Total	100.0		100.0		100.0		100.0	

There were no differences by region in the percentages of operations in which cows drank chlorinated water.

e. Percentage of operations by whether usual water source for cows was chlorinated, and by region:

	Percent Operations			
	Region			
	West		**East**	
Chlorinated Water	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Yes	16.7	(4.0)	7.9	(1.3)
Don't know	0.4	(0.4)	1.2	(0.6)
No	82.9	(4.0)	90.9	(1.4)
Total	100.0		100.0	

NOTE: The estimates in tables a and b were calculated using data collected during Phase II of the study (see Methodology). Similar estimates were generated using data collected during Phase I of the study and are included on p 87 and 88 of Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007. The estimates from Phase I and Phase II are similar and within two standard errors of one another, even though they represent different 12-month periods.

10. Permanently removed cows

Cows are permanently removed from dairy operations for multiple reasons, including low productivity, clinical disease, and space issues. Excluding those that died, one of four cows (25.8 percent) were removed during the previous 12 months. There were no differences across herd sizes in the percentages of cows removed.

a. Percentage of cows permanently removed from the operation during the previous 12 months (excluding those that died), by herd size:

Percent Cows							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
25.2	(1.1)	24.8	(0.8)	26.7	(1.8)	25.8	(0.9)

The majority of operations that permanently removed cows (87.8 percent) sent cows to a market, auction, or stockyard. No differences were observed across herd sizes in the percentage of operations by destination of permanently removed cows.

b. Percentage of operations by destination for permanently removed cows during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Destination	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Another dairy	12.0	(2.4)	11.7	(2.6)	8.3	(3.4)	11.7	(1.8)
Market, auction, or stockyard	86.7	(2.7)	90.3	(2.1)	89.8	(3.6)	87.8	(2.0)
Packer or slaughter plant	23.2	(3.4)	26.2	(3.6)	41.1	(5.8)	25.0	(2.5)
Other	3.7	(1.5)	1.7	(0.7)	2.7	(1.9)	3.2	(1.1)

An average of 1.5 shipments per month was made to transport permanently removed cows to a market, auction, or stockyard. The number of shipments increased as herd size increased. On average, few shipments were reported for cows going to another dairy, packer or slaughter plant, or other destination.

c. Operation average number of shipments required to transport permanently removed cows off the operation during an average month, by destination and by herd size:

	Operation Average Number of Shipments (Month)							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Destination	**No.**	**Std. Error**	**No.**	**Std. Error**	**No.**	**Std. Error**	**No.**	**Std. Error**
Another dairy	0.6	(0.1)	1.0	(0.2)	1.1	(0.4)	0.8	(0.1)
Market, auction, or stockyard	1.1	(0.1)	2.2	(0.1)	3.8	(0.3)	1.5	(0.1)
Packer or slaughter plant	0.8	(0.1)	1.8	(0.3)	2.7	(0.3)	1.3	(0.1)
Other	0.2	(0.1)	1.2	(0.2)	1.9	(0.7)	0.5	(0.1)

Cows permanently removed later in lactation usually represent a lower financial loss than cows removed prior to peak lactation. The majority of permanently removed cows (58.0 percent) were 200 days or more in milk at the time of removal, while less than 20 percent were fewer than 50 days in milk.

d. For operations that permanently removed cows during the previous 12 months, percentage of cows removed, by days in milk and by herd size:

	Percent Cows							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Days in Milk	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Fewer than 50	15.9	(1.5)	19.3	(1.3)	14.4	(1.9)	16.2	(1.1)
50 to 199	24.7	(1.7)	23.3	(1.5)	21.1	(2.5)	22.6	(1.3)
200 or more	54.5	(2.1)	53.7	(2.0)	62.5	(3.3)	58.0	(1.8)
Dry cows	4.9	(0.9)	3.7	(0.9)	2.0	(0.4)	3.2	(0.4)
Total	100.0		100.0		100.0		100.0	

Operations in the West region permanently removed a higher percentage of cows 200 days or more in milk (65.7 percent) compared with operations in the East region (53.1 percent). A higher percentage of dry cows in the East region (4.2 percent) were permanently removed compared with dry cows in the West region (1.7 percent).

e. For operations that permanently removed cows during the previous 12 months, percentage of cows removed, by days in milk and by region:

	Percent Cows			
	Region			
	West		East	
Days in Milk	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Fewer than 50	13.1	(2.2)	18.1	(1.0)
50 to 199	19.5	(2.6)	24.6	(1.3)
200 or more	65.7	(3.5)	53.1	(1.7)
Dry cows	1.7	(0.3)	4.2	(0.6)
Total	100.0		100.0	

The longer a cow stays in the herd and is productive, the more milk and income she generates. Cows removed during first lactation are not able to generate enough income to cover their rearing costs. Approximately one in six permanently removed cows (16.9 percent) was in its first lactation; there were no differences across herd size in the percentage of cows removed in first lactation. A higher percentage of cows on small operations (32.8 percent) were removed at the fifth lactation or more compared with medium and large operations (26.0 and 19.5 percent of cows, respectively).

f. For operations that permanently removed cows during the previous 12 months, percentage of cows removed, by lactation number and by herd size:

	Percent Cows							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Lactation Number	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
First	17.5	(1.1)	16.4	(0.9)	17.0	(2.2)	16.9	(1.1)
2 to 4	49.7	(1.8)	57.6	(1.8)	63.5	(2.6)	58.5	(1.4)
5 or more	32.8	(1.9)	26.0	(1.7)	19.5	(2.4)	24.6	(1.4)
Total	100.0		100.0		100.0		100.0	

E. Milk Quality and Milking Procedures

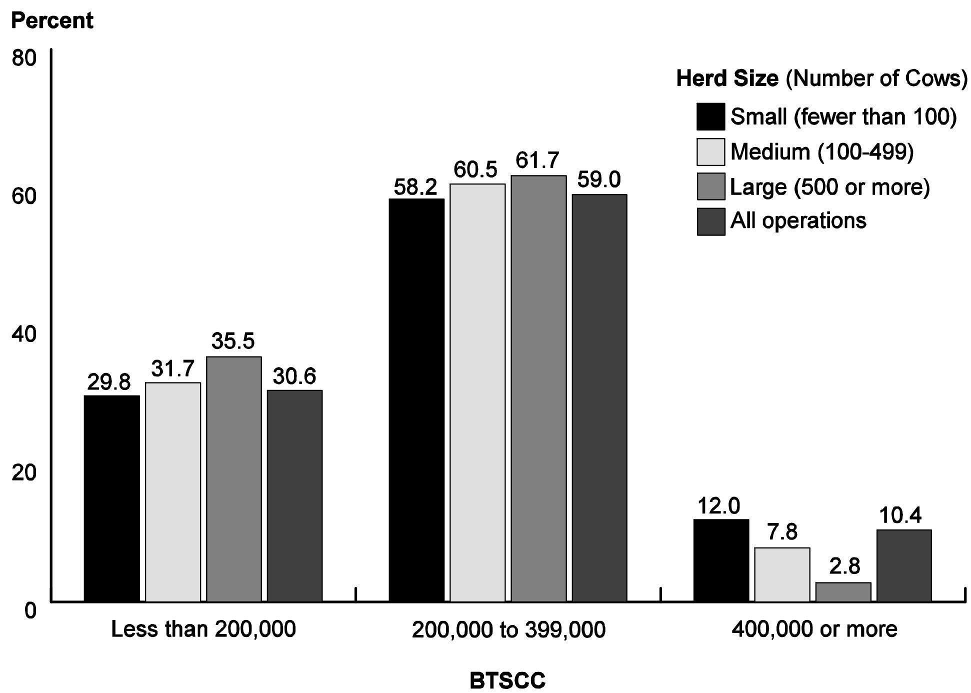
1. Bulk tank somatic cell count

Bulk tank somatic cell count (BTSCC) refers to the number of white blood cells (leukocytes) and secretory cells per milliliter of raw milk and is used a measure of milk quality and udder health. Increased BTSCCs are generally associated with increased intramammary infection and decreased milk production. The current regulatory limit for BTSCC in the United States is 750,000 cells/ml. Although the U.S. regulatory limit is 750,000 cells/ml, producers may lose quality premiums or receive less money for their milk if it does not meet the quality guidelines determined by the processor who purchases their milk. Almost 9 of 10 operations (89.6 percent) reported an average BTSCC below 400,000 cells/ml, and 70.9 percent reported less than 300,000 cells/ml. Herd-size differences were minimal, with a lower percentage of medium operations having a BTSCC of less than 100,000 cells/ml compared with small and large operations.

a. Percentage of operations by average BTSCC for milk shipped during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
BTSCC (cells/ml)	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Less than 100,000	3.7	(1.4)	0.3	(0.2)	3.2	(1.8)	2.8	(1.0)
100,000 to 199,000	26.1	(3.5)	31.4	(4.0)	32.3	(5.5)	27.8	(2.6)
200,000 to 299,000	38.4	(3.7)	43.5	(4.3)	47.6	(6.2)	40.3	(2.8)
300,000 to 399,000	19.8	(2.7)	17.0	(3.0)	14.1	(4.1)	18.7	(2.0)
400,000 to 499,000	9.6	(2.6)	7.8	(2.3)	2.3	(1.2)	8.7	(1.9)
500,000 or more	2.4	(1.5)	0.0	(--)	0.5	(0.5)	1.7	(1.0)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Average BTSCC for Milk Shipped During the Previous 12 Months, and by Herd Size



There were no substantial differences by region in the percentages of operations by average BTSCC.

b. Percentage of operations by average BTSCC for milk shipped during the previous 12 months, and by region:

	Percent Operations			
	Region			
	West		East	
BTSCC (cells/ml)	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 100,000	2.7	(1.4)	2.8	(1.1)
100,000 to 199,000	34.6	(5.1)	27.2	(2.8)
200,000 to 299,000	38.2	(4.9)	40.5	(3.0)
300,000 to 399,000	18.9	(4.5)	18.7	(2.2)
400,000 to 499,000	4.7	(2.1)	9.1	(2.1)
500,000 or more	0.9	(0.6)	1.7	(1.1)
Total	100.0		100.0	

2. Milking personnel and training

Owners of large operations are usually more involved with the overall management of the operation than with specific labor-intensive procedures such as milking cows. The percentage of owners/operators that milked the majority of cows decreased from 74.8 percent for small operations to 0.0 percent of large operations. Family members milked the majority of cows on 17.4 percent of small operations and on 14.3 percent of medium operations. No large operations reported family members performing the majority of milking. The number of employees increased as herd size increased. Large operations averaged almost 13 full-time employees, while small operations averaged 2 (see table 4b p 11). The percentage of operations in which hired workers milked the majority of cows increased as herd size increased. Hired workers milked the majority of cows on 100.0 percent of large operations.

a. Percentage of operations by personnel who milked the majority of cows, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Personnel	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Owner/operator	74.8	(3.3)	33.7	(3.9)	0.0	(--)	59.8	(2.5)
Family member(s) of operator	17.4	(3.0)	14.3	(3.1)	0.0	(--)	15.6	(2.2)
Hired worker(s)	7.8	(1.8)	52.0	(3.9)	100.0	(0.0)	24.6	(1.7)
Total	100.0		100.0		100.0		100.0	

Hired workers milked the majority of cows on the highest percentage of operations in the West region (82.7 percent), while owners/operators milked the majority of cows on the highest percentage of operations in the East region (64.1 percent). A higher percentage of operations in the East region had family members milk the majority of cows compared with operations in the West region (16.9 and 1.2 percent, respectively).

b. Percentage of operations by personnel who milked the majority of cows, and by region:

	Percent Operations			
	Region			
	West		East	
Personnel	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Owner/operator	16.1	(3.4)	64.1	(2.7)
Family member(s) of operator	1.2	(0.8)	16.9	(2.4)
Hired worker(s)	82.7	(3.5)	19.0	(1.8)
Total	100.0		100.0	

Although owners/operators milked the majority of cows on the most operations (reflecting the practice of small operations), the highest percentage of cows were milked by hired workers (68.2 percent) [reflecting the practice of large operations]. Almost one-quarter of cows (24.4 percent) were milked by owners/operators, while 7.4 percent were milked by family members.

c. Percentage of cows on operations in which the majority of cows were milked by the specified personnel:

Personnel	**Percent Cows**	**Standard Error**
Owner/operator	24.4	(1.5)
Family member(s) of operator	7.4	(1.1)
Hired worker(s)	68.2	(1.6)
Total	100.0	

Training milking personnel in the proper procedures used to milk cows and providing reasons for the procedures are usually ongoing processes, as milking protocols are often modified or updated. Milker training increased as herd size increased, with 42.3 percent of small operations training milking personnel compared with 75.3 percent of medium operations and 97.8 percent of large operations. Approximately one of three operations (35.6 percent) trained new employees only, while almost half of operations (46.0 percent) provided no milker training. However, approximately one of three operations that reported no milker training also reported they had no employees. A lower percentage of small operations (2.9 percent) performed training one to two times/year for all milkers compared with medium and large operations (14.1 and 27.0 percent, respectively).

d. Percentage of operations by how frequently milking personnel were trained, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Frequency	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
As new employees only	31.2	(3.6)	46.4	(4.1)	41.5	(5.6)	35.6	(2.7)
1 to 2 times/year for all milkers	2.9	(1.0)	14.1	(2.8)	27.0	(5.5)	7.2	(1.0)
3 to 4 times/year for all milkers	2.3	(1.3)	4.1	(1.3)	13.7	(3.8)	3.5	(1.0)
5 times/year or more for all milkers	1.0	(0.9)	6.6	(2.4)	10.5	(3.4)	3.0	(0.9)
Other	4.9	(1.6)	4.1	(1.8)	5.1	(2.5)	4.7	(1.2)
No milker training	57.7	(3.8)	24.7	(3.7)	2.2	(2.1)	46.0	(2.8)
Total	100.0		100.0		100.0		100.0	

Photo courtesy of Keith Weller, Agricultural Research Service

A higher percentage of operations in the West region provided milker training to new employees only or provided training one to two times/year for all milkers, compared with operations in the East region.

e. Percentage of operations by how frequently milking personnel were trained, and by region:

	Percent Operations			
	Region			
	West		East	
Frequency	**Percent**	**Std. Error**	**Percent**	**Std. Error**
As new employees only	53.5	(5.6)	33.9	(2.9)
1 to 2 times/year for all milkers	20.7	(4.0)	5.9	(1.1)
3 to 4 times/year for all milkers	6.7	(2.8)	3.2	(1.0)
5 times/year or more for all milkers	1.5	(0.9)	3.1	(1.0)
Other	2.0	(1.4)	5.0	(1.3)
No milker training	15.6	(3.9)	48.9	(3.0)
Total	100.0		100.0	

Almost all operations that trained milkers (97.1 percent) used on-the-job training. Almost one-third (31.9 percent) used discussion and lecture, while less than 1 of 10 (6.9 percent) used video training.

f. For operations that trained milking personnel, percentage of operations by training method used:

Training Method	Percent Operations	Standard Error
Video training	6.9	(1.1)
Discussion/lecture	31.9	(3.2)
On-the-job training	97.1	(0.9)
Other	3.9	(1.0)

3. Milking frequency

Milk production can be negatively affected by intramammary pressure. Frequent milking during peak production can decrease periods of increased intramammary pressure. Although increased milking frequency opens the teat canal more times, the risk for intramammary infection does not appear to be increased. Evidence suggests that increasing the times per day that fresh cows (cows less than 30 days in milk) are milked increases milk production, which persists throughout lactation. More than 9 of 10 operations (91.8 percent) milked fresh cows twice daily, while less than 1 of 10 (6.2 percent) milked fresh cows 3 times daily. Few operations milked fresh cows one time per day or more than three times per day (0.6 and 1.4 percent, respectively). The percentage of operations that milked fresh cows three times per day increased as herd size increased.

a. Percentage of operations by number of times per day the majority of ***fresh*** cows were milked, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Times per Day	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1	0.6	(0.6)	0.5	(0.5)	0.0	(--)	0.6	(0.4)
2	98.4	(0.9)	81.8	(2.8)	58.9	(4.7)	91.8	(1.0)
3	1.0	(0.6)	13.3	(2.4)	35.1	(4.4)	6.2	(0.8)
More than 3	0.0	(--)	4.4	(1.7)	6.0	(2.7)	1.4	(0.5)
Total	100.0		100.0		100.0		100.0	

A lower percentage of operations in the West region (82.2 percent) milked fresh cows twice daily compared with operations in the East region (92.7 percent). A higher percentage of operations in the West region (17.8 percent) milked fresh cows three or more times daily compared with operations in the East region (6.7 percent).

b. Percentage of operations by number of times per day the majority of ***fresh*** cows were milked, and by region:

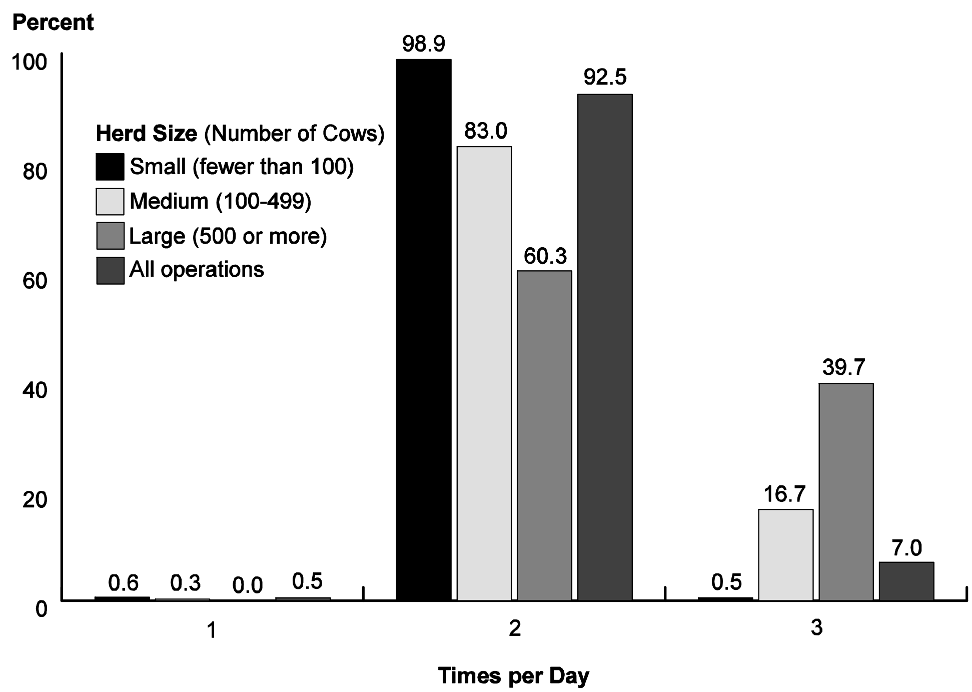
	Percent Operations			
	Region			
	West		**East**	
Times per Day	**Percent**	**Std. Error**	**Percent**	**Std. Error**
1	0.0	(--)	0.6	(0.5)
2	82.2	(3.4)	92.7	(1.0)
3	13.7	(3.1)	5.5	(0.8)
More than 3	4.1	(2.0)	1.2	(0.5)
Total	100.0		100.0	

The majority of operations (92.5 percent) milked cows (other than fresh cows) twice daily. As was observed with the frequency of milking fresh cows, the percentage of operations that milked cows three times per day increased as herd size increased. No operations milked the majority of their cows more than three times per day.

c. Percentage of operations by number of times per day the majority of cows (other than fresh cows) were milked, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Times per Day	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	0.6	(0.6)	0.3	(0.3)	0.0	(--)	0.5	(0.4)
2	98.9	(0.7)	83.0	(2.8)	60.3	(5.2)	92.5	(0.9)
3	0.5	(0.4)	16.7	(2.8)	39.7	(5.2)	7.0	(0.8)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Number of Times per Day the Majority of Cows (Other than Fresh Cows) Were Milked, and by Herd Size



A higher percentage of operations in the West region (14.9 percent) milked cows three times daily compared with operations in the East region (6.2 percent). No operations milked the majority of their cows more than three times per day.

d. Percentage of operations by the number of times per day the majority of cows, other than fresh cows, were milked, and by region:

	Percent Operations			
	Region			
	West		East	
Times per Day	**Percent**	**Std. Error**	**Percent**	**Std. Error**
1	0.0	(--)	0.6	(0.5)
2	85.1	(3.0)	93.2	(1.0)
3	14.9	(3.0)	6.2	(0.8)
Total	100.0		100.0	

The percentage of operations that milked fresh cows more frequently than nonfresh cows increased as herd size increased. Only 0.5 percent of small operations milked fresh cows more often than nonfresh cows, compared with 5.7 percent of medium operations and 12.3 percent of large operations.

e. Percentage of operations that milked fresh cows more often than nonfresh cows:

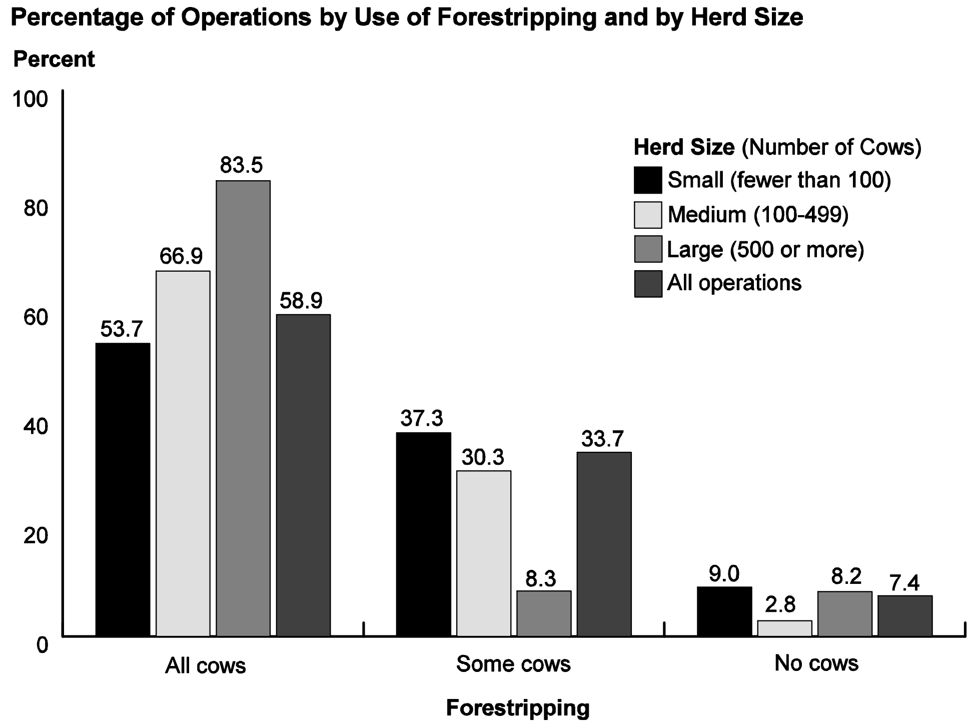
Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
0.5	(0.5)	5.7	(1.8)	12.3	(4.4)	2.5	(0.6)

4. Premilking procedures

Forestripping is the manual removal of a small amount of milk from each teat prior to the attachment of the milking machine. Forestripping cows stimulates milk secretion from mammary tissue, allows the milker to observe any abnormalities in the milk, and removes milk with concentrated somatic cells, thereby improving milk quality. A higher percentage of large operations (83.5 percent) forestripped all cows compared with medium and small operations (66.9 and 53.7 percent, respectively). A higher percentage of small and medium operations forestripped some cows (37.3 and 30.3 percent, respectively), compared with 8.3 percent of large operations. Less than 10 percent of operations across all herd sizes did not forestrip any cows.

a. Percentage of operations by use of forestripping and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Forestripping	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
All cows	53.7	(3.9)	66.9	(3.9)	83.5	(4.2)	58.9	(2.9)
Some cows	37.3	(3.8)	30.3	(3.9)	8.3	(2.4)	33.7	(2.8)
No cows	9.0	(2.3)	2.8	(1.1)	8.2	(3.6)	7.4	(1.6)
Total	100.0		100.0		100.0		100.0	



If forestripping is performed before teat disinfection or while disinfectant is still on the teat, it may reduce the transfer of organisms from the milker to the teat. Teats may become recontaminated with bacteria if forestripping is performed after drying. Approximately one of four operations (27.4 percent) forestripped cows prior to teat disinfection. A lower percentage of small operations forestripped cows after disinfection but prior to drying compared to large operations (26.8 and 46.7 percent, respectively), while a higher percentage of small operations (47.0 percent) forestripped cows after disinfection and drying compared with large operations (22.4 percent).

b. For operations that forestripped any cows, percentage of operations by order of forestripping and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Order	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Prior to teat disinfection	26.2	(3.4)	29.7	(3.9)	30.9	(5.7)	27.4	(2.6)
After teat disinfection but prior to drying teats	26.8	(3.5)	31.6	(3.6)	46.7	(6.2)	29.3	(2.6)
After disinfection and/or drying	47.0	(4.0)	38.7	(4.1)	22.4	(5.0)	43.3	(2.9)
Total	100.0		100.0		100.0		100.0	

A lower percentage of operations in the West region (22.8 percent) forestripped after disinfection and/or drying compared with operations in the East region (45.2 percent).

c. For operations that forestripped any cows, percentage of operations by order of forestripping and by region:

	Percent Operations			
	Region			
	West		East	
Order	Percent	Std. Error	Percent	Std. Error
Prior to teat disinfection	37.4	(5.6)	26.4	(2.7)
After teat disinfection but prior to drying teats	39.8	(5.6)	28.4	(2.7)
After disinfection and/or drying	22.8	(4.3)	45.2	(3.1)
Total	100.0		100.0	

Disinfecting teats before milking reduces environmental bacteria on the teat surface, bacterial counts in milk, and the incidence of new intramammary infections. Scientific studies evaluating the efficacy of premilking and postmilking teat disinfectants have been evaluated and are summarized each year in the proceedings from the NMC annual meeting. Using a new paper or cloth towel on each cow also reduces the risk of transmitting organisms from one cow to another. More than 4 of 10 large operations (41.5 percent) used a wash pen prior to milking, compared with less than 3 percent of small and medium operations. There were no differences by herd size in the percentage of operations that used water hoses; 2.8 percent of operations used water hoses with disinfectant and 4.2 percent used water hoses without disinfectant. A single-use paper towel dry wipe was used on 7.0 percent of operations. A single-use towel with labeled disinfectant was the predominant wet wipe used on 8.5 percent of operations. A higher percentage of small operations used this wet wipe method (10.3 percent) compared with large operations (1.5 percent). Almost half of all operations (49.0 percent) applied a labeled disinfectant in a predip via a predip cup. Predip (using a labeled disinfectant) applied via a sprayer was reported on 18.1 percent of operations, with a higher percentage of large operations using this method of teat disinfection than small operations.

d. Percentage of operations by teat preparation and by herd size:

Teat Preparation		Percent Operations Herd Size (Number of Cows) Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
General Method	**Specific Procedure**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Wash pen	Wash animals in pen prior to entering parlor	1.2	(1.0)	2.4	(1.0)	41.5	(5.1)	4.1	(0.8)
Water hose	With disinfectant	2.6	(1.4)	2.3	(0.9)	6.7	(2.8)	2.8	(1.0)
	Without disinfectant	4.7	(1.3)	2.3	(0.9)	5.9	(2.8)	4.2	(1.0)
Dry wipe	Single-use cloth towel	2.7	(1.3)	4.7	(2.0)	3.8	(2.1)	3.3	(1.0)
	Multiple-use cloth towel	1.3	(0.7)	3.3	(1.2)	6.0	(2.9)	2.1	(0.6)
	Single-use paper towel	7.9	(1.9)	5.4	(2.1)	3.5	(2.4)	7.0	(1.4)
	Multiple-use paper towel	0.0	(--)	0.4	(0.3)	0.0	(--)	0.1	(0.1)
Wet wipe	Commercial teat wipes, single use	4.0	(1.4)	5.8	(2.3)	0.9	(0.8)	4.2	(1.1)
	Commercial teat wipes, multiple use	0.9	(0.9)	0.4	(0.4)	0.0	(--)	0.7	(0.6)
	Towel using labeled disinfectant, single use	10.3	(2.4)	5.1	(1.8)	1.5	(0.9)	8.5	(1.7)
	Towel using labeled disinfectant, multiple use	6.1	(1.9)	2.0	(0.9)	3.5	(2.4)	4.9	(1.4)
	Towel using nonlabeled/homemade disinfectant, single use	3.2	(1.7)	2.1	(1.3)	0.0	(--)	2.7	(1.2)
	Towel using nonlabeled/homemade disinfectant, multiple use	0.5	(0.5)	0.6	(0.5)	0.0	(--)	0.5	(0.3)
	Multiple use sponge with disinfectant	1.8	(0.9)	0.2	(0.2)	0.0	(--)	1.3	(0.6)
Predip applied via ...	Sprayer, labeled disinfectant	13.6	(2.5)	25.4	(3.5)	38.2	(5.6)	18.1	(2.0)
	Sprayer, nonlabeled/ homemade disinfectant	0.0	(--)	2.0	(1.4)	1.7	(1.6)	0.6	(0.4)
	Predip cup, labeled disinfectant	49.8	(3.9)	51.0	(4.2)	32.3	(5.3)	49.0	(2.9)
	Predip cup, nonlabeled/homemade disinfectant	2.8	(1.5)	0.7	(0.7)	1.9	(1.3)	2.2	(1.0)
	Foam, labeled disinfectant	1.4	(0.8)	8.2	(2.1)	6.1	(2.5)	3.4	(0.8)
	Foam, nonlabeled/ homemade disinfectant	0.0	(--)	0.7	(0.7)	0.0	(--)	0.2	(0.2)
Other		6.5	(1.9)	3.7	(1.4)	1.4	(0.7)	5.5	(1.3)

Few regional differences were observed in the implementation of premilking teat preparation practices. A higher percentage of operations in the West used a wash pen, a water hose without disinfectant, or applied a labeled disinfectant in a predip via a sprayer compared with operations in the East region. A higher percentage of operations in the East region used a predip cup to apply a labeled disinfectant to teats compared with operations in the West.

e. Percentage of operations by teat preparation and by region:

		Percent Operations			
		Region			
Teat Preparation		West		East	
General Method	Specific Procedure	Percent	Std. Error	Percent	Std. Error
Wash pen	Wash animals in pen prior to entering parlor	36.8	(4.6)	0.9	(0.8)
Water hose	With disinfectant	9.3	(2.9)	2.2	(1.0)
	Without disinfectant	13.9	(3.7)	3.3	(1.0)
Dry wipe	Single-use cloth towel	4.2	(2.4)	3.2	(1.1)
	Multiple-use cloth towel	4.7	(2.4)	1.8	(0.6)
	Single-use paper towel	12.3	(4.6)	6.5	(1.5)
	Multiple-use paper towel	0.4	(0.4)	0.1	(0.1)
Wet wipe	Commercial teat wipes, single use	3.5	(2.2)	4.3	(1.2)
	Commercial teat wipes, multiple use	0.0	(--)	0.8	(0.7)
	Towel using labeled disinfectant, single use	2.2	(1.6)	9.1	(1.9)
	Towel using labeled disinfectant, multiple use	7.1	(3.6)	4.7	(1.5)
	Towel using nonlabeled/homemade disinfectant, single use	3.0	(3.0)	2.7	(1.3)
	Towel using nonlabeled/homemade disinfectant, multiple use	0.4	(0.4)	0.5	(0.4)
	Multiple use sponge with disinfectant	0.8	(0.8)	1.4	(0.7)
Predip applied via . . .	Sprayer, labeled disinfectant	36.5	(4.7)	16.3	(2.1)
	Sprayer, nonlabeled/ homemade disinfectant	1.1	(1.1)	0.5	(0.4)
	Predip cup, labeled disinfectant	27.4	(4.6)	51.1	(3.1)
	Predip cup, nonlabeled/homemade disinfectant	0.9	(0.9)	2.4	(1.1)
	Foam, labeled disinfectant	0.0	(--)	3.7	(0.9)
	Foam, nonlabeled/ homemade disinfectant	0.0	(--)	0.2	(0.2)
Other		0.0	(--)	6.0	(1.5)

The majority of operations (about 60 percent) used iodophor compounds as predips in both summer and winter. Chlorhexidine was the next most common predip used by about 1 of 10 operations. There were no differences in summer or winter in the percentage of operations by compound used.

f. Percentage of operations by primary ***predip*** compounds used as disinfectants, and by season:

	Percent Operations			
	Season			
	Summer		**Winter**	
Compound	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Iodophor (iodine containing)	59.6	(2.9)	59.7	(2.9)
Chlorhexidine	11.7	(2.1)	11.8	(2.1)
Fatty acid based	2.5	(0.7)	2.5	(0.7)
Quaternary ammonium	0.3	(0.2)	0.3	(0.2)
Phenols	0.1	(0.1)	0.1	(0.1)
Chlorine product	7.2	(1.5)	7.1	(1.5)
Other	7.9	(1.6)	8.0	(1.6)
None	10.7	(1.8)	10.5	(1.8)
Total	100.0		100.0	

Wet teats can cause liner slips and rapid air movement inside the milking claw, which may result in the injection of bacteria into teat canals, potentially resulting in mastitis. If teats become wet during premilking teat preparation, they should be dried using a single-use towel to decrease the risk of new infections. There were no seasonal differences in teat drying methods. Single-use paper or cloth towels were used on the majority of operations during summer and winter.

g. Percentage of operations by the method used to dry teats ***prior*** to milking, and by season:

	Percent Operations			
	Summer		**Winter**	
Drying Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Air dry	12.4	(2.1)	12.3	(2.1)
Single-use cloth towel	21.5	(2.1)	21.6	(2.1)
Single-use paper towel	54.8	(2.8)	54.6	(2.8)
Multiple-use cloth towel	7.1	(1.3)	7.1	(1.3)
Multiple-use paper towel	0.6	(0.4)	0.6	(0.4)
Other	0.4	(0.3)	0.6	(0.3)
Not applicable–teats not wet prior to milking	3.2	(1.1)	3.2	(1.1)
Total	100.0		100.0	

Photo courtesy of Judy Rodriguez

5. Postmilking procedures

The use of postmilking teat disinfectant reduces the incidence of contagious mastitis. Less than 2 percent of operations did not use a postmilking teat disinfectant during summer and/or winter (1.4 and 1.2 percent, respectively). More than three of four operations dipped teats with a labeled postdip product in each season. Approximately one of eight operations applied labeled disinfectant with a sprayer during the summer and winter (12.6 and 12.8 percent, respectively).

a. Percentage of operations by postmilking teat disinfection method and by season:

	Percent Operations			
	Summer		Winter	
Teat Disinfection Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Teats dipped with labeled postdip product	79.7	(2.4)	77.0	(2.5)
Teats dipped with nonlabeled/homemade solution	0.5	(0.4)	0.5	(0.4)
Teats sprayed with commercial postdip product	12.6	(1.8)	12.8	(1.9)
Teats foamed with commercial postdip product	0.5	(0.3)	0.5	(0.3)
Teats covered in commercial powder product	0.1	(0.1)	2.7	(0.9)
Other	1.4	(0.9)	1.2	(0.6)
None	5.2	(1.6)	5.3	(1.6)
Total	100.0		100.0	

The percentages of operations by postdip compound were similar to the percentages of operations by predip compound. The majority of operations (approximately 70 percent) used an iodophor compound. Chlorhexidine was used by about 13 percent of operations.

b. Percentage of operations by primary ***postdip*** compounds used as disinfectants, and by season:

	Percent Operations			
	Season			
	Summer		Winter	
Compound	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Iodophor (iodine containing)	69.8	(2.9)	67.8	(2.9)
Chlorhexidine	12.1	(2.1)	13.4	(2.2)
Fatty acid based	6.4	(1.4)	7.2	(1.5)
Quaternary ammonium	0.3	(0.2)	0.8	(0.5)
Phenols	0.0	(--)	0.0	(0.0)
Chlorine product	2.3	(1.1)	1.7	(0.8)
Other	3.9	(1.1)	3.8	(1.1)
None	5.2	(1.6)	5.3	(1.6)
Total	100.0		100.0	

Barrier teat dip applied after milking provides germicidal protection, improves teat condition, and reduces the number of new cases of mastitis. Approximately one of four operations (24.5 percent) used a barrier teat dip on all cows all the time, with no differences across herd sizes. A higher percentage of large and medium operations used a barrier teat dip on all cows during winter or adverse weather compared with small operations. Overall, two of three operations (66.7 percent) did not use a barrier dip, with a higher percentage of small operations (70.9 percent) not using a barrier dip compared with large operations (44.7 percent).

c. Percentage of operations by use of barrier teat dip* and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Use of Barrier Teat Dip	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
All cows all the time	22.2	(2.9)	29.8	(3.8)	29.3	(5.7)	24.5	(2.2)
All cows during winter or adverse weather	0.0	(--)	5.6	(1.8)	14.4	(4.8)	2.3	(0.6)
Other	6.9	(2.1)	4.2	(1.8)	11.6	(3.9)	6.5	(1.6)
None	70.9	(3.3)	60.4	(4.1)	44.7	(5.7)	66.7	(2.5)
Total	100.0		100.0		100.0		100.0	

*e.g., Blockade®, UDDERgold® 5-star.

A higher percentage of operations in the East region (68.4 percent) did not use a barrier teat dip compared with operations in the West region (49.0 percent). A higher percentage of operations in the West region (9.5 percent) used a barrier teat dip on all cows during winter or adverse weather compared with operations in the East region (1.6 percent).

d. Percentage of operations by use of barrier teat dip* and by region:

	Percent Operations			
	Region			
	West		**East**	
Use of Barrier Teat Dip	**Percent**	**Std. Error**	**Percent**	**Std. Error**
All cows all the time	37.8	(5.3)	23.2	(2.4)
All cows during winter or adverse weather	9.5	(3.4)	1.6	(0.5)
Other	3.7	(1.7)	6.8	(1.7)
None	49.0	(5.4)	68.4	(2.7)
Total	100.0		100.0	

*e.g., Blockade® Uddergold® 5-star.

6. Milking equipment

A backflush system is used between cows to wash the milking claw or cluster, thereby helping to reduce the spread of contagious mastitis pathogens. There were no differences in the percentage of operations that used a backflush system across herd sizes.

a. Percentage of operations that used a backflush system in milking units, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
5.9	(1.8)	8.6	(2.1)	9.3	(2.6)	6.8	(1.3)

A higher percentage of operations in the West region (20.9 percent) used a backflush system compared with operations in the East region (5.4 percent).

b. Percentage of operations that used a backflush system in milking units, by region:

Percent Operations			
Region			
West		**East**	
Percent	**Standard Error**	**Percent**	**Standard Error**
20.9	(4.0)	5.4	(1.4)

The majority of operations that used a backflush system (91.4 percent) used the system for every milking.

c. For operations that used a backflush system, percentage of operations that used the system for every milking:

Percent Operations	**Standard Error**
91.4	(4.1)

Automatic takeoffs may improve teat-end condition by promptly removing the milking claw at a predetermined flow rate. A higher percentage of medium and large operations (76.9 and 89.5 percent, respectively) used automatic takeoffs compared with small operations (30.2 percent).

d. Percentage of operations that used automatic takeoffs, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
30.2	(3.3)	76.9	(3.8)	89.5	(3.4)	45.4	(2.6)

About 7 of 10 operations in the West region (69.6 percent) used automatic takeoffs compared with approximately 4 of 10 operations in the East region (43.1 percent).

e. Percentage of operations that used automatic takeoffs, by region:

Percent Operations			
Region			
West		East	
Percent	Standard Error	Percent	Standard Error
69.6	(4.1)	43.1	(2.8)

7. Milking practices

Approximately half of operations (55.2 percent) reported that milkers wore latex or nitrile gloves to milk all cows. However, more than three of four cows (76.8 percent) were on operations in which gloves were used, suggesting that the practice is more common on large operations.

a. Percentage of operations (and percentage of cows on these operations) in which milkers wore latex or nitrile gloves to milk all cows:

Percent Operations	Standard Error	Percent Cows	Standard Error
55.2	(2.8)	76.8	(2.5)

Milking cows with clinical mastitis at the end of milking, with a separate milking unit, or in a separate string can reduce the exposure of noninfected cows to mastitis organisms. Approximately one of three operations (34.9 percent) used a separate milking unit to milk mastitic cows; no differences were observed across herd sizes. A higher percentage of large operations (83.4 percent) milked mastitic cows in a separate string from healthy cows compared with medium and small operations (33.4 and 29.8 percent, respectively).

b. Percentage of operations by method used for milking cows with clinical mastitis, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Separate milking unit from healthy cows	38.5	(3.7)	25.7	(3.6)	31.5	(5.3)	34.9	(2.7)
Separate string from healthy cows	29.8	(3.5)	33.4	(3.8)	83.4	(4.7)	34.1	(2.6)

About 6 of 10 operations in the West region (59.9 percent) milked mastitis cows in a separate string from healthy cows compared with approximately 3 of 10 operations in the East region (31.6 percent).

c. Percentage of operations by method used to milk cows with clinical mastitis, and by region:

	Percent Operations			
	Region			
	West		**East**	
Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Separate milking unit from healthy cows	27.5	(4.9)	35.6	(2.9)
Separate string from healthy cows	59.9	(5.0)	31.6	(2.8)

8. Vaccination

Although the efficacy of certain mastitis vaccines has been questioned, coliform vaccines have generally provided good protection. Coliform vaccines were used on at least some cows on 37.6 percent of operations, compared with vaccines for *Salmonella* (13.4 percent), siderophore receptors (4.1 percent), *Mycoplasma* (1.8 percent), and *Staphylococcus aureus* (7.3 percent).

a. Percentage of operations by type of vaccination used during the previous 12 months, and by proportion of cows vaccinated:

	Percent Operations						
	Proportion of Cows						
	All		Some		None		
Vaccination Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Total**
Coliform mastitis	32.6	(2.4)	5.0	(1.1)	62.4	(2.6)	100.0
Salmonella	11.1	(1.5)	2.3	(0.7)	86.6	(1.6)	100.0
Siderophore receptors and porins (SRPs) vaccine	3.3	(0.7)	0.8	(0.4)	95.9	(0.8)	100.0
Mycoplasma	1.4	(0.5)	0.4	(0.2)	98.2	(0.6)	100.0
Staphylococcus aureus	5.7	(1.1)	1.6	(0.6)	92.7	(1.2)	100.0

Regional differences in vaccine use were observed for coliform mastitis and *Salmonella* vaccines. More operations in the West region vaccinated their cows than operations in the East region.

b. Percentage of operations that vaccinated at least some cows during the previous 12 months, by vaccination type and by region:

	Percent Operations			
	Region			
	West		East	
Vaccination Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Coliform mastitis	65.1	(4.7)	35.0	(2.8)
Salmonella	36.4	(4.8)	11.1	(1.7)
Siderophore receptors and porins (SRPs) vaccine	9.2	(2.9)	3.6	(0.8)
Mycoplasma	4.1	(2.5)	1.6	(0.6)
Staphylococcus aureus	13.2	(3.5)	6.7	(1.3)

Less than 4 percent of operations administered an autogenous vaccine.

c. Percentage of operations that administered autogenous vaccines for any disease, by proportion of cows receiving vaccine:

Proportion of Cows	Percent Operations	Standard Error
All	2.2	(0.6)
Some	1.4	(0.9)
None	96.4	(1.1)
Total	100.0	

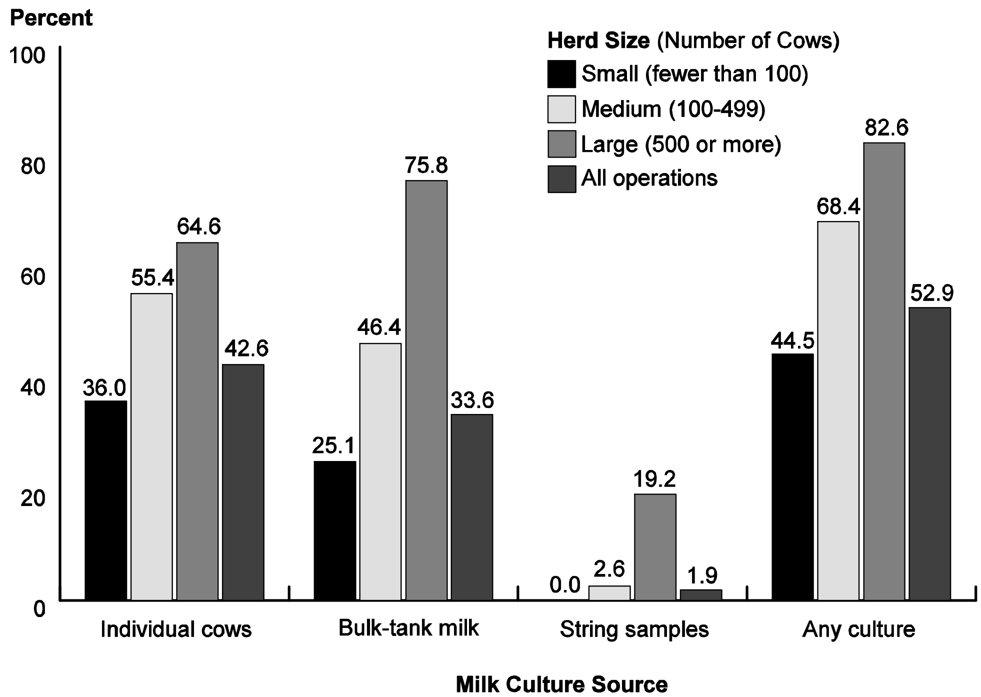
9. Milk cultures

Culturing milk has many benefits, including the identification of the most prevalent cause of clinical mastitis, helping direct mastitis therapy, and screening purchased herds or milking strings for contagious mastitis pathogens. A lower percentage of small operations performed individual cow, bulk-tank milk, string sample, or any cultures compared with medium and large operations. A higher percentage of large operations performed bulk-tank milk or string-sample cultures compared with medium and small operations. More than half of all operations (52.9 percent) performed milk cultures during the previous 12 months. More than 8 of 10 large operations (82.6 percent) performed any culture, compared with about 7 of 10 medium operations (68.4 percent) and 4 of 10 small operations (44.5 percent).

a. Percentage of operations by source of milk cultures performed during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Milk Culture Source	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Individual cows	36.0	(3.6)	55.4	(4.2)	64.6	(5.3)	42.6	(2.7)
Bulk-tank milk	25.1	(3.3)	46.4	(4.1)	75.8	(5.1)	33.6	(2.5)
String samples	0.0	(--)	2.6	(0.8)	19.2	(3.9)	1.9	(0.3)
Any culture	44.5	(3.8)	68.4	(3.9)	82.6	(4.6)	52.9	(2.8)

Percentage of Operations by Source of Milk Cultures Performed During the Previous 12 Months, and by Herd Size



A higher percentage of operations in the West region performed bulk-tank milk or string-sample cultures compared with operations in the East region.

b. Percentage of operations by source of milk cultures performed during the previous 12 months, and by region:

	Percent Operations			
	Region			
	West		East	
Milk Culture Source	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Individual cows	43.4	(5.3)	42.6	(2.9)
Bulk-tank milk	60.6	(5.1)	31.0	(2.7)
String samples	11.0	(3.0)	1.0	(0.2)
Any culture	65.1	(5.0)	51.7	(3.1)

For operations that performed milk cultures during the previous 12 months, a higher percentage of large operations (20.8 percent) performed on-farm cultures compared with small operations (4.2 percent). A higher percentage of medium operations (45.5 percent) had cultures performed at a State or university diagnostic laboratory compared with small operations (24.1 percent). There were no differences across herd sizes in the percentage of operations that used a commercial laboratory, with approximately 4 of 10 operations (41.5 percent) using this facility type to culture milk. Almost 50 percent of operations performing milk cultures (49.2 percent) used a private veterinary laboratory or clinic, with no differences across herd sizes.

c. For operations that performed milk cultures during the previous 12 months, percentage of operations by facility used to perform cultures, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Facility	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
On-farm, by farm personnel	4.2	(2.0)	14.0	(3.8)	20.8	(4.8)	9.0	(1.8)
State or university diagnostic laboratory	24.1	(4.9)	45.5	(5.0)	31.2	(4.4)	31.8	(3.3)
Commercial laboratory	38.9	(5.6)	45.3	(5.0)	43.8	(6.0)	41.5	(3.6)
Private veterinary laboratory (veterinary clinic)	50.5	(5.7)	43.2	(5.1)	60.8	(6.3)	49.2	(3.7)

The only regional difference in the percentage of operations that used a specific facility to perform milk cultures was observed for State or university diagnostic laboratory, which was used by 13.0 percent of operations in the West region compared with 34.0 percent of operations in the East region.

d. For operations that performed milk cultures during the previous 12 months, percentage of operations by facility used to perform cultures, and by region:

	Percent Operations			
	Region			
	West		**East**	
Facility	**Percent**	**Std. Error**	**Percent**	**Std. Error**
On-farm, by farm personnel	13.0	(4.6)	8.5	(1.9)
State or university diagnostic laboratory	13.0	(4.2)	34.0	(3.7)
Commercial laboratory	59.2	(6.4)	39.4	(4.0)
Private veterinary laboratory (veterinary clinic)	52.5	(6.6)	48.8	(4.1)

Milk was cultured most commonly from cows with chronic clinical disease and from clinical cases that did not respond to treatment (59.1 and 54.0 percent of operations, respectively). A higher percentage of large operations performed cultures on milk from individual fresh cows and from all clinical cases compared with medium and small operations.

e. For operations that performed cultures on milk from individual cows during the previous 12 months, percentage of operations by cow type and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cow Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Fresh cows	8.0	(3.5)	14.9	(3.8)	47.2	(6.6)	13.9	(2.5)
All clinical cases	22.2	(5.4)	35.4	(5.5)	65.4	(6.4)	30.5	(3.7)
Chronic clinical cases	54.8	(6.4)	64.5	(5.3)	67.0	(7.6)	59.1	(4.2)
Clinical cases that did not respond to treatment	50.1	(6.5)	61.1	(5.6)	53.5	(7.9)	54.0	(4.3)
High somatic cell count cows	37.9	(5.7)	49.6	(5.8)	31.5	(6.2)	41.1	(3.9)
Other	11.0	(4.8)	7.0	(2.5)	8.6	(4.4)	9.5	(3.0)

A higher percentage of operations in the West region performed cultures on milk from individual fresh cows and all clinical cases (49.8 and 60.7 percent, respectively) compared with operations in the East region (10.5 and 27.7 percent, respectively).

f. For operations that performed milk cultures on individual cows during the previous 12 months, percentage of operations by cow type and by region:

	Percent Operations			
	Region			
	West		**East**	
Cow Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Fresh cows	49.8	(7.9)	10.5	(2.6)
All clinical cases	60.7	(8.3)	27.7	(4.0)
Chronic clinical cases	55.4	(8.5)	59.4	(4.5)
Clinical cases that did not respond to treatment	43.9	(8.1)	54.9	(4.7)
High somatic cell count cows	46.6	(8.2)	40.6	(4.1)
Other	4.8	(2.6)	9.9	(3.2)

Similar percentages of operations that performed milk cultures during the previous 12 months detected *Staphylococcus aureus*, *E. coli/Klebsiella/*other gram negative, or environmental strep (*Strep.* spp.) (52.3, 53.3, and 60.1 percent of operations, respectively). A higher percentage of large operations (21.4 percent) identified *Mycoplasma* compared with medium and small operations (3.8 and 4.0 percent, respectively). A lower percentage of small operations identified *E. coli/Klebsiella/*other gram negative or coagulase negative staph (*Staph.* spp. non-*aureus*) organisms compared with large operations.

g. For operations that performed milk cultures on individual cows during the previous 12 months, percentage of operations by organism identified and by herd size:

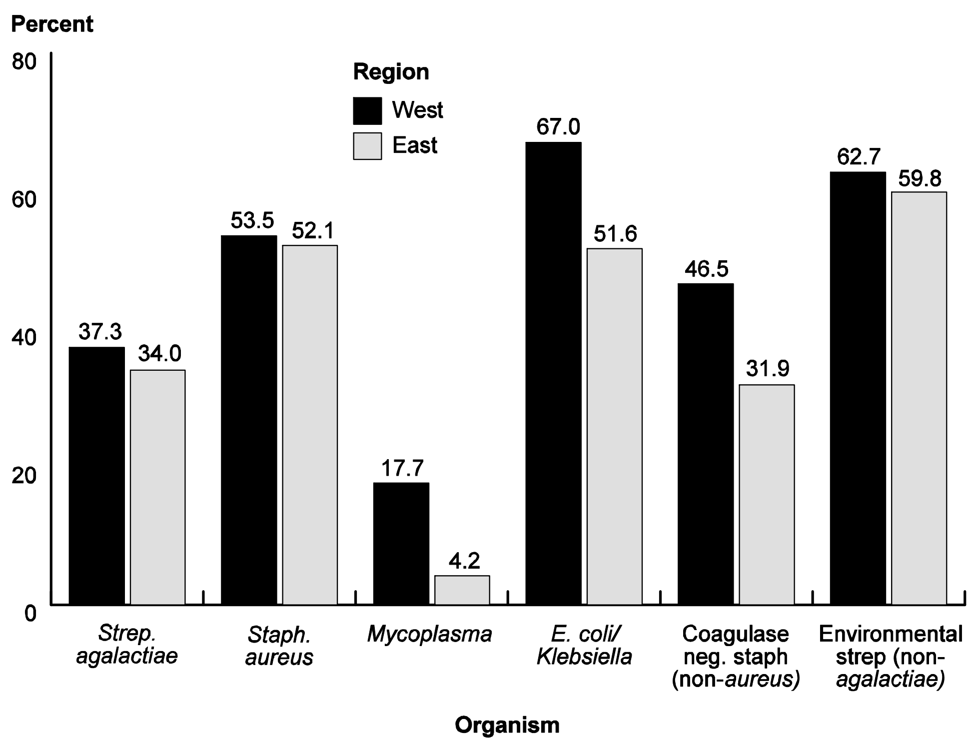
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Organism	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Strep. agalactiae	29.4	(5.4)	42.2	(5.0)	35.6	(5.7)	34.4	(3.6)
Staph. aureus	50.5	(6.1)	51.4	(5.1)	64.4	(6.1)	52.3	(3.9)
Mycoplasma	4.0	(3.2)	3.8	(1.9)	21.4	(4.7)	5.7	(1.9)
*E. coli/ Klebsiella/*other gram negative	41.8	(5.9)	64.3	(4.8)	78.9	(5.4)	53.3	(3.8)
Coagulase negative staph (*Staph.* spp. non-*aureus*)	25.3	(5.5)	37.6	(4.8)	63.4	(6.0)	33.5	(3.5)
Environmental strep (*Strep.* spp. non-*agalactiae*)	52.4	(6.1)	67.0	(4.8)	78.3	(5.1)	60.1	(3.8)

Mycoplasma was isolated from a higher percentage of operations in the West region (17.7 percent) than operations in the East region (4.2 percent).

h. For operations that performed milk cultures on individual cows during the previous 12 months, percentage of operations by organism identified and by region:

	Percent Operations			
	Region			
	West		East	
Organism	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Strep. agalactiae	37.3	(6.2)	34.0	(3.9)
Staph. aureus	53.5	(6.4)	52.1	(4.3)
Mycoplasma	17.7	(4.5)	4.2	(2.1)
E. coli/Klebsiella/ other gram negative	67.0	(6.3)	51.6	(4.2)
Coagulase negative staph (*Staph.* spp. non-*aureus*)	46.5	(6.5)	31.9	(3.9)
Environmental strep (*Strep.* spp. non-*agalactiae*)	62.7	(6.5)	59.8	(4.2)

For Operations that Performed Milk Cultures on Individual Cows During the Previous 12 months, Percentage of Operations by Organism Identified and by Region



10. Residue testing

Every tanker load of milk in the United States is tested at the milk plant prior to processing for the presence of specific antibiotics. Consequences of a positive test include discarding the entire truckload of milk and the possible suspension of the producer's permit to sell milk. Milk from cows treated with antibiotics should be discarded on the operation for a specified withdrawal period, as directed by the drug manufacturer via the product label. Manufacturers are required to go through an exhaustive drug approval process that determines the withdrawal period. If approved drugs are used in the manner prescribed by the label, producers can use the withdrawal period stated on the label to ensure that the milk does not contain violative drug residues. However, producers may use on-farm drug residue testing to be confident that the milk is free from violative drug residues. One caveat of on-farm drug testing is that the residue testing kits are approved for bulk milk and not for individual cows. Using residue tests on individual cows may result in milk being discarded even though it is below the violative level.

Almost half of operations (49.8 percent) performed residue testing of milk (either bulk-tank milk or individual cows), with a higher percentage of medium operations (64.5 percent) performing testing compared with small operations (44.2 percent).

a. Percentage of operations that performed on-farm antibiotic residue testing of milk, by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
44.2	(3.8)	64.5	(4.0)	53.2	(5.4)	49.8	(2.9)

Numerous tests can be used to screen milk for antibiotic residues. An excellent reference is the “Milk and Dairy Beef Residue Prevention Protocol,” produced by the Milk and Dairy Beef Quality Assurance Center. The most commonly reported residue screening test was the Delvotest®, which was used by 62.9 percent of operations that tested for residues.

b. For operations that performed on-farm antibiotic residue testing of milk, percentage of operations by test most commonly used:

Test	**Percent Operations**	**Standard Error**
Snap® test (beta-lactam or tetracycline)	22.8	(2.9)
Delvotest®	62.9	(3.6)
CITE Probe®	0.0	(--)
Charm Farm	10.8	(2.7)
Penzyme® Milk Test	1.7	(0.6)
Other	1.8	(0.8)
Total	100.0	

The majority of operations that screened for antibiotic residues tested individual cows recently treated for mastitis (90.0 percent of operations), followed by fresh cows (57.8 percent of operations).

c. For operations that performed on-farm antibiotic residue testing of milk, percentage of operations by source of sample tested:

Sample Source	**Percent Operations**	**Standard Error**
Fresh cows	57.8	(3.7)
Individual cows recently treated for mastitis	90.9	(1.6)
Bulk tank prior to processor pickup	29.1	(3.3)
Other	8.3	(1.9)

11. Dry-off procedures/antibiotic treatment

Research suggests that about half of new intramammary infections occur during the dry period. Reasons for the increased susceptibility during this period include increased gland pressure, leading to easier entrance of bacteria through the teat canal; decreased local immune response; and because milk and bacteria are not being removed, as would occur during lactation. Internal teat sealants were developed to reduce the potential of bacteria entering the teat canal and causing infection at dry-off. A higher percentage of large and medium operations used an internal teat sealant on all cows at dry-off (49.0 and 45.7 percent, respectively) compared with small operations (22.7 percent). Approximately 3 of 10 operations (30.1 percent) used an internal teat sealant on all cows at dry-off, with an additional 6.2 percent of operations using the sealant on cows with chronic mastitis, on all cows at dry-off during winter or adverse weather, or at other times. Approximately 7 of 10 small operations (71.0 percent) did not use an internal teat sealant, compared with about 5 of 10 medium and large operations (48.2 and 45.2 percent, respectively).

a. Percentage of operations by use of ***internal*** teat sealant* at dry-off and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Use of Internal Teat Sealant	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
All cows at dry-off	22.7	(3.2)	45.7	(4.2)	49.0	(5.4)	30.1	(2.5)
Cows with chronic mastitis	2.3	(1.1)	2.4	(1.2)	1.2	(1.2)	2.2	(0.8)
All cows at dry-off but only during winter or adverse weather	2.2	(1.4)	0.8	(0.8)	4.3	(2.5)	2.0	(1.0)
Other	1.8	(1.0)	2.9	(1.6)	0.3	(0.2)	2.0	(0.8)
No internal teat sealant used on this operation	71.0	(3.5)	48.2	(4.2)	45.2	(5.4)	63.7	(2.7)
Total	100.0		100.0		100.0		100.0	

*e.g., Orbeseal®.

The only regional difference in the use of internal teat sealant was that no operations in the West region used the sealant only on cows with chronic mastitis, while 2.5 percent of operations in the East region did use sealant only on chronic mastitis cows.

b. Percentage of operations by use of ***internal*** teat sealant* at dry-off and by region:

	Percent Operations			
	Region			
	West		**East**	
Use of Internal Teat Sealant	**Percent**	**Std. Error**	**Percent**	**Std. Error**
All cows at dry-off	20.5	(4.2)	31.0	(2.8)
Cows with chronic mastitis	0.0	(--)	2.5	(0.9)
All cows at dry-off but only during winter or adverse weather	3.1	(1.8)	1.8	(1.0)
Other	0.2	(0.1)	2.2	(0.9)
No internal teat sealant used on this operation	76.2	(4.4)	62.5	(2.9)
Total	100.0		100.0	

*e.g., Orbeseal®.

Coating the exterior of the teat with a sealant that remains in place for an extended period (4 to 5 days) is another method used to prevent bacterial entrance into the mammary gland at dry-off. The majority of all operations (82.8 percent) did not use an external teat sealant. Over 1 of 10 operations (14.0 percent) used a sealant on all cows at dry-off, with no differences across herd sizes.

c. Percentage of operations by use of ***external*** teat sealant* at dry-off and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Use of External Teat Sealant	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
All cows at dry-off	12.5	(2.6)	15.1	(2.9)	26.1	(5.7)	14.0	(2.0)
Cows with chronic mastitis	1.1	(0.8)	1.7	(1.3)	0.0	(--)	1.2	(0.6)
All cows at dry-off but only during winter or adverse weather	1.1	(0.7)	0.1	(0.1)	0.0	(--)	0.8	(0.5)
Other	0.8	(0.8)	2.2	(1.4)	2.0	(1.5)	1.2	(0.7)
No external teat sealant used on the operation	84.5	(2.9)	80.9	(3.3)	71.9	(5.7)	82.8	(2.2)
Total	100.0		100.0		100.0		100.0	

*e.g., Stronghold™.

There were no regional differences in the use of external teat sealants.

d. Percentage of operations by use of ***external*** teat sealant* at dry-off and by region:

	Percent Operations			
	Region			
	West		**East**	
Use of External Teat Sealant	**Percent**	**Std. Error**	**Percent**	**Std. Error**
All cows at dry-off	19.6	(4.3)	13.5	(2.1)
Cows with chronic mastitis	0.0	(--)	1.3	(0.7)
All cows at dry-off but only during winter or adverse weather	0.0	(--)	0.8	(0.5)
Other	1.1	(1.1)	1.3	(0.7)
No external teat sealant used on the operation	79.3	(4.3)	83.1	(2.3)
Total	100.0		100.0	

*e.g., Stronghold™.

Administering intramammary antibiotics at the time of dry-off cures many existing infections and reduces the incidence of new infections. Almost 1 of 10 operations (9.9 percent) did not use any dry-cow treatment, and a percentage of these were organic operations in which the use of antibiotics is not allowed. Some, but not all, cows were treated on 17.8 percent of operations, and all cows were treated on 72.3 percent of operations. More than four of five cows (81.7 percent) were treated at dry-off, while 5.9 percent were not treated.

e. Percentage of operations (and percentage of cows on these operations) by percentage of cows treated with dry-cow intramammary antibiotics at dry-off during the previous 12 months:

Percent of Dry Cows Treated	Percent Operations	Standard Error	Percent Cows	Standard Error
0.0	9.9	(1.7)	5.9	(1.5)
1.0 to 33.0	5.6	(1.4)	2.7	(0.9)
33.1 to 66.0	3.0	(0.8)	2.4	(0.8)
66.1 to 99.9	9.2	(1.8)	7.3	(1.3)
100.0	72.3	(2.7)	81.7	(2.3)
Total	100.0		100.0	

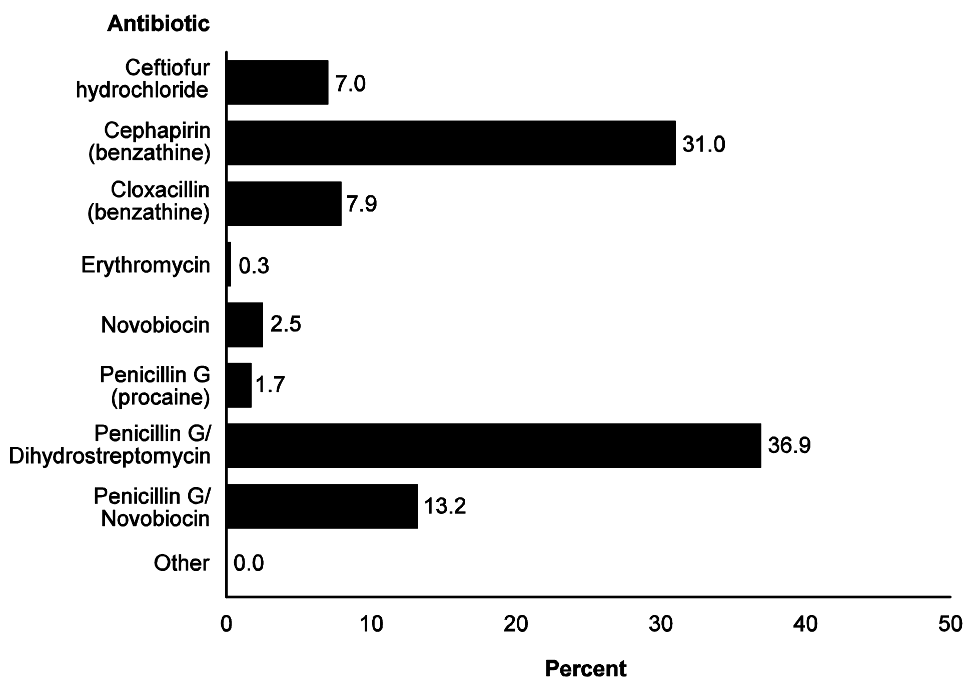
The most commonly used dry-cow antibiotics were cephapirin (31.0 percent of cows) and penicillin G (procaine)/dihydrostreptomycin (36.9 percent of cows).

f. For cows treated with dry-cow intramammary antibiotics during the previous 12 months, percentage of cows treated, by type of antibiotic:

Antibiotic	Percent Cows*	Standard Error
Ceftiofur hydrochloride	7.0	(2.0)
Cephapirin (benzathine)	31.0	(2.3)
Cloxacillin (benzathine)	7.9	(1.8)
Erythromycin	0.3	(0.1)
Novobiocin	2.5	(1.9)
Penicillin G (procaine)	1.7	(0.5)
Penicillin G (procaine)/ Dihydrostreptomycin	36.9	(3.2)
Penicillin G (procaine)/ Novobiocin	13.2	(2.4)
Other	0.0	(--)

*As a percentage of cows dry treated during the previous 12 months. Some cows were treated with more than one antibiotic.

For Cows Treated with Dry-Cow Intramammary Antibiotics During the Previous 12 Months, Percentage of Cows Treated, by Type of Antibiotic



F. Antibiotic Use

NOTE: In this section antibiotic and antimicrobial are used synonymously (see Terms Used in This Report, p 3).

1. Unweaned heifers

Almost one of four unweaned heifers had diarrhea (23.9 percent) during the previous 12 months, and 17.9 percent of all unweaned heifers were treated for diarrhea. A lower percentage of unweaned heifers had respiratory disease (12.4 percent), and 11.4 percent of heifers were treated for respiratory disease.

a. Percentage of unweaned heifers affected and treated with antibiotics for a disease or disorder during the previous 12 months:

	Percent Unweaned Heifers*			
	Affected		Treated	
Disease or Disorder	Percent	Std. Error	Percent	Std. Error
Respiratory	12.4	(1.3)	11.4	(1.3)
Diarrhea or other digestive problem	23.9	(1.9)	17.9	(1.7)
Navel infection	1.6	(0.2)	1.5	(0.2)
Other	0.6	(0.2)	0.6	(0.2)

*As a percentage of dairy heifer calves born alive in 2006.

More than 9 of 10 of calves affected with respiratory disease or navel infection were treated with an antibiotic (93.4 and 92.3 percent, respectively). Almost three-fourths of unweaned calves affected with diarrhea (74.5 percent) were treated with an antibiotic.

b. For unweaned heifers affected with a disease or disorder during the previous 12 months, percentage of unweaned heifers treated with an antibiotic:

Disease or Disorder	Percent Affected Unweaned Heifers Treated	Standard Error
Respiratory	93.4	(2.3)
Diarrhea or other digestive problem	74.5	(4.8)
Navel infection	92.3	(2.4)
Other	97.2	(1.9)

Two-thirds of all operations (66.7 percent) used an antibiotic to treat respiratory disease in unweaned heifers. The primary antibiotics used to treat respiratory disease were florfenicol, macrolide, and beta-lactam (18.3, 15.2, and 11.6 percent of all operations, respectively). More than 6 of 10 operations (62.1 percent) treated unweaned heifers with diarrhea with antibiotics, while 17.4 percent of operations with unweaned heifers that had diarrhea did not treat these animals with antibiotics. The most commonly used primary antibiotics used for diarrhea were tetracycline, “other,” beta-lactam, and sulfonamide (16.2, 10.5, 9.4, and 9.2 percent, of all operations, respectively). The primary antibiotics from the “other” category included trimethoprim sulfamethoxazole, amprolium, and lincomycin/spectinomycin. Navel infection was treated on 28.7 percent of operations, and the primary antibiotics used were beta-lactam (21.2 percent of all operations). Less than 5 percent of all operations (4.5 percent) treated for other diseases.

c. Percentage of operations (including those not reporting diseases or disorders) by primary antibiotic used to treat unweaned heifers during the previous 12 months, and by disease or disorder treated:

	Percent Operations							
	Disease/Disorder							
	Respiratory		**Diarrhea***		**Navel Infection**		**Other**	
Primary Antibiotic Used	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Aminocyclitol	0.0	(0.0)	1.7	(0.7)	0.0	(--)	0.0	(--)
Aminoglycoside	0.6	(0.4)	4.0	(1.1)	0.0	(0.0)	0.4	(0.4)
Beta-lactam	11.6	(2.0)	9.4	(1.8)	21.2	(2.5)	1.4	(0.7)
Cephalosporin	8.2	(1.5)	5.6	(1.1)	2.2	(0.6)	0.5	(0.4)
Florfenicol	18.3	(2.2)	4.0	(1.1)	1.1	(0.5)	0.0	(0.0)
Macrolide	15.2	(2.1)	1.5	(0.5)	0.8	(0.4)	0.3	(0.2)
Sulfonamide	1.9	(0.7)	9.2	(1.5)	0.9	(0.9)	0.2	(0.1)
Tetracycline	8.9	(1.7)	16.2	(2.3)	1.4	(0.4)	1.0	(0.6)
Other/unknown	2.0	(0.7)	10.5	(1.8)	1.1	(0.6)	0.7	(0.5)
Any antibiotic	66.7	(2.8)	62.1	(2.8)	28.7	(2.6)	4.5	(1.1)
No treatment but disease	1.4	(0.6)	17.4	(2.2)	2.5	(0.7)	0.2	(0.2)
No disease or disorder	31.9	(2.8)	20.5	(2.4)	68.8	(2.7)	95.3	(1.2)
Total	100.0		100.0		100.0		100.0	

*Or other digestive problem.

The majority of unweaned heifers treated for respiratory disease were on operations that used florfenicol, cephalosporin, macrolide, or tetracycline (25.4, 24.6, 19.8, and 13.2 percent of unweaned heifers, respectively). To treat diarrhea, sulfonamide, tetracycline, and “other” were the antibiotics used on operations for the highest percentage of unweaned heifers.

d. Of unweaned heifers treated with antibiotics during the previous 12 months, percentage of unweaned heifers by primary antibiotic used on the operation for the following diseases/disorders:

	Percent Treated Unweaned Heifers							
	Disease/Disorder							
	Respiratory		Diarrhea*		Navel Infection		Other	
Primary Antibiotic Used	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Aminocyclitol	0.1	(0.1)	5.1	(2.0)	0.0	(--)	0.0	(--)
Aminoglycoside	2.4	(1.7)	11.5	(3.9)	0.3	(0.2)	0.9	(0.9)
Beta-lactam	7.9	(2.1)	11.0	(2.8)	69.6	(7.9)	12.9	(6.4)
Cephalosporin	24.6	(8.5)	9.5	(2.3)	5.0	(1.7)	4.0	(3.4)
Florfenicol	25.4	(5.5)	5.2	(1.8)	3.7	(2.0)	0.2	(0.2)
Macrolide	19.8	(3.7)	2.8	(1.6)	11.6	(8.9)	15.2	(10.3)
Sulfonamide	3.3	(1.8)	23.3	(6.2)	1.8	(1.8)	10.2	(9.1)
Tetracycline	13.2	(3.3)	16.5	(2.9)	6.7	(3.2)	24.8	(16.5)
Other	3.3	(1.5)	15.1	(3.0)	1.3	(0.6)	31.8	(18.6)
Total	100.0		100.0		100.0		100.0	

*Or other digestive problem.

2. Weaned heifers

More than half of operations (50.9 percent) used antibiotics in rations for weaned heifers, including 32.7 percent that used only ionophores.

a. Percentage of operations by use of antibiotics in weaned-heifer rations during the previous 12 months to prevent disease or promote growth:

Usage	Percent Operations	Standard Error
Antibiotics in heifer ration	18.2	(2.0)
Ionophores only in heifer rations	32.7	(2.6)
Did not know if antibiotics were in heifer ration	2.3	(0.9)
No antibiotics in heifer ration	44.2	(2.8)
No weaned heifers on operation	2.6	(0.8)
Total	100.0	

The majority of operations that used antibiotics in weaned heifer rations used ionophores (84.9 percent) followed by chlortetracycline (14.4 percent) and oxytetracycline compounds (10.9 percent).

b. For operations that used antibiotics in rations for weaned dairy heifers during the previous 12 months, percentage of operations by antibiotic used:

Antibiotic Used	**Percent Operations**	**Standard Error**
Bacitracin methylene disalicylate	0.0	(--)
Bambermycin	0.5	(0.5)
Chlortetracycline compounds	14.4	(2.3)
Neomycin sulfate	4.1	(1.8)
Ionophores	84.9	(2.8)
Neomycin-oxytetracycline	5.4	(1.9)
Oxytetracycline compounds	10.9	(2.2)
Sulfamethazine	5.7	(1.5)
Tylosin phosphate	0.0	(--)
Virginiamycin	0.2	(0.2)
Other antibiotics	2.0	(1.4)

Few weaned heifers were affected by or treated for disease. Only 5.9 percent of weaned heifers were affected with respiratory disease, and 5.5 percent of all weaned heifers were treated with antibiotics. Diarrhea was reported in 1.9 percent of weaned heifers, and 1.6 percent of all weaned heifers were treated. Less than 2 percent of weaned heifers had other diseases or disorders.

c. Percentage of weaned heifers affected and treated with antibiotics for a disease or disorder during the previous 12 months:

	Percent Weaned Heifers*			
	Affected		Treated	
Disease or Disorder	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Respiratory	5.9	(0.5)	5.5	(0.5)
Diarrhea or other digestive problem	1.9	(0.7)	1.6	(0.7)
Other	1.7	(0.6)	1.4	(0.6)

*As a percentage of weaned heifer inventory on January 1, 2007.

More than 9 of 10 weaned heifers affected with respiratory disease (93.3 percent) were treated with antibiotics. About 8 of 10 weaned heifers with diarrhea or other digestive problems (85.4 percent) were treated.

d. For weaned heifers affected with a disease or disorder during the previous 12 months, percentage of weaned heifers treated with an antibiotic:

Disease or Disorder	Percent Affected Weaned Heifers Treated	Standard Error
Respiratory	93.3	(1.8)
Diarrhea or other digestive problem	85.4	(7.8)
Other	81.3	(8.9)

Almost half of operations (49.2 percent) treated some weaned heifers for respiratory disease, while only 7.4 percent treated for diarrhea and 6.2 percent treated for other diseases. The primary antibiotics used on operations for respiratory disease in weaned heifers were florfenicol and tetracycline (12.4 and 11.0 percent of operations, respectively). Antibiotics used to treat diarrhea in weaned calves included "other" (primarily amprolium), beta-lactam, and tetracycline. Other diseases were treated with beta-lactam and tetracycline on 3.3 and 1.9 percent of operations, respectively.

e. Percentage of operations (including those not reporting diseases or disorders) by primary antibiotic used to treat weaned heifers during the previous 12 months, and by disease or disorder:

	Percent Operations					
	Disease/Disorder					
	Respiratory		Diarrhea*		Other	
Primary Antibiotic Used	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Aminocyclitol	0.4	(0.2)	0.0	(--)	0.0	(--)
Aminoglycoside	0.0	(--)	0.2	(0.1)	0.0	(--)
Beta-lactam	7.8	(1.6)	1.6	(0.8)	3.3	(1.1)
Cephalosporin	4.5	(1.3)	0.7	(0.2)	0.2	(0.2)
Florfenicol	12.4	(1.7)	0.4	(0.2)	0.0	(--)
Macrolide	8.0	(1.2)	0.2	(0.2)	0.2	(0.2)
Sulfonamide	1.5	(0.5)	0.4	(0.1)	0.2	(0.1)
Tetracycline	11.0	(1.7)	1.4	(0.5)	1.9	(0.6)
Other	3.6	(1.1)	2.5	(0.7)	0.4	(0.2)
Any antibiotic	49.2	(2.9)	7.4	(1.3)	6.2	(1.3)
No treatment but disease	5.1	(1.4)	4.2	(1.1)	4.7	(1.5)
No disease	45.7	(2.9)	88.4	(1.6)	89.1	(1.9)
Total	100.0		100.0		100.0	

*Or other digestive problem.

The majority of weaned heifers treated for respiratory disease were on operations that primarily treated with florfenicol, tetracycline, and macrolide. Tetracycline was the primary antibiotic used on operations to treat more than 50 percent of weaned heifers with diarrhea or “other” diseases (55.1 and 67.0 percent, respectively).

f. Of weaned heifers treated with antibiotics during the previous 12 months, percentage of weaned heifers by primary antibiotic used on the operation for the following diseases/disorders:

	Percent Treated Weaned Heifers					
	Disease/Disorder					
	Respiratory		Diarrhea*		Other	
Primary Antibiotic Used	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Aminocyclitol	2.8	(2.5)	0.0	(--)	0.0	(--)
Aminoglycoside	0.0	(--)	0.0	(--)	0.0	(--)
Beta-lactam	3.4	(0.8)	3.9	(2.8)	24.1	(14.2)
Cephalosporin	9.8	(2.8)	3.2	(2.3)	0.9	(0.9)
Florfenicol	30.3	(4.9)	10.0	(8.3)	0.0	(--)
Macrolide	15.6	(3.2)	0.2	(0.2)	0.5	(0.4)
Sulfonamide	4.1	(1.7)	2.0	(1.2)	1.7	(1.4)
Tetracycline	25.0	(4.7)	55.1	(22.2)	67.0	(16.2)
Other	9.0	(3.5)	25.6	(15.1)	5.8	(4.1)
Total	100.0		100.0		100.0	

*Or other digestive problem.

3. Cows

Mastitis was the disease that affected the highest percentage of cows (18.2 percent), and, not surprisingly, the highest percentage of cows were treated for mastitis (16.4 percent). Lameness and reproductive diseases affected 12.5 and 10.0 percent of cows, respectively, and 7.1 and 7.4 percent of all cows were treated for lameness and reproductive diseases, respectively.

a. Percentage of cows affected and treated with antibiotics for a disease or disorder during the previous 12 months:

	Percent Cows*			
	Affected		**Treated**	
Disease or Disorder	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Respiratory	2.9	(0.2)	2.8	(0.2)
Diarrhea or other digestive problem	6.0	(0.6)	1.9	(0.2)
Reproductive	10.0	(0.7)	7.4	(0.7)
Mastitis	18.2	(0.9)	16.4	(0.8)
Lameness	12.5	(0.9)	7.1	(0.7)
Other	0.7	(0.2)	0.5	(0.1)

*As a percentage of cow inventory on January 1, 2007.

More than 95 percent of cows with respiratory disease (96.4 percent) were treated with antibiotics, while 89.9 percent of cows with mastitis were treated. Less than one-third of cows with diarrhea or digestive disease (32.3 percent) were treated with antibiotics.

b. For cows affected with a disease or disorder during the previous 12 months, percentage of cows treated with an antibiotic:

Disease or Disorder	**Percent Affected Cows Treated**	**Standard Error**
Respiratory	96.4	(1.2)
Diarrhea or other digestive problem	32.3	(4.0)
Reproductive	74.7	(3.1)
Mastitis	89.9	(1.3)
Lameness	56.5	(4.1)
Other	66.2	(12.7)

More than 8 of 10 operations (85.4 percent) treated cows for mastitis. About half of operations treated cows for respiratory disease, reproductive disease, or lameness. One-quarter of operations treated cows for diarrhea. Third-generation cephalosporin was the primary antibiotic used to treat all diseases listed, with the exception of reproductive diseases. Cephalosporin was most likely used because some products require no milk withdrawal, and slaughter withdrawal is relatively short compared to other antibiotics. Beta-lactam was the primary antibiotic used to treat respiratory diseases on 10.5 percent of operations, reproductive diseases on 13.5 percent, mastitis on 16.9 percent, and lameness on 13.6 percent of operations. Lincosamide was the primary antibiotic used to treat mastitis on 15.8 percent of operations. Tetracycline was the primary antibiotic used for reproductive and lameness on 17.7 and 18.6 percent of operations, respectively.

c. Percentage of operations (including those not reporting diseases or disorders) by primary antibiotic used to treat cows during the previous 12 months, and by disease or disorder:

	Percent Operations											
	Disease or Disorder											
	Respiratory		Diarrhea*		Repro-ductive		Mastitis		Lameness		Other	
Primary Antibiotic Used	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Aminocyclitol	1.0	(0.5)	0.0	(--)	0.6	(0.6)	1.1	(0.6)	0.0	(--)	0.0	(--)
Aminoglycoside	0.3	(0.3)	0.6	(0.3)	0.0	(--)	0.5	(0.4)	0.0	(--)	0.0	(--)
Beta-lactam	10.5	(1.8)	8.8	(1.6)	13.5	(2.0)	16.9	(2.0)	13.6	(2.1)	3.0	(1.1)
Cephalosporin	33.0	(2.7)	11.3	(1.8)	17.2	(2.0)	44.5	(2.9)	23.0	(2.2)	1.8	(0.7)
Florfenicol	2.4	(0.9)	0.3	(0.2)	0.2	(0.2)	0.0	(--)	0.3	(0.2)	0.0	(--)
Lincosamide							15.8	(2.1)				
Macrolide	1.2	(0.6)	0.6	(0.4)	0.0	(--)	0.3	(0.2)	0.2	(0.1)	0.0	(--)
Sulfonamide	1.7	(0.8)	1.3	(0.4)	0.1	(0.1)	1.8	(0.9)	1.4	(0.4)	0.0	(--)
Tetracycline	4.7	(1.0)	1.1	(0.4)	17.7	(2.1)	2.5	(0.7)	18.6	(2.2)	0.6	(0.4)
Other	1.0	(0.5)	1.1	(0.6)	3.6	(1.3)	2.0	(1.0)	1.5	(0.6)	1.5	(0.8)
Any antibiotic	55.8	(2.9)	25.0	(2.4)	52.9	(2.8)	85.4	(2.2)	58.6	(2.9)	6.9	(1.5)
No treatment but disease	3.5	(1.2)	31.6	(2.7)	21.8	(2.5)	7.7	(1.5)	17.2	(2.4)	3.5	(1.2)
No disease	40.7	(2.9)	43.4	(2.9)	25.3	(2.5)	6.9	(1.7)	24.2	(2.6)	89.6	(1.8)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

*Or other digestive problem.

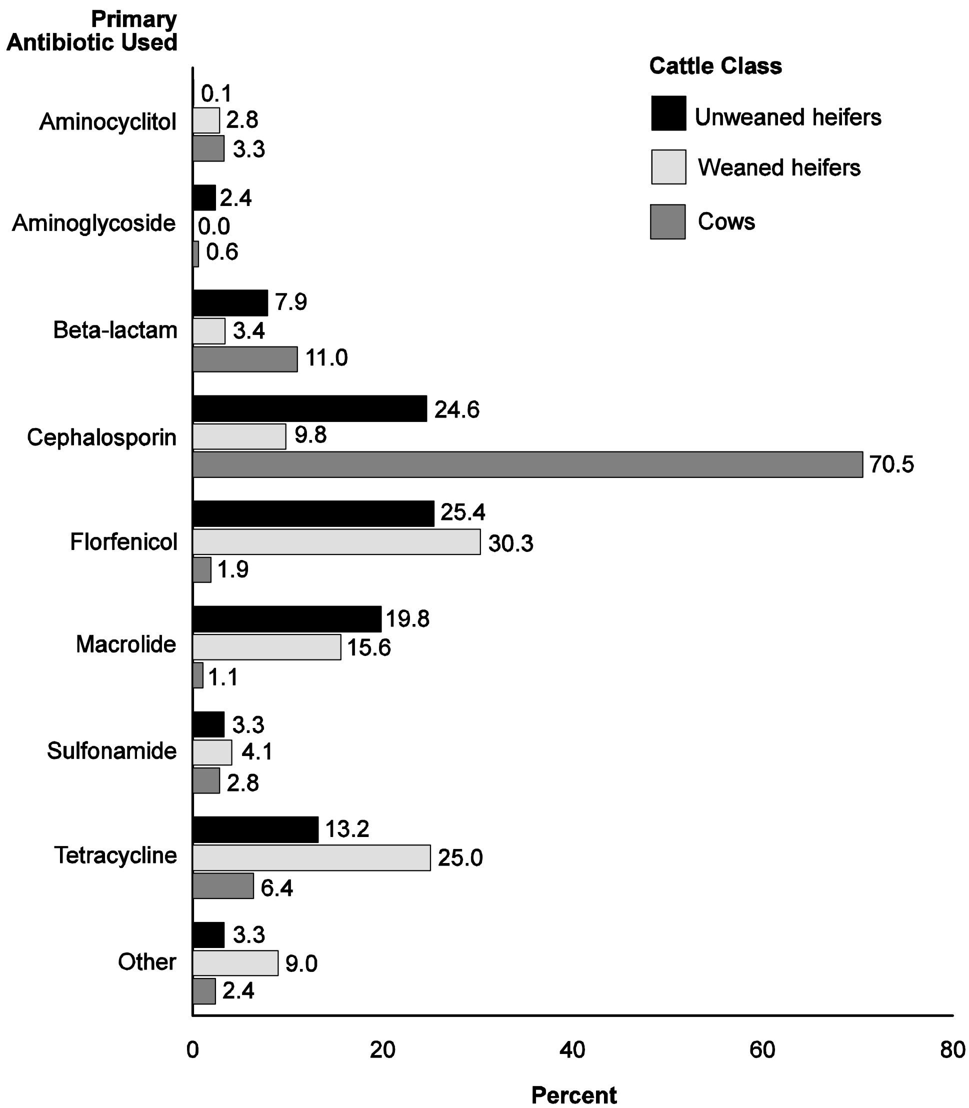
The primary antibiotics used to treat cows with specific diseases or disorders were similar to the primary antibiotics used at the operation level. Beta-lactam was the primary antibiotic used on operations for more than 19 percent of cows treated for diarrhea, reproductive disease, mastitis, and lameness. Cephalosporin was the primary antibiotic used on 70.5 percent of cows treated for respiratory disease, 53.2 percent treated for mastitis, 36.0 treated for diarrhea, and approximately 27 percent of cows treated for reproductive or lameness problems. Lincosamide was used on 19.4 percent of cows with mastitis. Sulfonamide was the primary antibiotic used on 15.6 percent of cows with diarrhea. Tetracycline was used to treat more than 4 of 10 cows with reproductive disease or lameness (44.4 and 42.1 percent, respectively).

d. Of cows treated with antibiotics during the previous 12 months, percentage of cows by primary antibiotic used on the operation for the following diseases/disorders:

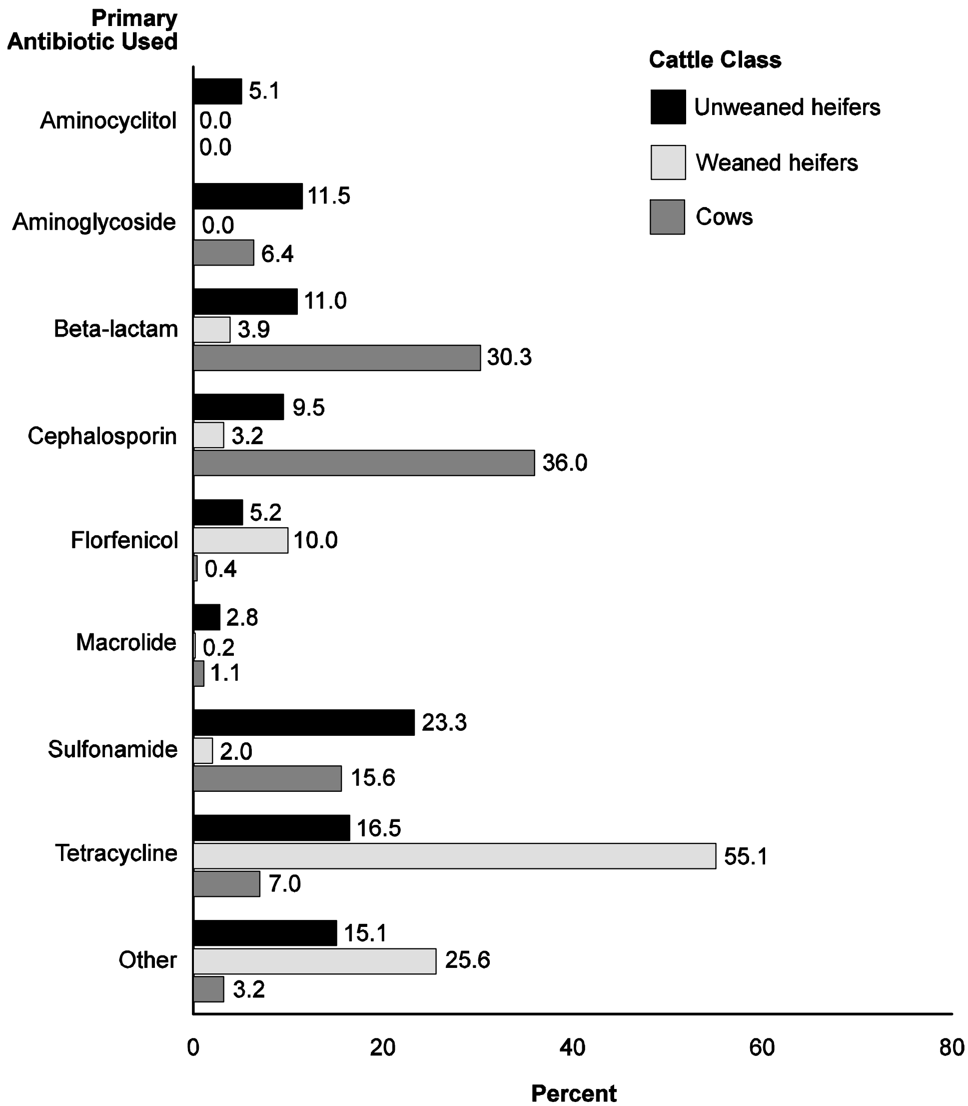
	Percent Treated Cows											
	Disease/Disorder											
	Respiratory		Diarrhea*		Repro-ductive		Mastitis		Lameness		Other	
Primary Antibiotic Used	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Aminocyclitol	3.3	(1.6)	0.0	(--)	0.2	(0.2)	2.9	(2.0)	0.0	(--)	0.0	(--)
Aminoglycoside	0.6	(0.5)	6.4	(4.4)	0.0	(--)	0.2	(0.2)	0.0	(--)	0.0	(--)
Beta-lactam	11.0	(2.5)	30.3	(5.7)	19.7	(3.8)	19.1	(3.0)	19.5	(5.4)	29.9	(11.6)
Cephalosporin	70.5	(3.9)	36.0	(5.9)	27.9	(4.7)	53.2	(4.1)	27.2	(3.8)	23.6	(11.5)
Florfenicol	1.9	(0.7)	0.4	(0.4)	0.2	(0.2)	0.0	(--)	0.5	(0.3)	0.0	(--)
Lincosamide							19.4	(3.1)				
Macrolide	1.1	(0.5)	1.1	(0.8)	0.0	(--)	0.2	(0.2)	0.5	(0.3)	0.0	(--)
Sulfonamide	2.8	(1.4)	15.6	(6.6)	0.2	(0.2)	1.2	(0.5)	4.2	(1.4)	0.0	(--)
Tetracycline	6.4	(1.6)	7.0	(2.9)	44.4	(6.0)	2.0	(0.7)	42.1	(5.4)	2.6	(1.9)
Other	2.4	(1.3)	3.2	(2.2)	7.4	(4.5)	1.8	(0.9)	6.0	(3.0)	43.9	(16.6)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

*Or other digestive problem.

For Cattle Treated for Respiratory Disease During the Previous 12 Months, Percentage of Cattle by Class and by Primary Antibiotic Used for Treatment



For Cattle Treated for Diarrhea or Other Digestive Problems During the Previous 12 Months, Percentage of Cattle by Class and by Primary Antibiotic Used for Treatment



Historical effectiveness was the predominant criterion for mastitis treatment (86.4 percent of operations). Veterinary recommendation was reported as a criterion on 46.3 percent of operations.

e. For operations that treated lactating cows for mastitis with an intramammary antibiotic during the previous 12 months, percentage of operations by criterion for treatment:

Criterion	**Percent Operations**	**Standard Error**
Veterinary recommendation	46.3	(3.0)
Historical effectiveness	86.4	(2.1)
Historical culture and antimicrobial sensitivity results	20.9	(2.2)
Individual cow culture results prior to therapy	20.2	(2.3)
Other	4.0	(1.1)

Section II: Methodology

A. Needs Assessment

NAHMS develops study objectives by exploring existing literature and contacting industry members about their informational needs and priorities during a needs-assessment phase. The objective of the needs assessment for the NAHMS Dairy 2007 study was to collect information from U.S. dairy producers and other dairy specialists about what they perceived to be the most important dairy health and productivity issues. A driving force of the needs assessment was the desire of NAHMS to receive as much input as possible from a variety of producers, industry experts and representatives, veterinarians, extension specialists, universities, and dairy organizations. Information was collected via focus groups and through a Needs Assessment Survey.

Focus group teleconferences and meetings were held to help determine the focus of the study.

Teleconference, March 30, 2006
National Johne's Working Group

Louisville, KY, April 2, 2006
National Johne's Working Group
National Institute for Animal Agriculture

Louisville, KY, April 3, 2006
National Milk Producers Federation
Animal Health Committee

Teleconference, December 15, 2006
Bovine Alliance on Management and Nutrition

The Needs Assessment Survey was designed to ascertain the top three management issues, diseases/disorders, and producer incentives from producers, veterinarians, extension personnel, university researchers, and allied industry groups. The survey, created in SurveyMonkey, was available online from early February through late April 2006. The survey was promoted via electronic newsletters, magazines, and Web sites. Organizations/magazines promoting the study included Vance Publishing's "Dairy Herd Management, Dairy Alert," "Dairy Today," "Hoard's Dairyman," NMC, "Journal of the American Veterinary Medical Association," and the American Association of Bovine Practitioners. E-mail messages asking for input were also sent to cooperative members of the National Milk Producers Federation as well as State and Federal personnel. A total of 313 people completed the questionnaire.

Universities/extension personnel accounted for 23 percent of respondents, while producers accounted for 22 percent, and veterinarians/consultants accounted for another 20 percent.

Fort Collins, CO, May 18, 2006
CEAH Focus Group meeting

Draft objectives for the Dairy 2007 study, using input from teleconferences, face-to-face meetings, and the online survey, were drafted prior to the CEAH focus group meeting. Attendees included producers, university/extension personnel, veterinarians, and government personnel. The day-long meeting culminated in the formulation of eight objectives for the study:

- Describe trends in dairy cattle health and management practices,
- Evaluate management factors related to cow comfort and removal rates,
- Describe dairy-calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices,
- Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVD),
- Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens,
- Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis* (Johne's disease),
- Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices, and
- Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns.

B. Sampling and Estimation

1. State selection

The preliminary selection of States to be included in the study was done in February 2006, using the National Agricultural Statistics Service (NASS) January 27, 2006, "Cattle Report." A goal for NAHMS national studies is to include States that account for at least 70 percent of the animals and producer population in the United States. The initial review of States identified 16 major States representing 82.0 percent of the milk cow inventory and 79.3 percent of the operations with milk cows (dairy herds). The States were: California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Washington, and Wisconsin.

A memo identifying these 16 States was provided in March 2006 to the USDA-APHIS-VS CEAH Director and, in turn, the VS Regional Directors. Each Regional Director sought input from the respective States about being included or excluded from the study. Virginia expressed interest in participating and was included, bringing the total number of States to 17.

2. Operation selection

The list sampling frame was provided by NASS. Within each State a stratified random sample was selected. The size indicator was the number of milk cows for each operation. NASS selected a sample of dairy producers in each State for making the January 1 cattle estimates. The list sample from the January 2006 survey was used as the screening sample. Among producers reporting one or more milk cows on January 1, 2006, a total of 3,554 operations were selected in the sample for contact in January 2007 during Phase I.

Operations with 30 or more dairy cows that participated in Phase I were invited to participate in data collection for Phase II. A total of 1,077 operations agreed via written consent to be contacted by veterinary medical officers to determine whether to complete Phase II.

3. Population inferences

a. Phase I: General Dairy Management Report

Inferences cover the population of dairy producers with at least 1 milk cow in the 17 participating States. As of January 1, 2007, these States accounted for 82.5 percent (7,536,000 head) of milk cows and 79.5 percent (59,640) of operations with milk cows in the United States. (See Appendix II for respective data on individual States.) All respondent data were statistically weighted to reflect the population from which it was selected. The inverse of the probability of selection for each operation was the initial selection weight. This selection weight was adjusted for nonresponse within each State and size group to allow for inferences back to the original population from which the sample was selected.

b. Phase II: VS Initial Visit

Inferences cover the population of dairy producers with 30 or more milk cows in the 17 participating States. For operations eligible for Phase II data collection (those with 30 or more milk cows) weights were adjusted to account for operations that did not want to continue to Phase II. The 17-State target population of operations with 30 or more dairy cows represented 82.5 percent of dairy cows and 84.7 percent of U.S. dairy operations with 30 or more milk cows (see Appendix II).

C. Data Collection

1. Phase I: General Dairy Management Report

From January 1-31, 2007, NASS enumerators administered the General Dairy Management Report. The interview took slightly over 1 hour.

2. Phase II: VS Initial Visit

From February 26 to April 30, 2007, Federal and State veterinary medical officers (VMOs) and/or animal health technicians (AHTs) collected the data from producers during an interview that lasted approximately 2 hours.

D. Data Analysis

1. Validation

a. Phase I: Validation—General Dairy Management Report

Initial data entry and validation for the General Dairy Management Report were performed in individual NASS State offices. Data were entered into a SAS® data set. NAHMS national staff performed additional data validation on the entire data set after data from all States were combined.

b. Phase II: Validation—VS Initial Visit Questionnaires

After completing the VS Initial Visit Questionnaires, data collectors sent them to their respective State NAHMS Coordinators who reviewed the questionnaire responses for accuracy. Data entry and validation were completed by CEAH staff using SAS.

E. Sample Evaluation

The purpose of this section is to provide various performance measurement parameters. Historically, the term “response rate” was used as a catch-all parameter, but there are many ways to define and calculate response rates. Therefore, the table below presents an evaluation based upon a number of measurement parameters, which are defined with an “x” in categories that contribute to the measurement.

1. Phase I: General Dairy Management Report

A total of 3,554 operations were selected for the survey. Of these operations, 3,304 (93.0 percent) were contacted. There were 2,519 operations that provided usable inventory information (70.9 percent of the total selected and 76.2 percent of those contacted). In addition, there were 2,194 operations (61.7 percent) that provided "complete" information for the questionnaire. Of operations that provided complete information and were eligible to participate in Phase II (VMO collection) of the study (2,067 operations), 1,077 (52.1 percent) consented to be contacted for consideration/discussion about further participation.

			Measurement Parameter		
Response Category	**Number Operations**	**Percent Operations**	**Contacts**	**Usable[1]**	**Complete[2]**
Survey complete and VMO consent	1,077	30.3	x	x	x
Survey complete, refused VMO consent	990	27.9	x	x	x
Survey complete, ineligible[3] for VMO	127	3.6	x	x	x
No dairy cows on January 1, 2007	214	6.0	x	x	
Out of business	111	3.1	x	x	
Out of scope	6	0.2			
Refusal of GDMR	785	22.1	x		
Office hold (NASS elected not to contact)	126	3.5			
Inaccessible	118	3.3			
Total	3,554	100.0	3,304	2,519	2,194
Percent of total operations			93.0	70.9	61.7
Percent of total operations weighted[4]			94.0	74.1	59.6

[1]Useable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions for at least one site.
[3]Ineligible—less than 30 head of milk cows on January 14, 2007.
[4]Weighted response—the rate was calculated using the initial selection weights.

2. Phase II: VS Initial Visit

There were 1,077 operations that provided consent during Phase I to be contacted by a veterinary medical officer for Phase II. Of these 1,077, 582 (54.0 percent) agreed to continue in Phase II of the study and completed the VMO Initial Visit Questionnaire; 380 (35.3 percent) refused to participate. Approximately 10 percent of the 1,077 operations were not contacted, and 0.4 percent were ineligible because they had no dairy cows at the time they were contacted by the VMO during Phase II.

			Measurement Parameter		
Response Category	**Number Operations**	**Percent Operations**	**Contacts**	**Usable[1]**	**Complete[2]**
Survey complete	582	54.0	x	x	x
Survey refused	380	35.3	x		
Not contacted	111	10.3			
Ineligible[3]	4	0.4	x	x	
Total	1,077	100.0	966	586	582
Percent of total operations			89.7	54.4	54.0
Percent of total operations weighted[4]			87.5	50.8	50.4

[1]Useable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—no dairy cows at time of interview, which occurred from February 26 through April 30, 2007.
[4]Weighted response—the rate was calculated using the turnover weights.

Appendix I: Sample Profile

A. Responding Operations

1. Number of responding operations, by herd size

	Phase I: General Dairy Management Report	Phase II: VS Initial Visit
Herd Size (Number of Cows)	**Number of Responding Operations**	
Fewer than 100	1,028	233
100 to 499	691	215
500 or more	475	134
Total	2,194	582

2. Number of responding operations, by region

	Phase I: General Dairy Management Report	Phase II: VS Initial Visit
Region	**Number of Responding Operations**	
West	426	108
East	1,768	474
Total	2,194	582

Appendix II: Antibiotic/Antimicrobial Class

Antibiotic/ Antimicrobial Class	Product Name	Active Ingredient
Aminocyclitol	Adspec®	Spectinomycin
Aminoglycoside	AmTech Neomycin Oral Solution	Neomycin
	Biosol® Liquid	Neomycin sulfate
	Gentamicin	Gentamicin
	Neomix Ag® 325 Soluble Powder	Neomycin sulfate
	Neomix® 325 Soluble Powder	Neomycin sulfate
	Neomycin 325 Soluble Powder	Neomycin sulfate
	Neomycin Oral Solution	Neomycin sulfate
	Neo-Sol 50	Neomycin sulfate
	Strep Sol 25%	Streptomycin sulfate
	Streptomycin Oral Solution	Streptomycin
Beta-lactam	Agri-Cillin™	Penicillin G procaine
	Amoxi-Bol®	Amoxicillin
	Amoxi-Inject ®	Amoxicillin
	Amoxi-Mast® Intramammary Infusion	Amoxicillin
	Aquacillin™	Penicillin G procaine
	Aqua-Mast Intramammary Infusion	Penicillin G (procaine)
	Combi-Pen™-48	Penicillin G (benzathine)
	Crysticillin 300 AS Vet.	Penicillin G procaine
	Dariclox® Intramammary Infusion	Cloxacillin (sodium)
	Duo-Pen®	Penicillin G benzathine; procaine
	Durapen™	Penicillin G benzathine; procaine
	Hanford's/US Vet Masti-Clear Intramammary Infusion	Penicillin G (procaine)
	Hanford's/US Vet/Han-Pen G/Ultrapen	Penicillin G Procaine
	Hanford's/US Vet/Han-Pen-B/Ultrapen B	Penicillin G (benzathine)
	Hetacin®K Intramammary Infusion	Hetacillin (potassium)
	Microcillin	Penicillin G procaine
	Pen-G Max™	Penicillin G (procaine)
	Penicillin G Procaine	Penicillin G procaine
	PFI-Pen G®	Penicillin G procaine
	Polyflex®	Ampicillin
	Princillin Bolus	Ampicillin trihydrate
	Pro-Pen-G™ Injection	Penicillin G procaine

Antibiotic/ Antimicrobial Class	Product Name	Active Ingredient
Cephalosporin	Cefa-Lak®/Today Intramammary Infusion	Cephapirin (sodium)
	Excede™ Sterile Suspension	Ceftiofur crystalline free acid
	Excenel® RTU	Ceftiofur hydrochloride
	Naxcel®	Ceftiofur sodium
	Spectramast™ LC Intramammary Infusion	Ceftiofur
	ToDAY® Intramammary Infusion	Cephapirin (sodium)
Florfenicol	Nuflor Injectable Solution	Florfenicol
Lincosamide	Pirsue® Intramammary Infusion	Pirlimycin
Macrolide	Draxxin™	Tulathromycin
	Gallimycin®-100 Injection	Erythromycin
	Gallimycin®-36 Intramammary Infusion	Erythromycin
	Micotil® 300 Injection	Tilmicosin phosphate
	Tylan Injection 50/200 Tylosin Injection	Tylosin
Other	AS700	Chlortetracycline/sulfamethazine
	CORID 20% Soluble Powder	Amprolium
	CORID 9.6% Oral Solution	Amprolium
	Deccox-M	Decoquinate
	Linco-Spectin® Sterile Solution	Lincomycin/Spectinomycin
	TMZ	Trimethoprim sulfamethoxazole
Sulfonamide	20% SQX Solution	Sulfaquinoxaline
	Albon® Bolus	Sulfadimethoxine
	Albon® Concentrated Sol.12.5%	Sulfadimethoxine
	Albon® Injection 40%	Sulfadimethoxine
	Albon® SR Bolus	Sulfadimethoxine
	Di-Methox & 12.5% Oral Solution	Sulfadimethoxine
	Di-Methox Injection 40%	Sulfadimethoxine
	Di-Methox Soluble Powder	Sulfadimethoxine
	Liquid Sul-Q-Nox	Sulfaquinoxaline (sodium)
	SDM Injection	Sulfadimethoxine
	SDM Injection 40%	Sulfadimethoxine
	SDM Solution	Sulfadimethoxine
	Sulfadimethoxine 12.5% Oral Solution	Sulfadimethoxine
	Sulfadimethoxine Inj. 40%	Sulfadimethoxine
	Sulfadimethoxine Soluble Powder	Sulfadimethoxine
	Sulfa-Nox Concentrate	Sulfaquinoxaline
	Sulfa-Nox Liquid	Sulfaquinoxaline (sodium)
	Sulfaquinoxaline Sodium Solution 20%	Sulfaquinoxaline (sodium)
	SulfaSure™ SR Cattle/Calf Bolus	Sulfamethazine
	Sulmet® Drinking Water Solution 12.5%	Sulfamethazine (sodium)
	Sulmet® Oblets®	Sulfamethazine
	Sulmet® Soluble Powder	Sulfamethazine (sodium)
	Sustain III® Cattle Bolus	Sulfamethazine
	Vetisulid Injection	Sulfachlorpyridazine (sodium)
	Vetisulid Powder	Sulfachlorpyridazine (sodium)

Antibiotic/ Antimicrobial Class	Product Name	Active Ingredient
Tetracycline	Agrimycin™ 100	Oxytetracycline hydrochloride
	Agrimycin™ 200	Oxytetracycline hydrochloride
	AmTech Oxytetracycline HCL Solution Powder - 343	Oxytetracycline
	Aureomycin® Soluble Powder	Chlortetracycline hydrochloride
	Aureomycin® Soluble Powder Concentrate	Chlortetracycline hydrochloride
	Bio-Mycin® 200	Oxytetracycline
	Bio-Mycin® C	Oxytetracycline hydrochloride
	CLTC 100 MR	Chlortetracycline calcium
	Duramycin-100	Oxytetracycline hydrochloride
	Duramycin-200	Oxytetracycline hydrochloride
	Liquamycin® LA-200®	Oxytetracycline
	Maxim-200®	Oxytetracycline
	Maxim™-100	Oxytetracycline hydrochloride
	Oxy 500 and 1000 Calf Bolus	Oxytetracycline hydrochloride
	Oxybiotic™ 200	Oxytetracycline
	Oxycure™ 100	Oxytetracycline hydrochloride
	Oxy-Mycin™ 100	Oxytetracycline hydrochloride
	Oxy-Mycin™ 200	Oxytetracycline hydrochloride
	Oxytetracycline HCL Soluble Powder	Oxytetracycline hydrochloride
	Oxytetracycline HCL Soluble Powder 343	Oxytetracycline hydrochloride
	Panmycin® 500 Bolus	Tetracycline hydrochloride
	Pennchlor™ 64 Soluble Powder	Chlortetracycline hydrochloride
	Pennox™ 200 Injectable	Oxytetracycline
	Pennox™ 343 Soluble Powder	Oxytetracycline hydrochloride
	Polyotic® Soluble Powder	Tetracycline hydrochloride
	Promycin™ 100	Oxytetracycline hydrochloride
	Solu/Tet Soluble Powder	Tetracycline hydrochloride
	Terramycin® 343 Soluble Powder	Oxytetracycline hydrochloride
	Terramycin® Scours Tablets	Oxytetracycline hydrochloride
	Terramycin® Soluble Powder	Oxytetracycline hydrochloride
	Terra-Vet 100	Oxytetracycline hydrochloride
	Tet-324	Tetracycline hydrochloride
	Tetra-Bac 324	Tetracycline hydrochloride
	Tetracycline HCL Soluble Powder-324	Tetracycline hydrochloride
	Tetradure™ 300	Oxytetracycline
	Tetrasol Soluble Powder	Tetracycline hydrochloride
	Tet-Sol™ 324	Tetracycline hydrochloride

Appendix III: U.S. Milk Cow Population and Operations

		Number of Milk Cows, January 1, 2007* (Thousand Head)		Number of Operations 2006*		Average Herd Size	
Region	State	Milk cows on operations with 1 or more head	Milk cows on operations with 30 or more head	Operations with 1 or more head	Operations with 30 or more head	Operations with 1 or more head	Operations with 30 or more head
West	California	1,790	1,788.2	2,200	1,920	813.6	931.4
	Idaho	502	501.0	800	620	627.5	808.1
	New Mexico	360	358.9	450	180	800.0	1,993.9
	Texas	347	344.2	1,300	660	266.9	521.5
	Washington	235	234.3	790	540	297.5	433.9
	Total	3,234	3,226.6	5,540	3,920	583.8	823.1
East	Indiana	166	154.4	2,100	1,150	79.0	134.3
	Iowa	210	203.7	2,400	1,870	87.5	108.9
	Kentucky	93	86.5	2,000	1,180	46.5	73.3
	Michigan	327	320.5	2,700	1,910	121.1	167.8
	Minnesota	455	441.3	5,400	4,800	84.3	91.9
	Missouri	114	108.3	2,600	1,400	43.8	77.4
	New York	628	612.3	6,400	5,100	98.1	120.1
	Ohio	274	252.1	4,300	2,400	63.7	105.0
	Pennsylvania	550	536.3	8,700	7,000	63.2	76.6
	Vermont	140	137.2	1,300	1,100	107.7	124.7
	Virginia	100	97.0	1,300	820	76.9	118.3
	Wisconsin	1,245	1,213.9	14,900	12,800	83.6	94.8
	Total	4,302	4,163.5	54,100	41,530	79.5	100.3
Total (17 States)		7,536	7,390.1	59,640	45,450	126.4	162.6
Percentage of U.S.		82.5	82.5	79.5	84.7		
Total U.S. (50 States)		9,132.0	8,958.5	74,980	53,680	121.8	166.9

*Source: NASS Cattle report, February 2, 2007, and NASS Farms, Land in Farms, and Livestock Operations 2006 Summary report, February 2007. An operation is any place having one or more head of milk cows, excluding cows used to nurse calves, on hand at any time during the year.

Updates: NASS Cattle report, February 1, 2008, and NASS Farms, Land in Farms, and Livestock Operations 2007 Summary report, February 1, 2008.

Appendix IV: Study Objectives and Related Outputs

1. Describe trends in dairy cattle health and management practices
• Part II: Changes in the U.S. Dairy Cattle Industry 1991-2007, March 2008
• Part V: Changes in Dairy Cattle Health and Management in the United States, 1991-2007, 2007, expected fall 2008

2. Evaluate management factors related to cow comfort and removal rates
• Dairy Facilities and Cow Comfort on U.S Dairy Operations, 2007, interpretive Report, expected fall 2008

3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices
• Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
• Off-Site Heifer Raising on U.S. Dairy Operations, 2007, info sheet, November 2007
• Colostrum Feeding and Management on U.S. dairy Operations, 1991-2007, info sheet, March 2008
• Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, expected fall 2008
• Calf Health and Management Practices on U.S. Dairy Operations, 2007, interpretive report, expected fall 2008
• Calving Management on U.S. Dairy Operations, 2007, info sheet, expected fall 2008

4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVD)
• Bovine Viral Diarrhea (BVD) Detection in Bulk Tank Milk and BVD Management Practices in the United States, 1996-2007, info sheet, expected September 2008

5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens
• **Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008**
• Milking Procedures on U.S. Dairy Operations, 2007, info sheet, expected September 2008

6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis*
• Johne’s Disease on U.S. Dairies, 1991-2007, info sheet, April 2008

7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices

• Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007

• **Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008**

• Biosecurity Practices on U.S. Dairy operations, 2002-2007, interpretive report, expected fall 2008

8. Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns

• Antibiotic Use on U.S. Dairy Operations, 2002-2007, info sheet, expected September 2008

• Prevalence of *Salmonella and Listeria* in Bulk Tank Milk on U.S. Dairy Operations, 2007, info sheet, expected September 2008

• *Salmonella* and *Campylobacter* on U.S. Dairy Operations, 2002-2007, info sheet, expected fall 2008

• Food Safety Pathogens Isolated from U.S. Dairy Operations, 2007, interpretive report, expected winter 2008

Additional informational sheets

• Dairy Cattle Identification Practices in the United States, 2007, info sheet, November 2007

• Reproduction Practices on U.S. Dairy Operations, 2007, info sheet, expected fall 2008

• Bovine Leukosis Virus (BLV) on U.S. Dairy Operations, 2007, info sheet, expected September 2008

• Dairy Cattle Injection Practices in the United States, 2007, info sheet, expected fall 2008

• Methicillin-Resistant *Staphylococcus aureus* (MRSA) Isolation from Bulk Tank Milk in the United States, 2007, info sheet, expected fall 2008

United States
Department of
Agriculture

Animal and
Plant Health
Inspection
Service

Veterinary
Services

National
Animal Health
Monitoring
System

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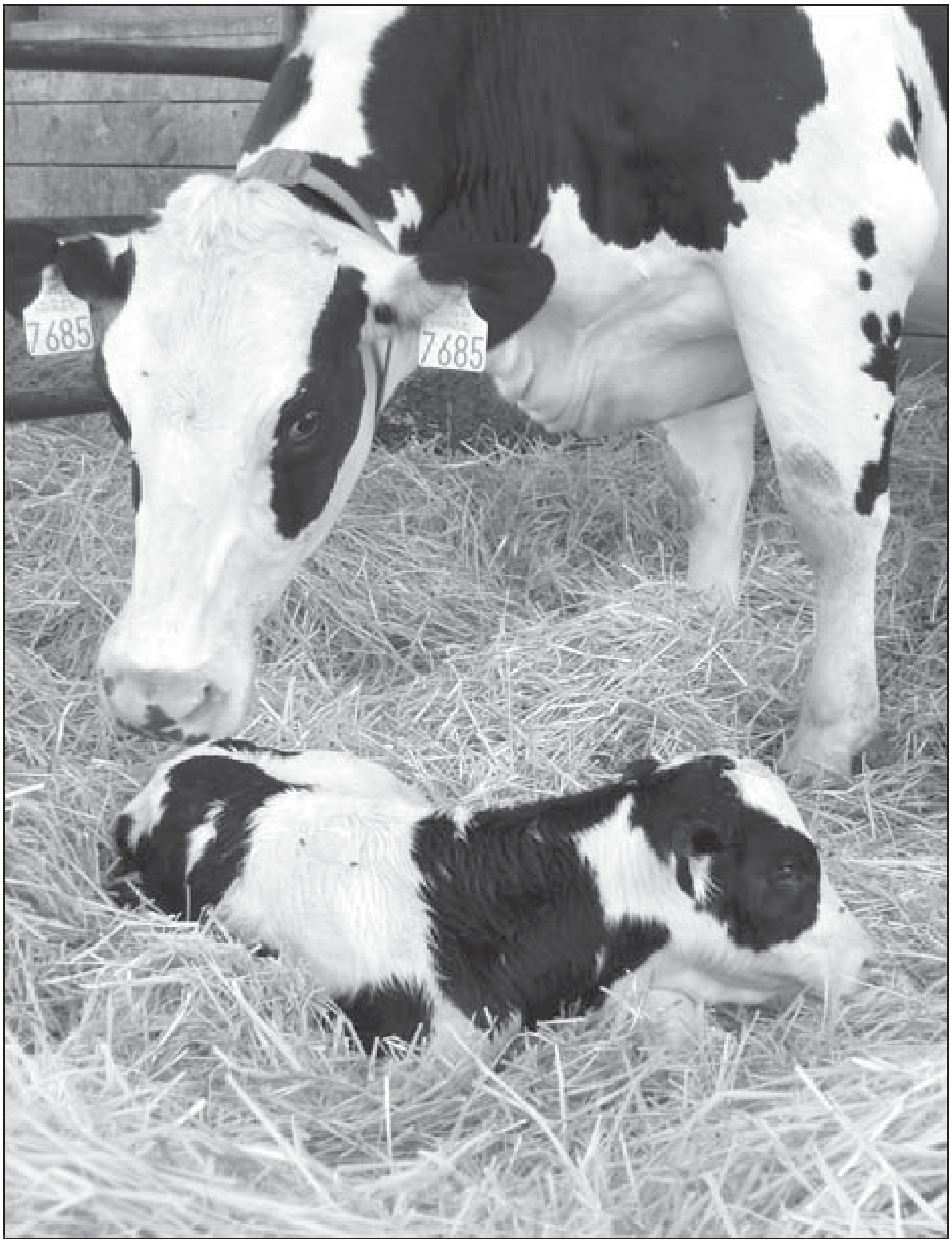
Dairy 2007

Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007



USDA-APHIS-VS-CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

#N494.0209

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Dr. Jason Lombard

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- University of Wisconsin, Madison; and
- Wisconsin Veterinary Diagnostic Laboratory.

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Larry M. Granger
Director
Centers for Epidemiology and Animal Health

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Contacts for further information:
Questions or comments on data analysis: Dr. Jason Lombard—970.494.7000
Information on reprints or other reports: Ms. Abigail Fienhold—970.494.7000
E-mail: NAHMS@aphis.usda.gov

Table of Contents

Introduction

The National Animal Health Monitoring System (NAHMS) is a nonregulatory program of the Animal and Plant Health Inspection Service (APHIS), a branch of the United States Department of Agriculture (USDA). Designed to help meet the animal health information needs of a variety of stakeholders, NAHMS has collected data on dairy health and management practices through three previous studies.

The NAHMS 1991–92 National Dairy Heifer Evaluation Project (NDHEP) provided the dairy industry's first national information on the health and management of dairy cattle in the United States. Just months after the study's first results were released in 1993, cases of acute bovine viral diarrhea (BVD) surfaced in the United States following a 1993 outbreak in Canada. NDHEP information on producer vaccination and biosecurity practices helped officials address the risk of disease spread and target educational efforts on vaccination protocols. When an outbreak of human illness related to *Escherichia coli* O157:H7 was reported in 1993 in the Pacific Northwest, NDHEP data on the bacteria's prevalence in dairy cattle helped officials define public risks as well as research needs. This baseline picture of the industry also helped identify additional research and educational needs in various production areas, such as feed management and weaning age.

Information from the NAHMS Dairy 1996 Study helped the U.S. dairy industry identify educational needs and prioritize research efforts on such timely topics as antibiotic use; Johne's disease; digital dermatitis; bovine leukosis virus (BLV); and potential foodborne pathogens, including *E. coli*, *Salmonella*, and *Campylobacter.*

Two major goals of the Dairy 2002 Study were to describe management strategies that prevent and reduce Johne's disease and to determine management factors associated with *Mycoplasma* and *Listeria* in bulk-tank milk. The study was designed also to describe levels of participation in quality assurance programs, the incidence of digital dermatitis, animal-waste handling systems used on U.S. dairy operations, and industry changes since the NDHEP in 1991 and Dairy 1996.

The Dairy 2007 Study was conducted in 17 of the Nation's major dairy States (see map on next page) and provides valuable information to participants, stakeholders, and the industry as a whole. Dairy operations and cows in these States represent 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. Results are presented in a variety of publications, including the following reports.

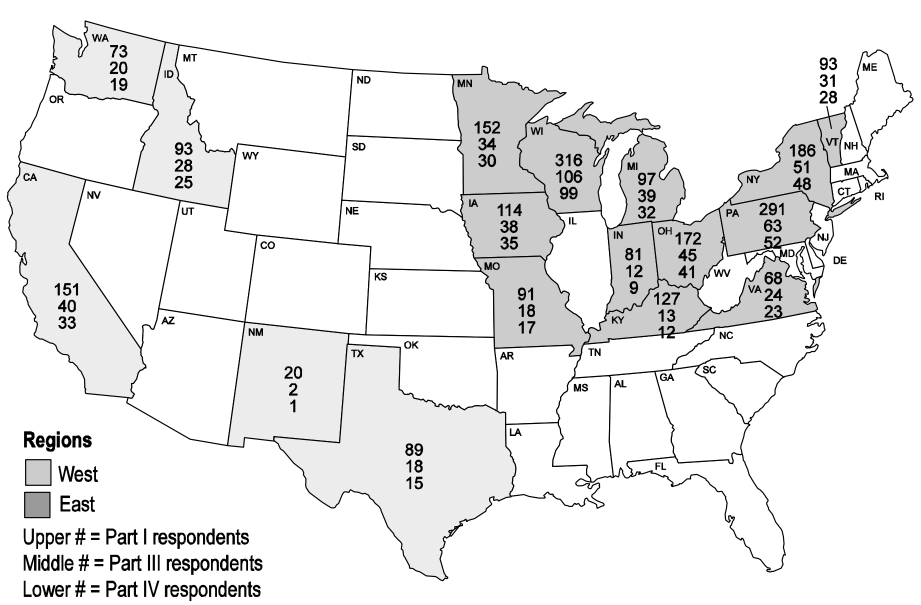
• Part 1: Reference of Dairy Cattle Health and Management Practices in the United States, 2007 (October 2007)—The first in a series of reports containing national information from the NAHMS Dairy 2007 Study, this report contains information collected from 2,194 dairy operations.

• Part II: Changes in the United States Dairy Industry, 1991–2007 (March 2008)—This report presents trends by providing national estimates of animal-health management practices for comparable populations from the NAHMS 1991–92 NDHEP, Dairy 1996, Dairy 2002, and Dairy 2007 studies.

• Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007 (September 2008)—This report presents national information from 582 operations with 30 or more dairy cows, a subset of the 2,194 operations described in Part I. State and Federal veterinary medical officers (VMOs) and animal health technicians (AHTs) conducted questionnaire interviews with producers and collected biological samples for analysis between February 26 and April 30, 2007.

• Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007—This report presents national information from 519 operations with 30 or more dairy cows, a subset of the 582 operations described in Part III. State and Federal VMOs and AHTs conducted questionnaire interviews with producers and collected biological samples for analysis between May 1 and August 31, 2007.

Dairy 2007 Participating States and Number of Respondents by State



Information on the methods used and number of respondents in the study can be found at the end of this report.

All Dairy 2007 Study reports, as well as reports from previous NAHMS dairy studies, are available online at http://nahms.aphis.usda.gov.

For questions about this report or additional copies, please contact

USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000

Terms Used In This Report

Cow: Female dairy bovine that has calved at least once.

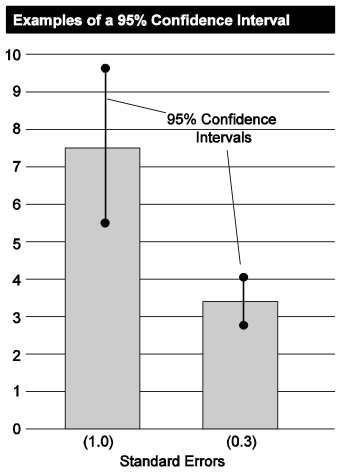
Estrous: Pertaining to estrus or in reference to the entire reproductive cycle (i.e., estrous cycle).

Estrus: Also referred to as "heat," the period of time during the reproductive cycle when the female displays interest in mating and will stand to be mounted. Behavioral signs of estrus, in addition to standing to be mounted, include passage of clear mucus from the vulva and swelling of the vulva.

Heifer: Female dairy bovine that has not yet calved.

Herd size: Herd size is based on January 1, 2007, inventory. Small herds are those with fewer than 100 cows, medium herds are those with 100 to 499 cows, and large herds are those with 500 or more cows.

Operation average: The average value for all operations. A single value for each operation is summed over all operations reporting divided by the number of operations reporting. For example, operation average voluntary waiting period (see table a. on p 5) is calculated by summing voluntary waiting period (in days) over all operations divided by the number of operations.



Population estimates: Estimates in this report are provided with a measure of precision called the **standard error.** A 95-percent confidence interval can be created with bounds equal to the estimate plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean 95 out of 100 times. In the example to the left, an estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). The second estimate of 3.4 shows a standard error of 0.3, which results in limits of 2.8 and 4.0. Alternatively, the 90-percent confidence interval would be created by multiplying the standard error by 1.65 instead of 2. Most estimates in this report are rounded to the nearest tenth. If rounded to 0, the standard error was reported (0.0). If there were no reports of the event, no standard error was reported (--).

Regions:
- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

Sample profile: Information that describes characteristics of the operations from which Dairy 2007 data were collected.

Section I: Population Estimates

A. Reproduction

1. Voluntary waiting period

The time between calving and subsequent rebreeding is referred to as the voluntary waiting period. This period of time allows uterine involution, including the clearing of material and bacteria associated with parturition and return of the uterus to its prepregnancy size. Normally, uterine involution occurs within 20 to 30 days of parturition. In addition, it has been reported that 20 to 30 percent of cows are not cycling at 60 days in milk. Increasing the voluntary waiting period may increase fertility but can also result in increased days open.

The operation average voluntary waiting period was 54.8 days. The length of the voluntary waiting period did not differ by herd size.

a. Operation average number of days after calving cows were declared eligible to be bred (elective or voluntary waiting period) during the previous 12 months, and by herd size:

Operation Average Number Days							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Avg.	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
55.2	(1.2)	53.4	(1.3)	56.1	(1.9)	54.8	(0.9)

More than one-half of dairy operations (53.5 percent) waited an average of 51 to 60 days after calving to start breeding cows during the previous 12 months. The low percentage of operations (2.3 percent) with a voluntary waiting period of 0 to 20 days likely housed bulls with all lactating cows. More than 9 of 10 operations (92.3 percent) declared cows eligible to be bred by 70 days after calving.

b. Percentage of operations by number of days after calving cows were declared eligible to be bred (elective or voluntary waiting period) during the previous 12 months:

Number of Days	Percent Operations	Standard Error
0 to 20	2.3	(0.9)
21 to 30	6.0	(1.4)
31 to 40	4.9	(1.2)
41 to 50	21.5	(2.3)
51 to 60	53.5	(2.8)
61 to 70	4.1	(1.0)
71 or more	7.7	(1.6)
Total	100.0	

2. Estrus (heat) detection

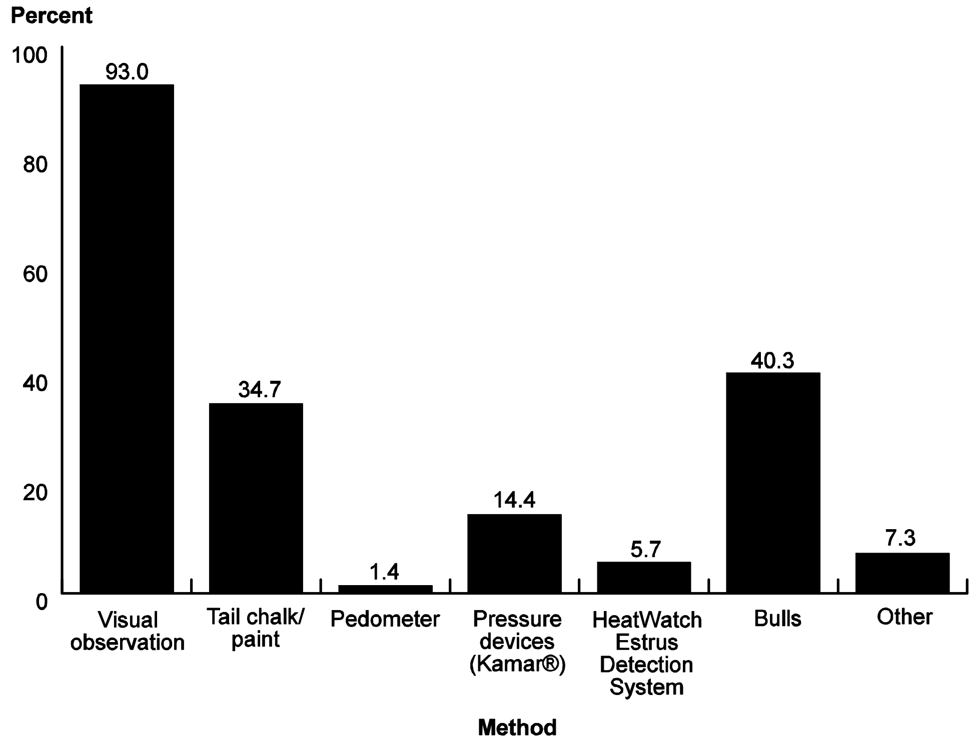
Detecting estrus is important in artificial insemination programs that do not rely exclusively on timed insemination. Research has shown that the duration and intensity of estrus in dairy cows have declined over time. Additionally, cows that spend a majority of time on concrete flooring have less-intense estrus. Recently developed methods to monitor estrus include electronic pedometers that measure increased activity, which is typical of cows in estrus, and electronic systems such as HeatWatch®, a device glued to the tailhead that detects the pressure of a mounting animal and transmits information about mounting activity.

The most common method used to detect estrus on operations during the previous 12 months was visual observation, with 93.0 percent of all operations using this practice. Bulls or tail chalk/paint were used to detect estrus by 40.3 and 34.7 percent of operations, respectively. Electronic methods of detection—pedometers and HeatWatch—were used by a low percentage of operations (1.4 and 5.7 percent, respectively). Visual observation to detect estrus was used by a higher percentage of small and medium operations (93.5 and 95.5 percent, respectively) than large operations (77.7 percent) during the previous 12 months. A higher percentage of large operations used tail chalk/ paint or pedometers (66.0 and 9.2 percent, respectively) than did small and medium operations. Although 51.7 percent of operations had bulls for breeding purposes (reported on p 72 of Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007), only 40.3 percent of operations used bulls to detect estrus. These operations may have housed bulls separately from cows and used other methods to detect estrus.

a. Percentage of operations by method used to detect estrus (heat) during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Visual observation	93.5	(1.8)	95.5	(1.3)	77.7	(6.0)	93.0	(1.3)
Tail chalk/paint	31.2	(3.6)	36.4	(4.1)	66.0	(6.0)	34.7	(2.7)
Pedometer	0.6	(0.4)	1.5	(0.7)	9.2	(3.0)	1.4	(0.4)
Pressure devices (Kamar®)	15.6	(2.8)	12.2	(2.8)	10.3	(4.0)	14.4	(2.1)
HeatWatch Estrus Detection System	5.2	(1.7)	7.4	(2.3)	4.8	(2.4)	5.7	(1.3)
Bulls	38.4	(4.0)	44.1	(4.5)	46.2	(6.1)	40.3	(3.0)
Other	5.9	(1.9)	10.1	(2.9)	10.9	(3.7)	7.3	(1.5)

Percentage of Operations by Method Used to Detect Estrus (Heat) During the Previous 12 Months



The only regional differences in estrus-detection methods were for visual observation and tail chalk/paint. Visual observation was used by a lower percentage of operations in the West region (73.0 percent) than in the East region (94.9 percent). The percentage of operations that used tail chalk/paint in the West region was almost twice that of the East region (61.6 and 32.1 percent, respectively).

b. Percentage of operations by method used to detect estrus (heat) during the previous 12 months, by region:

	Percent Operations			
	Region			
	West		East	
Method	Percent	Std. Error	Percent	Std. Error
Visual observation	73.0	(5.6)	94.9	(1.4)
Tail chalk/paint	61.6	(5.1)	32.1	(2.9)
Pedometer	0.9	(0.6)	1.4	(0.4)
Pressure devices (Kamar)	12.2	(4.2)	14.7	(2.2)
HeatWatch Estrus Detection System	4.4	(2.1)	5.8	(1.4)
Bulls	45.5	(6.1)	39.8	(3.2)
Other	7.3	(2.7)	7.3	(1.6)

Visual observation for estrus is generally accomplished by one of two methods. Either the owner/employees casually watch females for signs of estrus while performing other tasks around the dairy, or one or more people are designated to watch females for a specified length of time during a set number of times per day. The recommended minimum amount of time for visual observation of estrus is 30 minutes three times daily.

About 6 of 10 operations (59.7 percent) that used visual observation for estrus detection had a specific person observe cows for estrus, and the percentage did not differ by herd size or region.

c. For the 93.0 percent of operations that used visual observation for estrus (heat) detection, percentage of operations that had a designated person(s) specifically responsible for visually observing estrus, and by herd size:

Percent Operations

Herd Size (Number of Cows)

Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
61.2	(4.1)	53.6	(4.7)	69.1	(6.6)	59.7	(3.1)

d. For the 93.0 percent of operations that used visual observation for estrus (heat) detection, percentage of operations that had a designated person(s) specifically responsible for visually observing estrus, by region:

Percent Operations

Region

West		**East**	
Percent	**Standard Error**	**Percent**	**Standard Error**
71.2	(6.2)	58.8	(3.3)

For operations that used visual observation for estrus detection, 37.9 percent had a set number of times per day and duration each time for observing estrus. No herd size or regional differences were observed.

e. For the 93.0 percent of operations that used visual observation for estrus (heat) detection, percentage of operations that had a set number of times per day and duration each time for observing estrus, and by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
35.5	(4.0)	42.9	(4.6)	45.4	(6.8)	37.9	(3.0)

f. For the 93.0 percent of operations that used visual observation for estrus (heat) detection, percentage of operations that had a set number of times per day and duration each time for observing estrus, by region:

Percent Operations			
Region			
West		**East**	
Percent	**Standard Error**	**Percent**	**Standard Error**
48.2	(6.8)	37.1	(3.2)

For operations with a set number of times per day and duration each time for visually detecting estrus, one-half (50.3 percent) observed cows twice daily, while 31.1 percent observed cows three or more times daily.

g. For the 37.9 percent of operations with a set number of times per day and duration each time for observing estrus (heat), percentage of operations by number of times cows were visually observed for estrus:

Times Per Day	Percent Operations	Standard Error
1	18.6	(3.5)
2	50.3	(4.6)
3	15.3	(3.0)
4 or more	15.8	(3.2)
Total	100.0	

For operations with a set number of times per day and duration each time for visually observing cows for estrus, about one-third of operations (35.6 percent) observed cows for 11 to 20 minutes each time cows were observed. Overall, more than one-half of operations reported visually observing cows for estrus 20 minutes or less at each visual observation period.

h. For the 37.9 percent of operations with a set number of times per day and duration each time for observing estrus (heat), percentage of operations by duration each time cows were visually observed for estrus:

Duration Each Time (Minutes)	Percent Operations	Standard Error
10 or less	27.1	(4.1)
11 to 20	35.6	(4.4)
21 to 30	16.1	(3.5)
31 to 40	0.4	(0.2)
41 or more	20.8	(3.8)
Total	100.0	

For operations with a set number of times per day to observe cows for estrus, the operation average number of minutes per day that cows were observed was 62.5 minutes. Although the time spent visually observing estrus appears different by herd size, the differences were not significant.

i. For the 37.9 percent of operations with a set number of times per day and duration each time for observing for estrus (heat), operation average total duration per day in minutes that cows were visually observed for estrus, and by herd size:

Operation Average Number Minutes							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Avg.	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
61.1	(7.4)	60.7	(6.1)	85.9	(11.4)	62.5	(5.2)

Of operations visually observing cows for estrus a set number of times per day, approximately one-third of operations (30.3 percent) observed estrus for 21 to 40 minutes per day. Approximately 20 percent of operations observed for estrus 20 minutes or less, 41 to 60 minutes, or 81 or more minutes per day.

j. For the 37.9 percent of operations with a set number of times per day and duration each time for observing for estrus (heat), percentage of operations by total duration per day in minutes that cows were visually observed for estrus:

Duration Per Day (Minutes)	**Percent Operations**	**Standard Error**
20 or less	22.9	(3.9)
21 to 40	30.3	(4.3)
41 to 60	23.6	(4.0)
61 to 80	2.2	(1.5)
81 or more	21.0	(3.6)
Total	100.0	

3. Breeding practices

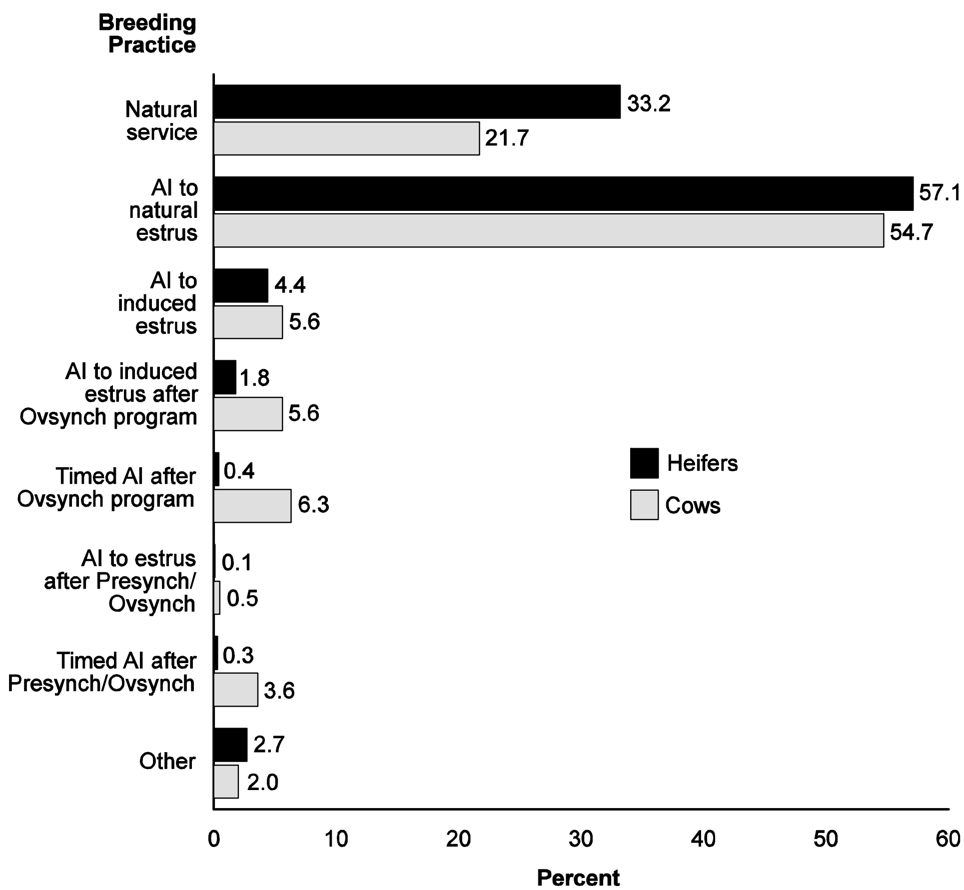
Advances in technology and increases in knowledge of cattle reproductive biology have enabled development of new methods of breeding cattle. Better understanding of dairy cattle reproduction has led to the induction of estrus and, more recently, the induction of ovulation. These two advances have allowed operations to breed cows and heifers at specific times rather than waiting for the cows to show natural estrus. One protocol, popularly known as Ovsynch, uses prostaglandins and gonadotropin-releasing hormone (GnRH) in combination to manipulate ovulation for timed artificial insemination (timed AI). The Presynch protocol involves the administration of prostaglandins to regress the corpus luteum, synchronize the timing of estrus, and/or prepare for a timed breeding program such as Ovsynch. The implementation of an additional Ovsynch protocol for the second or greater service is termed Resynch.

More than one-half of operations surveyed used artificial insemination (AI) to natural estrus for first service for the majority of heifers and cows (57.1 and 54.7 percent, respectively) during the previous 12 months. Natural service was used for the first service by one-third of operations (33.2 percent) for heifers and one-fifth of operations (21.7 percent) for cows. Timed-AI programs (timed AI after the Ovsynch protocol or after Presynch/Ovsynch) were used more frequently for first service of cows than heifers.

a. Percentage of operations by ***first-service*** breeding practice used for the majority of heifers and cows during the previous 12 months:

	Percent Operations			
	Heifers		Cows	
Breeding Practice	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Natural service (bull-bred)	33.2	(3.0)	21.7	(2.7)
AI to natural estrus (no injections given to induce estrus)	57.1	(3.0)	54.7	(3.0)
AI to induced estrus (prostaglandin injections only)	4.4	(1.0)	5.6	(1.3)
AI to induced estrus after Ovsynch program (prostaglandin and GnRH injections)	1.8	(0.8)	5.6	(1.3)
Timed AI after Ovsynch program (prostaglandin and GnRH injections)	0.4	(0.2)	6.3	(1.4)
AI to estrus after Presynch/Ovsynch	0.1	(0.1)	0.5	(0.2)
Timed AI after Presynch/Ovsynch	0.3	(0.2)	3.6	(0.8)
Other	2.7	(0.8)	2.0	(0.6)
Total	100.0		100.0	

Percentage of Operations by First-service Breeding Practice Used for the Majority of Heifers and Cows During the Previous 12 Months

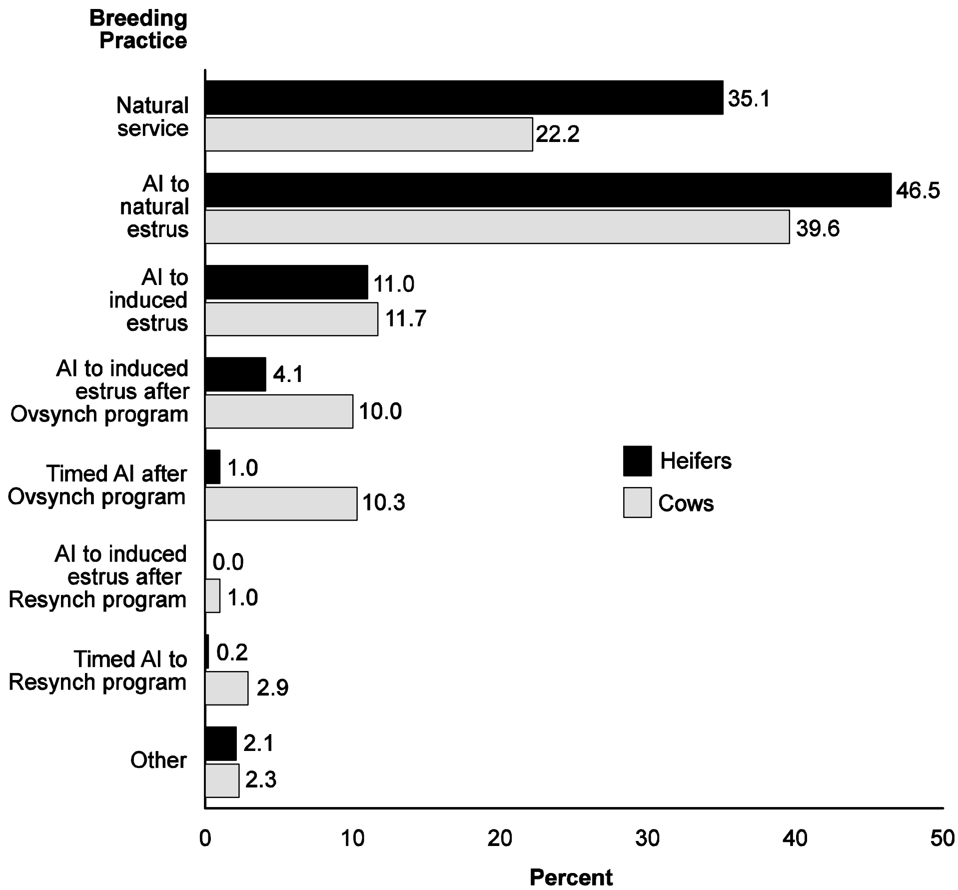


For the second or greater service, AI to natural estrus was used to breed the majority of heifers on 46.5 percent of operations and the majority of cows on 39.6 percent of operations during the previous 12 months. Bulls were used for the second or greater service for heifers on 35.1 percent of operations and for cows on 22.2 percent of operations. A higher percentage of operations used timed AI after Ovsynch or Resynch or AI to induced estrus after Resynch for the second or greater service in cows than in heifers. (The Resynch program is Ovsynch's first GnRH started 1 week prior to, or at, pregnancy diagnosis followed by prostaglandin and second GnRH injection.)

b. Percentage of operations by breeding practice used for the ***second or greater service*** for the majority of heifers and cows during the previous 12 months:

	Percent Operations			
	Heifers		**Cows**	
Breeding Practice	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Natural service (bull-bred)	35.1	(2.9)	22.2	(2.6)
AI to natural estrus (no injections given to induce estrus)	46.5	(3.0)	39.6	(3.0)
AI to induced estrus (prostaglandin injections only)	11.0	(2.0)	11.7	(2.0)
AI to induced estrus after Ovsynch program (prostaglandin and GnRH injections)	4.1	(1.2)	10.0	(1.8)
Timed AI after Ovsynch program (prostaglandin and GnRH injections)	1.0	(0.4)	10.3	(1.8)
AI to induced estrus after Resynch program (Ovsynch's 1st GnRH started 1 week prior to, or at, pregnancy diagnosis)	0.0	(--)	1.0	(0.4)
Timed AI to Resynch program (Ovsynch's 1st GnRH started 1 week prior to, or at, pregnancy diagnosis)	0.2	(0.1)	2.9	(0.9)
Other	2.1	(0.7)	2.3	(0.8)
Total	100.0		100.0	

Percentage of Operations by Breeding Practice Used for Second or Greater Service for the Majority of Heifers and Cows During the Previous 12 Months



More than one-half of operations (57.6 percent) used timed-AI programs for at least some cows during the previous 12 months and about one-fourth (25.4 percent) used timed-AI programs for at least some heifers. Timed-AI programs were used for either heifers or cows on 58.2 percent of operations. A higher percentage of medium operations used timed AI for cows (69.7 percent) and either heifers or cows (70.8 percent) compared with small operations (52.8 and 53.2 percent, respectively).

c. Percentage of operations that used timed-AI programs to manage reproduction in heifers, cows, or either heifers or cows during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Heifers	22.7	(3.3)	33.3	(4.2)	24.7	(5.2)	25.4	(2.5)
Cows	52.8	(4.0)	69.7	(3.8)	62.9	(6.2)	57.6	(2.9)
Either heifers or cows	53.2	(4.0)	70.8	(3.8)	62.9	(6.2)	58.2	(2.9)

Timed-AI programs for cows and either heifers or cows were used on a higher percentage of operations in the East region (59.9 and 60.3 percent) compared with 34.3 and 35.6 percent, respectively, in the West region.

d. Percentage of operations that used timed-AI programs to manage reproduction in heifers, cows, or either heifers or cows during the previous 12 months, by region:

	Percent Operations			
	Region			
	West		**East**	
Cattle Class	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Heifers	14.2	(3.7)	26.5	(2.7)
Cows	34.3	(4.8)	59.9	(3.2)
Either heifers or cows	35.6	(4.9)	60.3	(3.2)

About 4 of 10 operations (43.9 percent) that used timed-AI programs for either heifers or cows during the previous 12 months had been using timed AI for 7 years or more. More than one-third of operations (33.9 percent) had been using timed AI for 9 years or more.

e. For the 58.2 percent of operations that used timed-AI programs during the previous 12 months, percentage of operations by number of years timed-AI programs have been used:

Number of Years	Percent Operations	Standard Error
Fewer than 2.0	8.0	(2.2)
2.0 to 2.9	9.3	(2.3)
3.0 to 4.9	21.7	(3.2)
5.0 to 6.9	17.1	(2.8)
7.0 to 8.9	10.0	(2.3)
9.0 or more	33.9	(3.7)
Total	100.0	

Almost one-half of operations (48.8 percent) using timed-AI programs during the previous 12 months reported that timed AI was used only occasionally to catch up on nonpregnant cows. “Other” reasons best described use of timed AI on 5.6 percent of operations, and these included controlling only first-service, anestrus cows in addition to all reasons provided.

f. For the 58.2 percent of operations that used timed-AI programs during the previous 12 months, percentage of operations by reason that best describes why timed AI was used:

Reason	Percent Operations	Standard Error
To control all first and subsequent services	27.7	(3.2)
To control only second and greater services	17.9	(3.0)
Only occasionally to catch up on nonpregnant cows	48.8	(3.9)
Other	5.6	(1.4)
Total	100.0	

A controlled internal drug release (CIDR) insert has been approved for dairy cows and heifers since 2003. The product contains progesterone and is inserted vaginally to synchronize estrus in cattle. The CIDR insert is removed after 7 days, and estrus in nonpregnant cows is usually observed 3 to 4 days later.

Approximately one-third of operations (32.4 percent) used a CIDR insert during the previous 12 months. No significant differences were observed in the use of inserts by herd size or region.

g. Percentage of operations that used a CIDR insert during the previous 12 months, and by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
28.6	(3.5)	41.1	(4.5)	39.7	(5.5)	32.4	(2.7)

h. Percentage of operations that used a CIDR insert during the previous 12 months, by region:

Percent Operations			
Region			
West		**East**	
Percent	**Standard Error**	**Percent**	**Standard Error**
19.5	(4.2)	33.7	(2.9)

For operations that reported using a CIDR insert during the previous 12 months, nearly two-thirds of operations (65.7 percent) used inserts for anestrous females. A majority of the operations that noted “Other” as the reason for using a CIDR insert used them for problem breeders.

i. For the 32.4 percent of operations that used a CIDR insert during the previous 12 months, percentage of operations by reason(s) used:

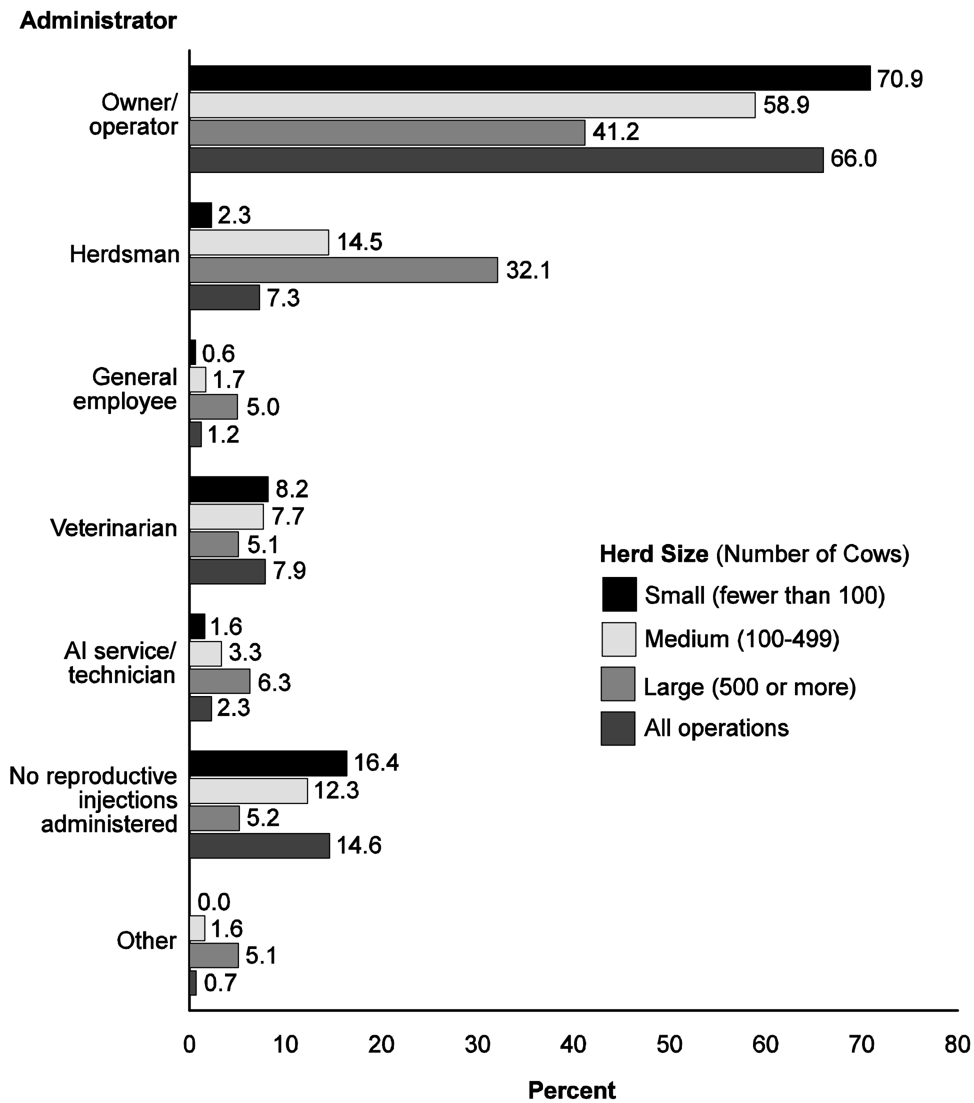
Reason	Percent Operations	Standard Error
As part of a herd synchronization program	34.3	(4.4)
Specifically for animals identified as anestrous	65.7	(4.4)
Specifically for animals identified as cystic	43.5	(4.7)
Postbreeding	15.0	(3.8)
Other	10.9	(3.1)

The owner/operator administered the majority of reproductive injections to cattle on two-thirds (66.0 percent) of all operations during the previous 12 months. For 70.9 percent of small operations and 58.9 percent of medium operations, the owner/operator gave the majority of reproductive injections. For large herds, the owner/operator gave the majority of reproductive injections on 41.2 percent of operations, with the herdsman giving the majority of reproductive injections on 32.1 percent of operations. The herdsman gave the majority of reproductive injections for fewer small operations (2.3 percent) than medium or large operations (14.5 and 32.1 percent, respectively). Reproductive injections were not administered on 16.4 percent of small operations, 12.3 percent of medium operations, and 5.2 percent of large operations.

j. Percentage of operations by person who administered the majority of reproductive injections during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Administrator	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Owner/operator	70.9	(3.7)	58.9	(4.4)	41.2	(6.2)	66.0	(2.8)
Herdsman	2.3	(1.1)	14.5	(3.0)	32.1	(5.2)	7.3	(1.1)
General employee	0.6	(0.5)	1.7	(0.8)	5.0	(2.6)	1.2	(0.4)
Veterinarian	8.2	(2.5)	7.7	(2.4)	5.1	(2.9)	7.9	(1.8)
AI service/ technician	1.6	(1.2)	3.3	(1.6)	6.3	(3.1)	2.3	(0.9)
No reproductive injections administered	16.4	(2.8)	12.3	(3.0)	5.2	(3.2)	14.6	(2.1)
Other	0.0	(--)	1.6	(1.1)	5.1	(2.8)	0.7	(0.3)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Person Who Administered the Majority of Reproductive Injections During the Previous 12 Months, and by Herd Size



The only regional difference in the administration of reproductive injections during the previous 12 months was observed for the owner/operator. The owner/operator gave the majority of reproductive injections on a lower percentage of operations in the West region (37.3 percent) than in the East region (68.7 percent).

k. Percentage of operations by person who administered the majority of reproductive injections during the previous 12 months, by region:

	Percent Operations			
	Region			
	West		East	
Administrator	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Owner/operator	37.3	(5.2)	68.7	(3.0)
Herdsman	12.4	(2.8)	6.8	(1.2)
General employee	3.1	(1.9)	1.0	(0.4)
Veterinarian	10.0	(3.6)	7.7	(1.9)
AI service/technician	8.3	(3.2)	1.7	(1.0)
No reproductive injections administered	25.6	(4.4)	13.6	(2.3)
Other	3.3	(2.1)	0.5	(0.3)
Total	100.0		100.0	

Embryo transfer (ET) can be used to obtain more offspring from cattle with superior genetics. In addition, for cattle with heat stress, ET has been shown to achieve higher pregnancy rates than routine AI. Embryos can be collected from donor cattle and then either transplanted immediately into recipient cattle or frozen for transplantation at a later date. Superovulated embryos result from eggs that are fertilized in the uterus of the dam. When the fertilization step occurs in the laboratory, the embryos are referred to as *in vitro* produced.

About 1 of 10 operations (11.5 percent) transplanted embryos into any heifers or cows during the previous 12 months. A similar percentage of each embryo type (fresh or frozen) was transplanted in heifers and cows. Fresh embryos were transplanted into heifers and/or cows on 8.2 percent of operations, while frozen embryos were transplanted into heifers and/or cows on 7.7 percent of operations.

l. Percentage of operations that transplanted fresh or frozen embryos, or either type, into heifers or cows, or either heifers or cows, during the previous 12 months:

	Percent Operations					
	Embryo Type					
	Fresh		Frozen		Either	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Heifers	7.1	(1.7)	5.2	(1.2)	8.9	(1.8)
Cows	6.1	(1.6)	4.3	(1.2)	8.6	(1.9)
Either heifers or cows	8.2	(1.8)	7.7	(1.5)	11.5	(2.0)

More than one-half of operations (54.9 percent) had cattle pregnancies conceived through natural service (bull breeding). Almost 9 of 10 operations (88.4 percent) had pregnancies conceived via AI, and about 1 of 10 operations (9.9 percent) had pregnancies via ET. A higher percentage of large operations (71.8 percent) used natural service compared with small operations (51.2 percent).

m. Percentage of operations with cattle pregnancies conceived during the previous 12 months by breeding method, and by herd size:

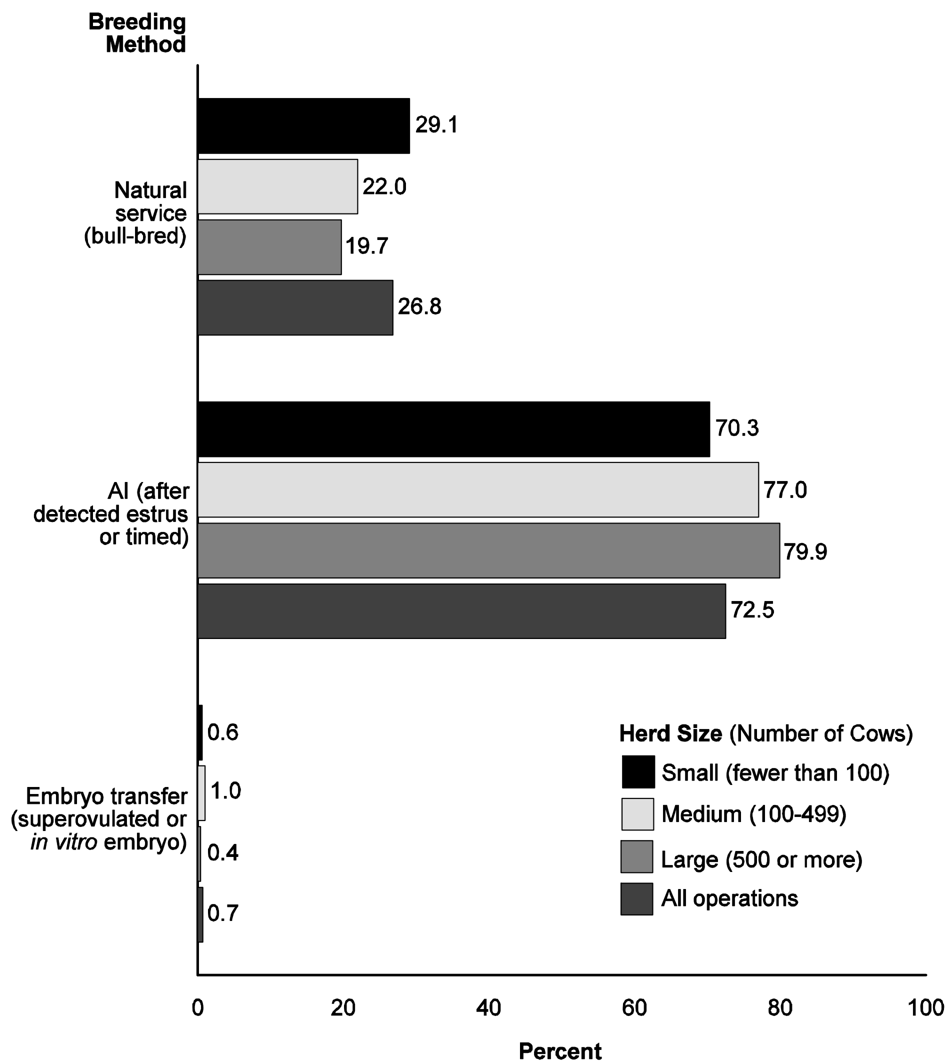
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Breeding Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Natural service (bull-bred)	51.2	(4.0)	60.9	(4.3)	71.8	(4.6)	54.9	(3.0)
AI (after detected estrus or timed)	86.4	(2.8)	93.7	(1.7)	89.6	(4.1)	88.4	(2.0)
Embryo transfer (superovulated or *in vitro* embryo)	8.5	(2.6)	13.0	(3.2)	12.7	(4.0)	9.9	(2.0)

On average, 72.5 percent of pregnancies were conceived by AI—either after detected estrus or timed—during the previous 12 months. About one-fourth of pregnancies (26.8 percent) were conceived through natural service. Less than 1 percent of pregnancies resulted from embryo transfer. No herd size differences were noted.

n. Operation average percentage of cattle pregnancies conceived during the previous 12 months by breeding method, and by herd size:

	Operation Average Percent Pregnancies							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Breeding Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Natural service (bull-bred)	29.1	(3.3)	22.0	(2.8)	19.7	(4.0)	26.8	(2.4)
AI (after detected estrus or timed)	70.3	(3.2)	77.0	(2.8)	79.9	(3.9)	72.5	(2.4)
Embryo transfer (superovulated or *in vitro* embryo)	0.6	(0.2)	1.0	(0.4)	0.4	(0.2)	0.7	(0.2)
Total	100.0		100.0		100.0		100.0	

Operation Average Percentage of Cattle Pregnancies Conceived During the Previous 12 Months by Breeding Method, and by Herd Size



There were no differences in operation average percent pregnancies by breeding method between the West and East regions.

o. Operation average percentage of cattle pregnancies conceived during the previous 12 months by breeding method, by region:

	Operation Average Percent Pregnancies			
	Region			
	West		**East**	
Breeding Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Natural service (bull-bred)	28.6	(4.5)	26.6	(2.6)
AI (after detected estrus or timed)	71.2	(4.5)	72.7	(2.6)
Embryo transfer (superovulated or *in vitro* embryo)	0.2	(0.1)	0.7	(0.2)
Total	100.0		100.0	

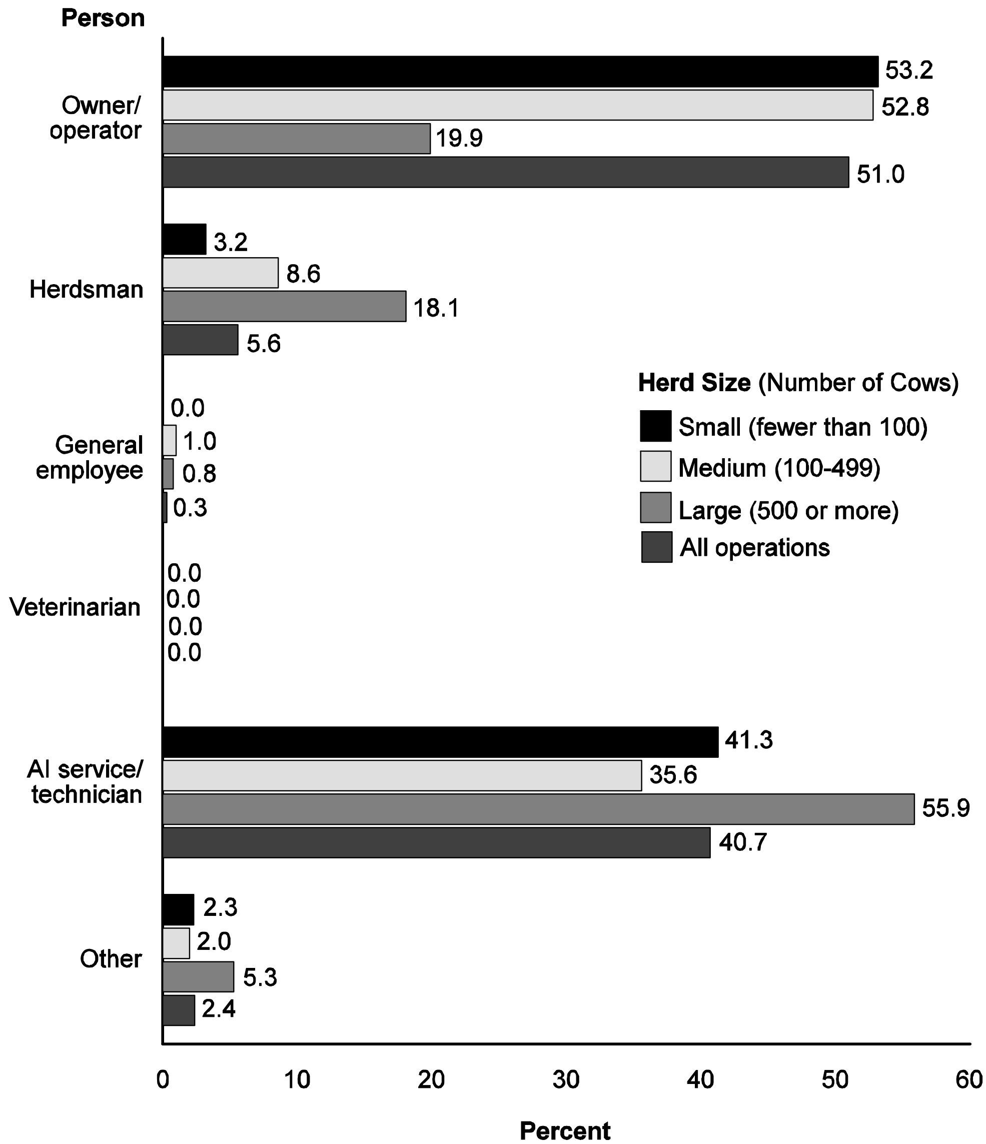
4. AI personnel and services

On operations with any pregnancies conceived through AI during the previous 12 months, the owner/operator performed the majority of AI services on 51.0 percent of operations, while an AI service/technician performed the majority of these services on 40.7 percent of operations. An AI service/technician performed the majority of AI services on more than one-half of large operations (55.9 percent). The owner/operator performed the majority of AI services on a lower percentage of large operations (19.9 percent) than small or medium operations (53.2 and 52.8 percent, respectively). A herdsman performed the majority of AI services on a higher percentage of large operations (18.1 percent) than small operations (3.2 percent).

a. For the 88.4 percent of operations with cattle pregnancies conceived through AI during the previous 12 months, percentage of operations by person who performed the majority of AI services, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Person	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Owner/ operator	53.2	(4.4)	52.8	(4.7)	19.9	(5.2)	51.0	(3.2)
Herdsman	3.2	(1.3)	8.6	(1.9)	18.1	(3.8)	5.6	(1.0)
General employee	0.0	(--)	1.0	(0.7)	0.8	(0.3)	0.3	(0.2)
Veterinarian	0.0	(--)	0.0	(--)	0.0	(--)	0.0	(--)
AI service/ technician	41.3	(4.4)	35.6	(4.6)	55.9	(6.5)	40.7	(3.2)
Other	2.3	(1.5)	2.0	(1.2)	5.3	(3.1)	2.4	(1.0)
Total	100.0		100.0		100.0		100.0	

For the 88.4 Percent of Operations with Cattle Pregnancies Conceived Through AI During the Previous 12 Months, Percentage of Operations by Person Who Performed the Majority of AI Services, and by Herd Size



A herdsman performed the majority of AI services on a higher percentage of operations in the West region (15.8 percent) than in the East region (4.7 percent).

b. For the 88.4 percent of operations with cattle pregnancies conceived through AI during the previous 12 months, percentage of operations by person who performed the majority of AI services, by region:

	Percent Operations			
	Region			
	West		**East**	
Person	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Owner/operator	39.1	(6.2)	52.0	(3.4)
Herdsman	15.8	(3.6)	4.7	(1.1)
General employee	0.0	(--)	0.3	(0.2)
Veterinarian	0.0	(--)	0.0	(--)
AI service/technician	39.2	(6.1)	40.9	(3.4)
Other	5.9	(3.2)	2.1	(1.1)
Total	100.0		100.0	

On almost all operations (95.9 percent) that had pregnancies conceived through AI during the previous 12 months, the person responsible for the majority of AI services had been formally trained via lecture and/or laboratory exercises in performing AI.

c. For the 88.4 percent of operations with cattle pregnancies conceived through AI during the previous 12 months, percentage of operations on which the person responsible for the majority of AI services was formally trained:

Percent Operations	**Standard Error**
95.9	(1.2)

Although it has been possible to sex and sort semen since the 1980s, the use of sexed semen is still not a common practice. The sorting process is extremely slow, can damage the semen, and greatly reduces the overall semen counts. Consequently, compared with unsexed semen, sexed semen costs more and contains fewer viable sperm per straw, leading to a lower conception rate. Because heifers are generally more fertile, it is recommended that sexed semen be used only in virgin heifers.

About 1 of 10 heifers (11.4 percent) that eventually entered the milking herd were inseminated with sexed semen, compared with 3.5 percent of cows.

d. For the 88.4 percent of operations with cattle pregnancies conceived through AI during the previous 12 months, percentage of heifers and of cows that were inseminated with sexed semen during that time:

Percent Heifers[1]	Std. Error	Percent Cows[2]	Std. Error
11.4	(2.4)	3.5	(2.3)

[1]As a percentage of dairy heifers that entered the milking herd in 2006.
[2]As a percentage of cows on the operation at the time of VS Initial Visit interview.

For operations with pregnancies conceived through AI during the previous 12 months, approximately two-thirds of operations (70.9 percent) attempted AI breeding three to six times before designating nonpregnant cows for a different strategy.

e. For the 88.4 percent of operations with cattle pregnancies conceived through AI during the previous 12 months, and for cows in which AI was unsuccessful, percentage of operations by typical maximum number of times AI was attempted before these cows were designated for a different strategy (e.g., moved to a bull pen, sold, etc.):

Number AI Attempts	Percent Operations	Standard Error
1 or 2	10.8	(2.2)
3 or 4	33.2	(3.0)
5 or 6	37.7	(3.2)
7 or more	18.3	(2.1)
Total	100.0	

5. Pregnancy diagnosis

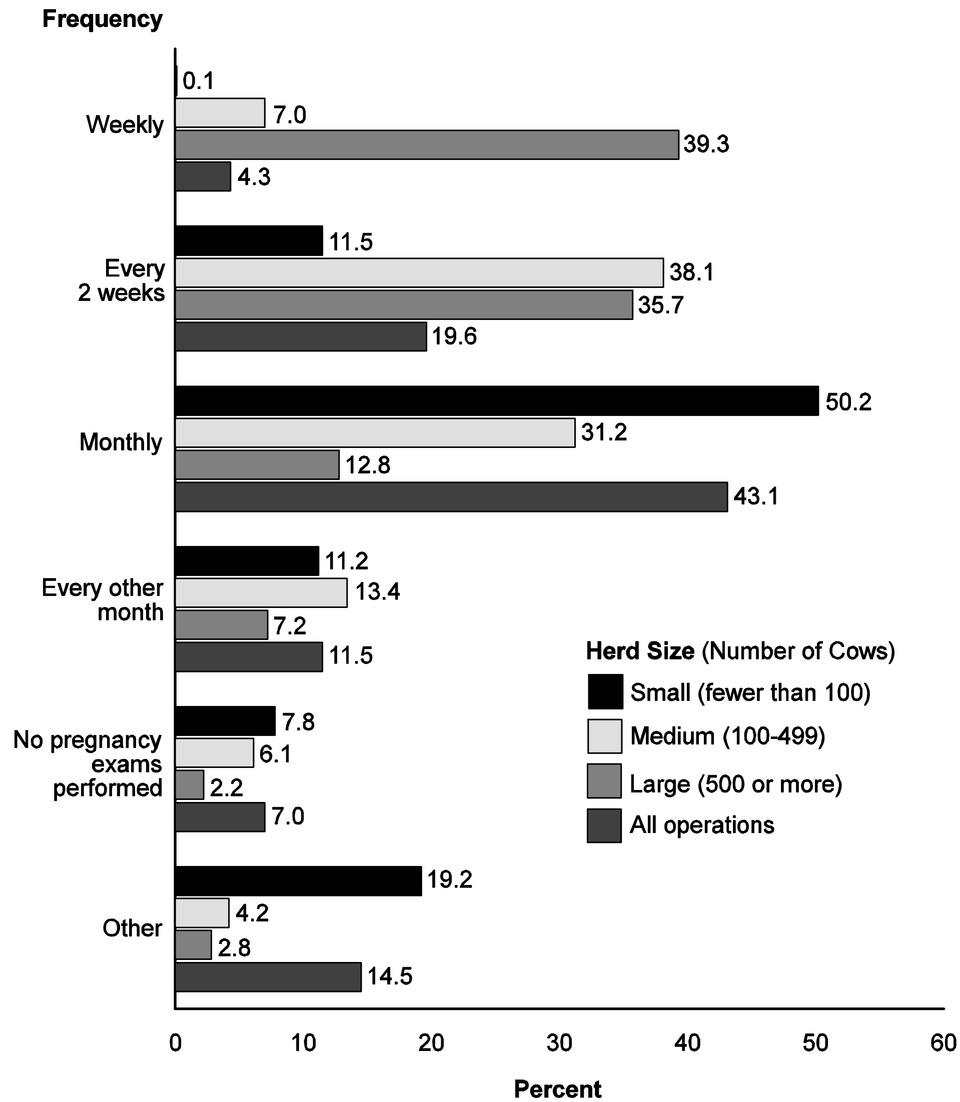
Pregnancy exams are important in evaluating the reproductive status of heifers and cows. The biggest advantage of performing pregnancy exams is identifying animals that are not pregnant so that they can be managed for rebreeding in a short period of time. Additional benefits of pregnancy exams include identification of uterine or ovarian disease, diagnosis of twins, and estimation of conception dates for animals in herds with unobserved natural service.

More than 9 of 10 operations (93.0 percent) had some pregnancy exams performed during the previous 12 months. Two-thirds of all operations (67.0 percent) performed pregnancy exams at least monthly during the previous 12 months. Most small operations (50.2 percent) performed exams on a monthly basis, while most medium operations performed exams every 2 weeks (38.1 percent) or monthly (31.2 percent). Most large operations performed exams weekly (39.3 percent) or every 2 weeks (35.7 percent). The increased frequency of exams with larger herd size might be related to the number of cows that need to be examined. On 7.0 percent of operations, no pregnancy exams were performed. Operations listing “Other” frequencies reported examining cows from 3 months of gestation to once annually.

a. Percentage of operations by frequency with which pregnancy exams were performed during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Frequency	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Weekly	0.1	(0.1)	7.0	(1.9)	39.3	(5.1)	4.3	(0.6)
Every 2 weeks	11.5	(2.5)	38.1	(4.2)	35.7	(5.9)	19.6	(2.1)
Monthly	50.2	(4.0)	31.2	(4.2)	12.8	(4.1)	43.1	(3.0)
Every other month	11.2	(2.7)	13.4	(3.4)	7.2	(3.3)	11.5	(2.0)
No pregnancy exams performed	7.8	(2.1)	6.1	(2.3)	2.2	(2.1)	7.0	(1.5)
Other	19.2	(3.2)	4.2	(1.3)	2.8	(2.2)	14.5	(2.2)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Frequency with Which Pregnancy Exams Were Performed During the Previous 12 Months, and by Herd Size



A higher percentage of operations in the East region (44.9 percent) performed monthly pregnancy exams than in the West region (25.0 percent).

b. Percentage of operations by frequency with which pregnancy exams were performed during the previous 12 months, by region:

	Percent Operations			
	Region			
	West		East	
Frequency	Percent	Std. Error	Percent	Std. Error
Weekly	10.8	(3.1)	3.7	(0.6)
Every 2 weeks	32.6	(5.1)	18.4	(2.2)
Monthly	25.0	(4.9)	44.9	(3.3)
Every other month	11.7	(3.4)	11.4	(2.2)
No pregnancy exams performed	10.2	(4.1)	6.7	(1.6)
Other	9.7	(3.7)	14.9	(2.4)
Total	100.0		100.0	

Almost 9 of 10 operations (89.5 percent) used a private veterinarian to perform the majority of pregnancy exams during the previous 12 months. A higher percentage of small operations (91.3 percent) used a private veterinarian than large operations (76.0 percent). Pregnancy exams were performed by nonveterinarian employees on a higher percentage of large operations (10.3 percent) than small or medium operations (0.4 and 0.0 percent, respectively).

c. For the 93.0 percent of operations that had pregnancy exams performed during the previous 12 months, percentage of operations by person who performed the majority of exams, and by herd size:

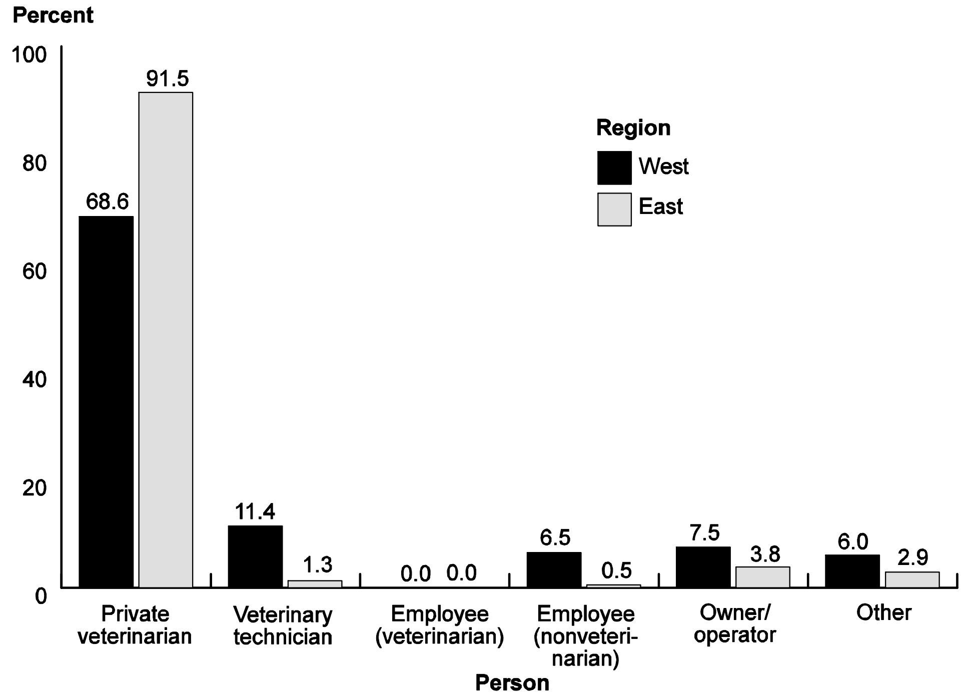
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Person	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Private veterinarian	91.3	(2.2)	88.2	(2.6)	76.0	(5.3)	89.5	(1.7)
Veterinary technician	1.6	(0.8)	2.4	(1.0)	7.5	(2.8)	2.2	(0.6)
Employee (veterinarian)	0.0	(--)	0.0	(--)	0.1	(0.1)	0.0	(0.0)
Employee (nonveterinarian)	0.4	(0.4)	0.0	(--)	10.3	(4.2)	1.0	(0.4)
Owner/operator	3.8	(1.2)	5.2	(1.6)	3.3	(1.9)	4.1	(0.9)
Other	2.9	(1.7)	4.2	(1.8)	2.8	(1.9)	3.2	(1.2)
Total	100.0		100.0		100.0		100.0	

A higher percentage of operations in the East region (91.5 percent) used a private veterinarian for pregnancy exams compared with operations in the West region (68.6 percent). In the West region, a higher percentage of operations (11.4 percent) used a veterinary technician to perform pregnancy exams than in the East region (1.3 percent).

d. For the 93.0 percent of operations that had pregnancy exams performed during the previous 12 months, percentage of operations by person who performed the majority of exams, by region:

	Percent Operations			
	Region			
	West		**East**	
Person	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Private veterinarian	68.6	(5.3)	91.5	(1.7)
Veterinary technician	11.4	(3.5)	1.3	(0.6)
Employee (veterinarian)	0.0	(--)	0.0	(0.0)
Employee (nonveterinarian)	6.5	(3.1)	0.5	(0.3)
Owner/operator	7.5	(2.7)	3.8	(0.9)
Other	6.0	(3.0)	2.9	(1.3)
Total	100.0		100.0	

For the 93.0 Percent of Operations that had Pregnancy Exams Performed During the Previous 12 Months, Percentage of Operations by Person Who Performed the Majority of Exams, by Region



The primary method used to restrain cows for pregnancy diagnosis on most small operations was tie stall/stanchion (80.7 percent of operations). The majority of large operations used headlocks (83.0 percent) for cow restraint.

e. For the 93.0 percent of operations that had pregnancy exams performed during the previous 12 months, percentage of operations by primary method used to restrain cows for pregnancy diagnosis, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Headlocks at the feed bunk	6.5	(1.9)	30.0	(3.7)	83.0	(4.4)	17.5	(1.7)
Palpation rail	0.6	(0.6)	10.3	(2.8)	6.0	(1.8)	3.4	(0.8)
Tie stall/ stanchion	80.7	(2.7)	18.2	(4.1)	1.8	(1.8)	59.7	(2.5)
Chute	3.0	(1.0)	10.0	(2.8)	1.2	(0.7)	4.7	(1.0)
Parlor	5.4	(1.2)	11.1	(2.4)	5.6	(3.2)	6.8	(1.0)
Loose in freestalls	0.4	(0.3)	14.3	(3.5)	0.5	(0.2)	3.9	(0.9)
Other	3.4	(1.4)	6.1	(2.3)	1.9	(1.9)	4.0	(1.1)
Total	100.0		100.0		100.0		100.0	

Similar to the differences observed by herd size, a higher percentage of operations in the West region restrained cows for pregnancy diagnosis using headlocks at the feed bunk (71.7 percent) than operations in the East region (12.5 percent). Tie stalls/stanchions were used to restrain cows by 65.0 percent of operations in the East region compared with 2.5 percent in the West region.

f. For the 93.0 percent of operations that had pregnancy exams performed during the previous 12 months, percentage of operations by primary method used to restrain cows for pregnancy diagnosis, by region:

	Percent Operations			
	Region			
	West		**East**	
Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Headlocks at the feed bunk	71.7	(5.5)	12.5	(1.8)
Palpation rail	2.4	(1.3)	3.5	(0.9)
Tie stall/stanchion	2.5	(1.8)	65.0	(2.6)
Chute	7.0	(2.4)	4.4	(1.0)
Parlor	13.6	(4.9)	6.2	(1.0)
Loose in freestalls	1.3	(1.3)	4.2	(1.0)
Other	1.5	(1.5)	4.2	(1.2)
Total	100.0		100.0	

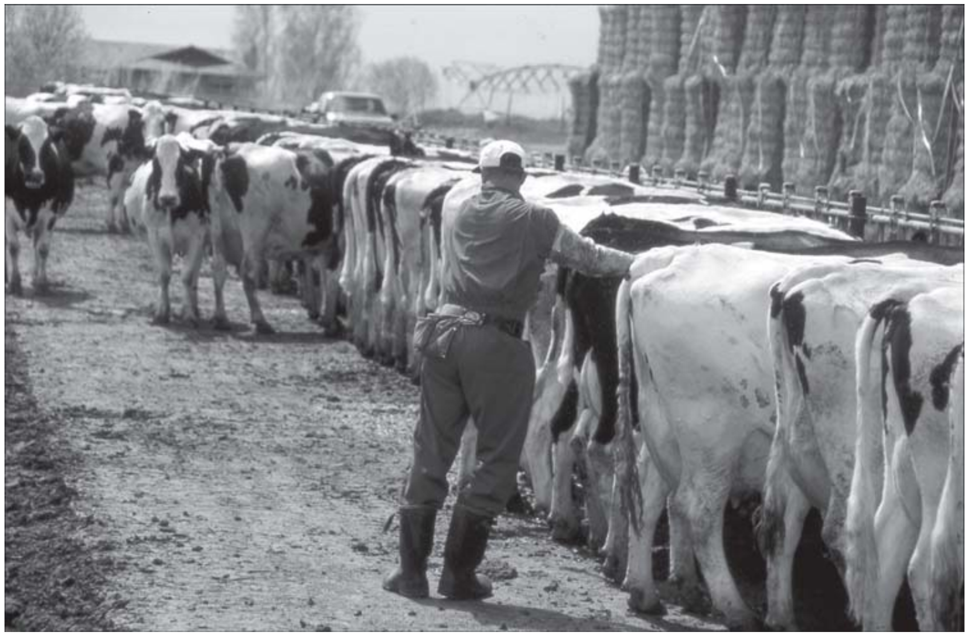


Photo courtesy of “Dairy Herd Management”/“Bovine Veterinarian”

The majority of operations (85.7 percent) routinely used rectal palpation to perform pregnancy exams. More than one-fourth of operations (27.4 percent) routinely used ultrasound to determine pregnancy status. Blood tests were not frequently used. There were no differences by herd size.

g. For the 93.0 percent of operations that had pregnancy exams performed during the previous 12 months, percentage of operations by method used routinely to determine pregnancy status, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Rectal palpation	84.6	(3.2)	88.5	(3.2)	86.5	(3.9)	85.7	(2.4)
Ultrasound	26.3	(3.7)	30.0	(4.3)	28.3	(5.4)	27.4	(2.8)
Blood test	4.5	(1.7)	2.3	(1.5)	7.4	(3.2)	4.1	(1.2)
Milk progesterone	0.0	(--)	0.0	(--)	0.0	(--)	0.0	(--)
Other	0.7	(0.5)	0.6	(0.6)	0.0	(0.0)	0.6	(0.3)

Rectal palpation was used to detect pregnancy on 96.3 percent of operations in the West region, compared with 84.7 percent in the East region. A higher percentage of operations in the East region (28.6 percent) used ultrasound for pregnancy exams than in the West region (14.0 percent).

h. For the 93.0 percent of operations that had pregnancy exams performed during the previous 12 months, percentage of operations by method used routinely to determine pregnancy status, by region:

	Percent Operations			
	Region			
	West		East	
Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Rectal palpation	96.3	(2.3)	84.7	(2.6)
Ultrasound	14.0	(4.0)	28.6	(3.0)
Blood test	2.6	(1.9)	4.3	(1.3)
Milk progesterone	0.0	(--)	0.0	(--)
Other	0.0	(--)	0.7	(0.4)

6. Ultrasound

Of operations that routinely used ultrasound to determine pregnancy status during the previous 12 months, more than three-fourths (77.4 percent) began using ultrasound for routine pregnancy diagnosis prior to 2006. Almost one-third of operations (29.6) reported using ultrasound for routine pregnancy exams in 2003 or earlier.

a. For the 27.4 percent of operations that routinely used ultrasound to determine pregnancy status during the previous 12 months, percentage of operations by year in which routine ultrasound diagnosis of pregnancy was first performed:

Year	Percent Operations	Standard Error	Cumulative Percent
2002 and before	16.4	(4.2)	16.4
2003	13.2	(4.5)	29.6
2004	14.9	(4.3)	44.5
2005	32.9	(6.0)	77.4
2006	14.9	(3.6)	92.3
2007	7.7	(2.6)	100.0
Total	100.0		

For operations that routinely used ultrasound to evaluate pregnancy status during the previous 12 months, almost all operations (99.6 percent) reported that the ultrasound equipment was owned by the veterinarian. No herd size or regional differences were observed for ownership of the ultrasound machine used for pregnancy diagnosis.

b. For the 27.4 percent of operations that routinely used ultrasound to determine pregnancy status during the previous 12 months, percentage of operations by owner of the ultrasound equipment used for the majority of pregnancy diagnoses:

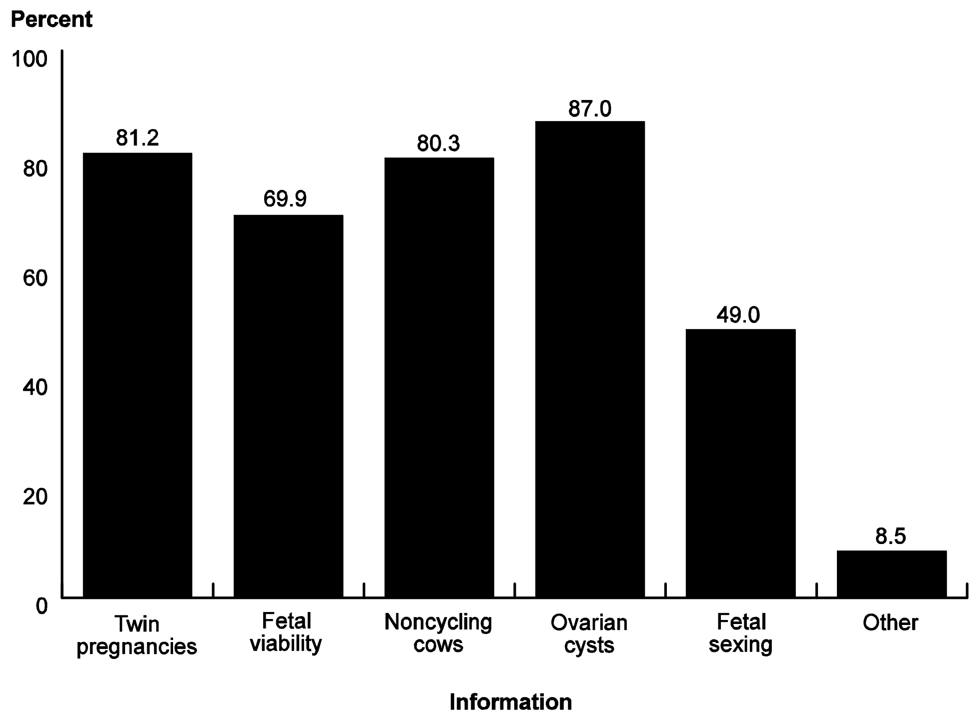
Owner	Percent Operations	Standard Error
Veterinarian	99.6	(0.2)
Dairy operation	0.2	(0.1)
Other	0.2	(0.1)
Total	100.0	

Ultrasound was often used to provide additional information during pregnancy exams. More than two-thirds of operations that routinely used ultrasound for pregnancy diagnosis during the previous 12 months collected and evaluated information on ovarian cysts (87.0 percent), twin pregnancies (81.2 percent), noncycling cows (80.3 percent), and fetal viability (69.9 percent). One-half the operations (49.0 percent) used ultrasound to determine the sex of the fetus.

c. For the 27.4 percent of operations that routinely used ultrasound to determine pregnancy status during the previous 12 months, percentage of operations by additional information collected/evaluated during ultrasound exams:

Information	Percent Operations	Standard Error
Twin pregnancies	81.2	(4.8)
Fetal viability	69.9	(5.6)
Noncycling (no heat) cows	80.3	(4.6)
Ovarian cysts	87.0	(4.2)
Fetal sexing	49.0	(5.9)
Other	8.5	(3.5)

For the 27.4 Percent of Operations that Routinely Used Ultrasound to Determine Pregnancy Status During the Previous 12 Months, Percentage of Operations by Additional Information Collected/Evaluated During Ultrasound Exams



7. Producer use of reproductive parameters

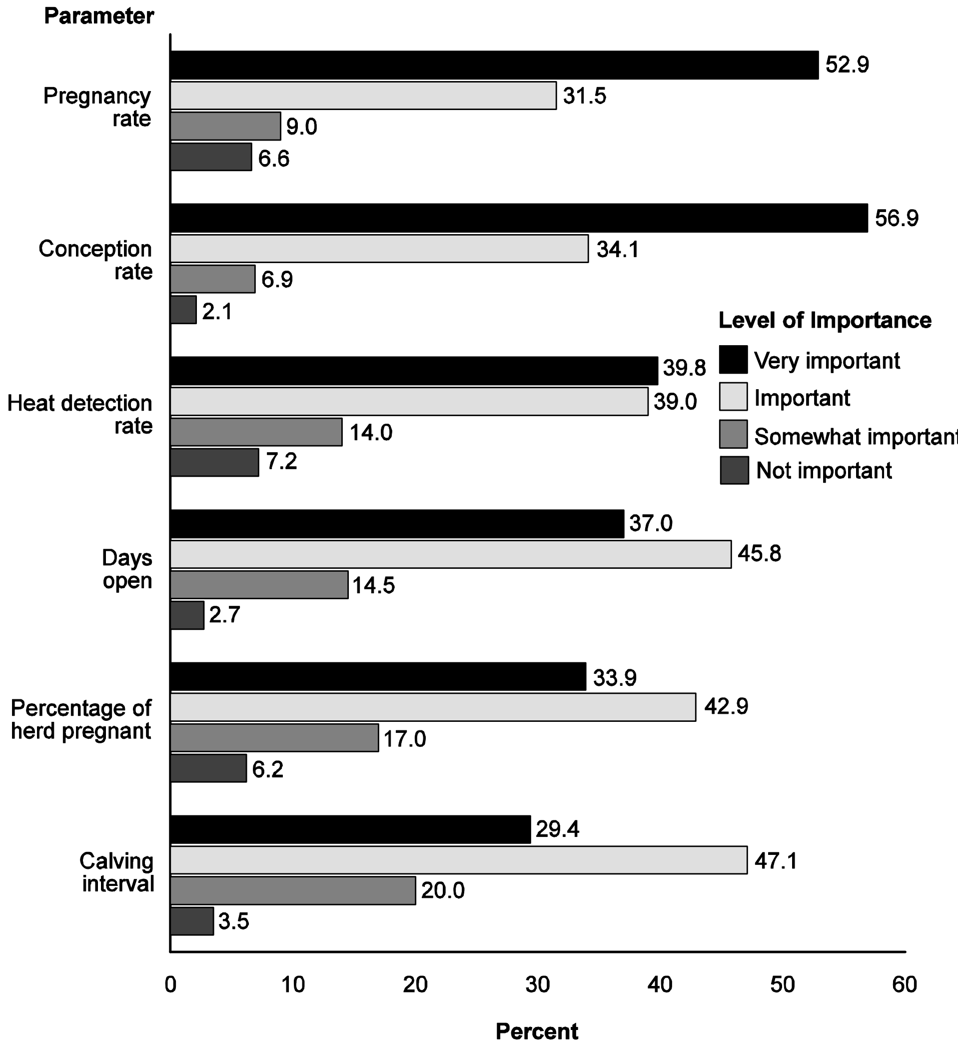
The parameters used to evaluate reproductive performance are interrelated and evolving. Pregnancy rate is calculated as the product of the conception rate times the heat detection rate. Conception rate is calculated by dividing the percentage of cows determined to be pregnant by those that were either naturally or artificially bred. Heat detection rate is the number of cows detected in estrus divided by the number of cows eligible to be bred within a 21-day period. Mean days open is typically the average number of days between calving and conception, but may also include the interval from calving to most recent service or current days in milk for cows that have gone beyond the voluntary waiting period and not been bred. The percentage of herd pregnant is typically reported for a given point in time. Calving interval is calculated by taking the mean number of months from one calving to the next calving for each cow in the herd.

For each reproductive performance parameter, less than 8 percent of operations reported that the parameter was not important. The majority of operations reported that conception rate and pregnancy rate were very important in evaluating the reproductive performance of the herd (56.9 and 52.9 percent of operations, respectively).

a. Percentage of operations by level of importance of reproductive parameters used in evaluating reproductive performance of the herd:

	Percent Operations Level of Importance								
	Very Important		Important		Somewhat Important		Not Important		
Parameter	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Total**
Pregnancy rate	52.9	(3.0)	31.5	(2.9)	9.0	(1.7)	6.6	(1.4)	100.0
Conception rate	56.9	(3.0)	34.1	(2.9)	6.9	(1.6)	2.1	(0.8)	100.0
Heat detection rate	39.8	(2.9)	39.0	(3.0)	14.0	(2.0)	7.2	(1.5)	100.0
Days open	37.0	(2.8)	45.8	(3.0)	14.5	(2.1)	2.7	(0.9)	100.0
Percentage of herd pregnant	33.9	(2.8)	42.9	(3.0)	17.0	(2.1)	6.2	(1.4)	100.0
Calving interval	29.4	(2.6)	47.1	(3.0)	20.0	(2.5)	3.5	(1.0)	100.0

Percentage of Operations by Level of Importance of Reproductive Parameters Used in Evaluating Reproductive Performance of the Herd



The highest percentage of operations (91.0 percent) considered conception rate to be important or very important in evaluating reproductive performance of the herd. For large operations, a higher percentage considered pregnancy rate, heat detection rate, and percentage of herd pregnant to be important or very important compared with small operations. There were no regional differences in the percentage of operations that considered reproductive parameters important or very important.

b. Percentage of operations that considered the following reproductive parameters to be important or very important in evaluating reproductive performance of the herd, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Parameter	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Pregnancy rate	81.0	(3.0)	90.4	(2.3)	96.7	(1.9)	84.4	(2.1)
Conception rate	90.3	(2.4)	92.0	(2.2)	94.2	(3.3)	91.0	(1.7)
Heat detection rate	76.3	(3.3)	82.5	(3.3)	90.4	(3.2)	78.8	(2.4)
Days open	80.3	(3.1)	88.1	(2.7)	88.4	(3.8)	82.8	(2.2)
Percentage of herd pregnant	74.4	(3.3)	79.7	(3.2)	91.0	(3.1)	76.8	(2.4)
Calving interval	75.7	(3.4)	77.8	(3.9)	80.3	(4.9)	76.5	(2.6)

B. Calving Practices

1. Guidelines

Many factors contribute to calving difficulty and the need to intervene and assist with the calving process. For heifers, an important factor is the relationship of the calf size to the heifer size. In cows, dystocias are often related to multiple fetuses or malposition of the fetus. Guidelines for when and how to assist with calving are available and are slightly different for heifers and cows. Intervening too early or too late in the calving process can cause injury or death to the dam, the calf, or both.

Approximately 6 of 10 operations had guidelines on when to intervene during calving for heifers (60.7 percent), cows (60.5 percent), or both (60.5 percent). There were no differences in the percentage of operations with calving guidelines by herd size or region.

a. Percentage of operations with general guidelines (e.g., standard operating procedures or established protocols) on when to intervene during calving for heifers, cows, or both, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Heifers	62.3	(3.8)	56.9	(4.6)	57.4	(6.5)	60.7	(2.9)
Cows	62.3	(3.8)	56.3	(4.6)	57.5	(6.5)	60.5	(2.9)
Both	62.3	(3.8)	56.3	(4.6)	57.4	(6.5)	60.5	(2.9)

b. Percentage of operations with general guidelines (e.g., standard operating procedures or established protocols) on when to intervene during calving for heifers, cows, or both, by region:

	Percent Operations			
	Region			
	West		East	
Cattle Class	Percent	Std. Error	Percent	Std. Error
Heifers	54.9	(6.2)	61.2	(3.1)
Cows	54.9	(6.2)	61.1	(3.1)
Both	54.9	(6.2)	61.1	(3.1)

For operations with guidelines for both heifers and cows, about one-half of operations (51.7 percent) used different guidelines for heifers and cows.

c. For the 60.5 percent of operations with guidelines for intervening during calving for both heifers and cows, percentage of operations that used different guidelines for heifers and cows:

Percent Operations	Standard Error
51.7	(3.9)

2. Calving personnel and training

For all operations, the average number of calving personnel (people with any work duties in the calving area, including employees and family members) was 2.4. The average number of calving personnel increased as herd size increased.

a. Average number of calving personnel, and by herd size:

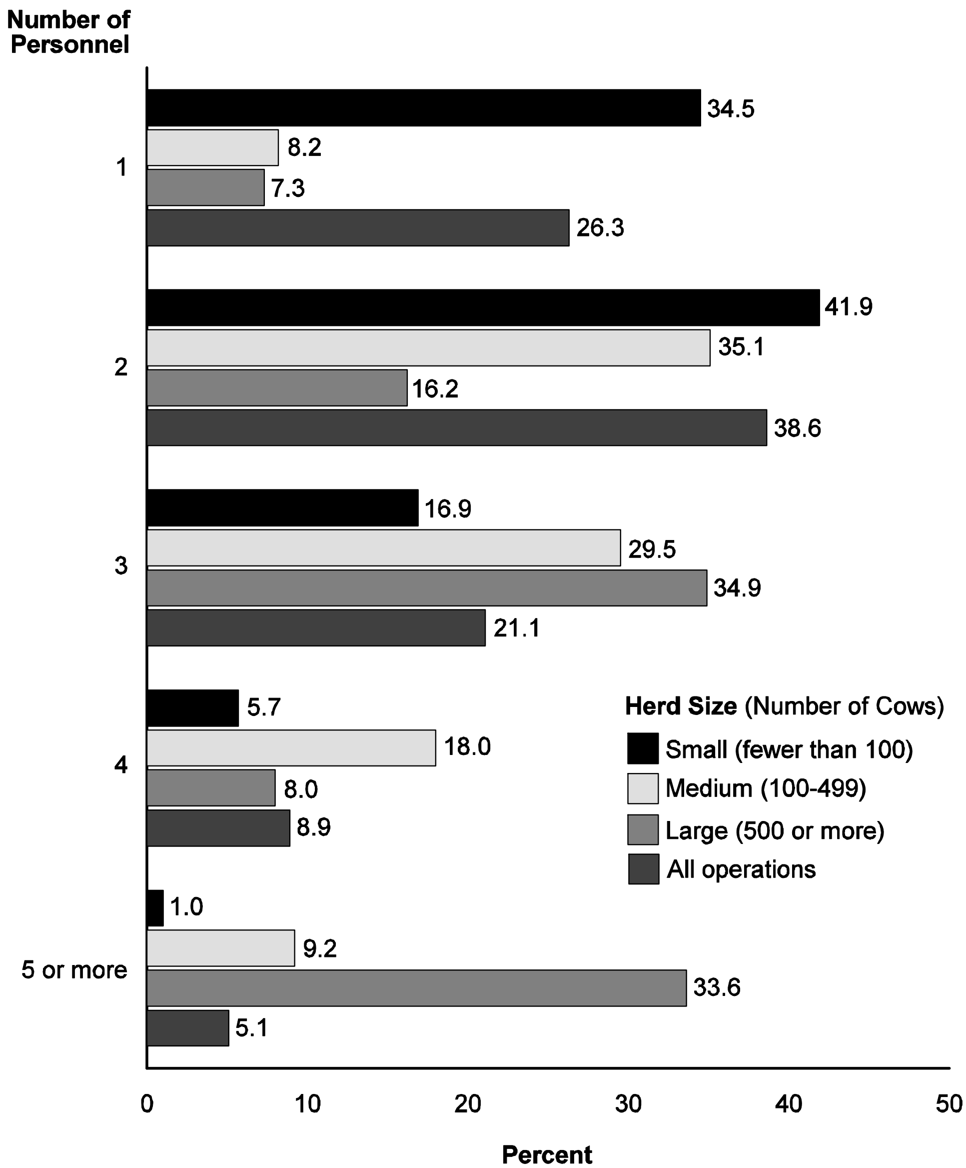
Average Number of Calving Personnel							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error
2.0	(0.1)	3.0	(0.1)	4.1	(0.3)	2.4	(0.1)

The majority of small operations (76.4 percent) had one or two calving personnel, compared with two or three people for medium operations (64.6 percent) and three or more people for large operations (76.5 percent).

b. Percentage of operations by number of calving personnel, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Number of Calving Personnel	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1	34.5	(3.9)	8.2	(2.3)	7.3	(3.7)	26.3	(2.8)
2	41.9	(4.0)	35.1	(4.3)	16.2	(4.7)	38.6	(3.0)
3	16.9	(3.1)	29.5	(4.2)	34.9	(6.4)	21.1	(2.4)
4	5.7	(1.6)	18.0	(3.5)	8.0	(3.3)	8.9	(1.5)
5 or more	1.0	(0.7)	9.2	(2.4)	33.6	(5.5)	5.1	(0.9)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Number of Calving Personnel, and by Herd Size



The West region had a higher percentage of operations with five or more people in the calving area (16.6 percent) than the East region (4.0 percent).

c. Percentage of operations by number of calving personnel, by region:

	Percent Operations			
	Region			
	West		East	
Number of Calving Personnel	Percent	Std. Error	Percent	Std. Error
1	15.7	(4.8)	27.3	(3.1)
2	35.1	(5.9)	38.9	(3.2)
3	27.4	(5.1)	20.6	(2.6)
4	5.2	(2.5)	9.2	(1.6)
5 or more	16.6	(3.9)	4.0	(0.9)
Total	100.0		100.0	

More than 90 percent of operations (91.9 percent) provided training in calving intervention for owners/employees of the operation. Most operations (90.4 percent) used on-the-job training in calving intervention. Approximately one of four operations (27.0 percent) provided training through discussion/lecture. Some operations used more than one method to train owners/employees in calving intervention.

d. Percentage of operations by training methods in calving intervention used for owners/employees of the operation:

Training Method	Percent Operations	Standard Error
Video	2.4	(0.7)
Discussion/lecture	27.0	(2.7)
On-the-job	90.4	(1.8)
Other	6.1	(1.5)
Any	91.9	(1.7)

3. Calving difficulty scoring

Recording and monitoring calving difficulty scores can help producers select sires and make decisions about retaining replacement heifers. The most common scoring system for the degree of calving difficulty is based on 5 points: 1 point = no problem, 2 = slight problem, 3 = needed assistance, 4 = needed considerable force, and 5 = extreme difficulty/surgical procedure. Studies have shown that a higher percentage of heifers require assistance than cows.

More than one-third of operations (38.5 percent) reported having a system for scoring calving difficulty. A higher percentage of large operations (57.9 percent) than small operations (35.2 percent) had a scoring system.

a. Percentage of operations with a system for scoring calving difficulty, and by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
35.2	(3.8)	42.6	(4.3)	57.9	(6.1)	38.5	(2.9)

There was no difference by region in the percentage of operations with a system for scoring calving difficulty.

b. Percentage of operations with a system for scoring calving difficulty, by region:

Percent Operations			
Region			
West		**East**	
Percent	**Standard Error**	**Percent**	**Standard Error**
35.4	(5.1)	38.8	(3.1)

Of the operations with a system for scoring calving difficulty, almost all (91.6 percent) record the score for assisted births.

c. For the 38.5 percent of operations with a system for scoring calving difficulty, percentage of operations that record the calving difficulty score for assisted births:

Percent Operations	Standard Error
91.6	(3.0)

4. Observation close to calving

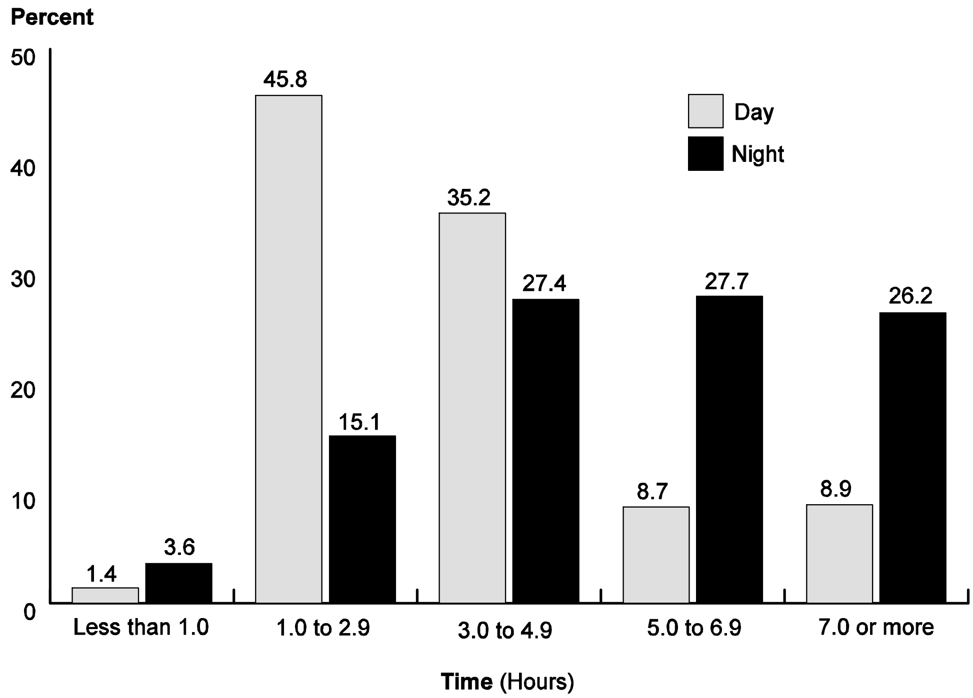
Ideally, heifers and cows close to calving would be observed at all times in case they need assistance, but this is not practical or even possible for many operations. The literature suggests, however, that no more than 3 hours should pass between observation periods.

As one would expect, females close to calving were observed more frequently during the day than at night. About one-half of operations (47.2 percent) allowed less than 3 hours, on average, to pass between observations during the day, with 17.6 percent of operations allowing 5 hours or more between observation periods. During the night, 18.7 percent of operations allowed less than 3 hours to pass between observations, and 53.9 percent of operations let 5 hours or more pass between observation periods.

a. Percentage of operations by average time between observation periods of cattle close to calving, by time of day:

	Percent Operations			
	Day		Night	
Time (Hours)	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 1.0	1.4	(0.6)	3.6	(1.3)
1.0 to 2.9	45.8	(3.0)	15.1	(2.1)
3.0 to 4.9	35.2	(2.9)	27.4	(2.8)
5.0 to 6.9	8.7	(1.8)	27.7	(2.7)
7.0 or more	8.9	(1.8)	26.2	(2.6)
Total	100.0		100.0	

Percentage of Operations by Average Time Between Observation Periods of Cattle Close to Calving, by Time of Day



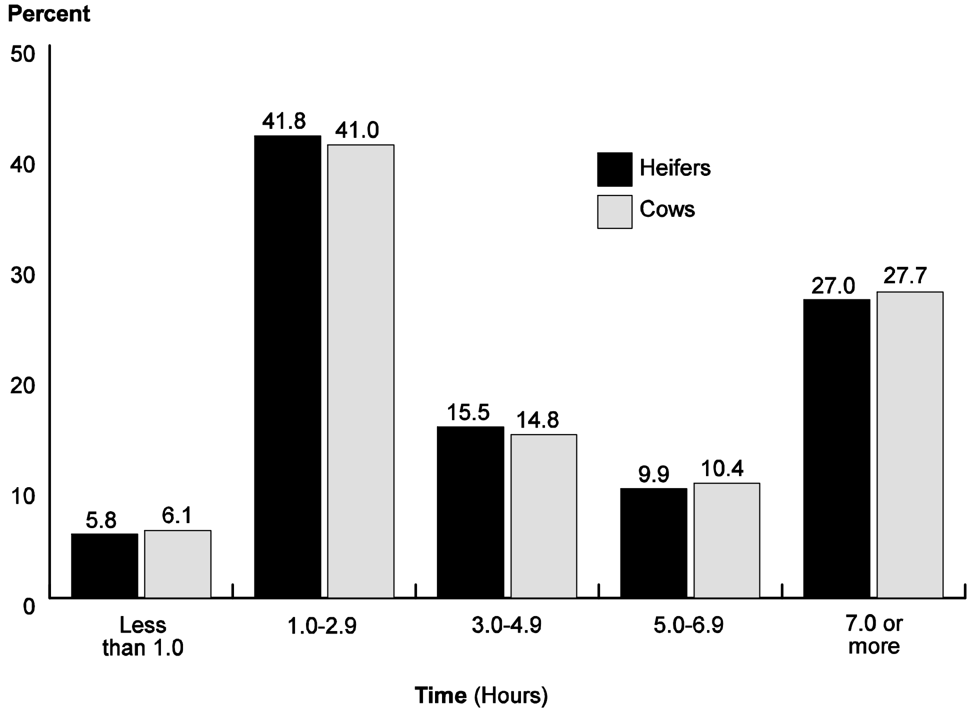
Although the normal calving process is classified into three stages, the process is continuous and proceeds gradually from one stage to the next. Stage 1 is characterized by cervical dilation and uterine contractions that usually are not evident as abdominal contractions. Cattle during this stage may be restless/off feed because of the discomfort of the uterine contractions. Stage 1 usually lasts 2 to 6 hours but may be longer in heifers. During stage 2 of labor, uterine contractions continue and abdominal contractions become evident. Stage 2 ends in the delivery of the fetus(es) and usually takes less than 2 hours for mature cows but up to 4 hours for heifers. In stage 3, the fetal membranes (placenta) are expelled as a result of continued uterine contractions. The duration of stage 3 can be minutes to multiple days, if the placenta is retained.

The majority of operations (63.1 percent for heifers and 61.9 percent for cows) reported that they would examine or assist an animal before 5 hours elapsed if she shows signs of stage 1 labor without subsequent straining. More than one-fourth of operations (27.0 percent for heifers and 27.7 percent for cows) would wait 7 hours or more to examine or assist an animal that exhibits signs of stage 1 labor without subsequent straining.

b. Percentage of operations by length of time producers would wait to examine or assist an animal when calving is imminent and the heifer or cow is restless/off feed but not observed to be straining:

	Percent Operations			
	Heifers		**Cows**	
Time (Hours)	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 1.0	5.8	(1.2)	6.1	(1.3)
1.0 to 2.9	41.8	(2.9)	41.0	(2.8)
3.0 to 4.9	15.5	(2.0)	14.8	(1.9)
5.0 to 6.9	9.9	(1.9)	10.4	(2.1)
7.0 or more	27.0	(2.8)	27.7	(2.8)
Total	100.0		100.0	

Percentage of Operations by Length of Time Producers Would Wait to Examine or Assist an Animal When Calving is Imminent and the Heifer or Cow is Restless/Off Feed but not Observed to be Straining



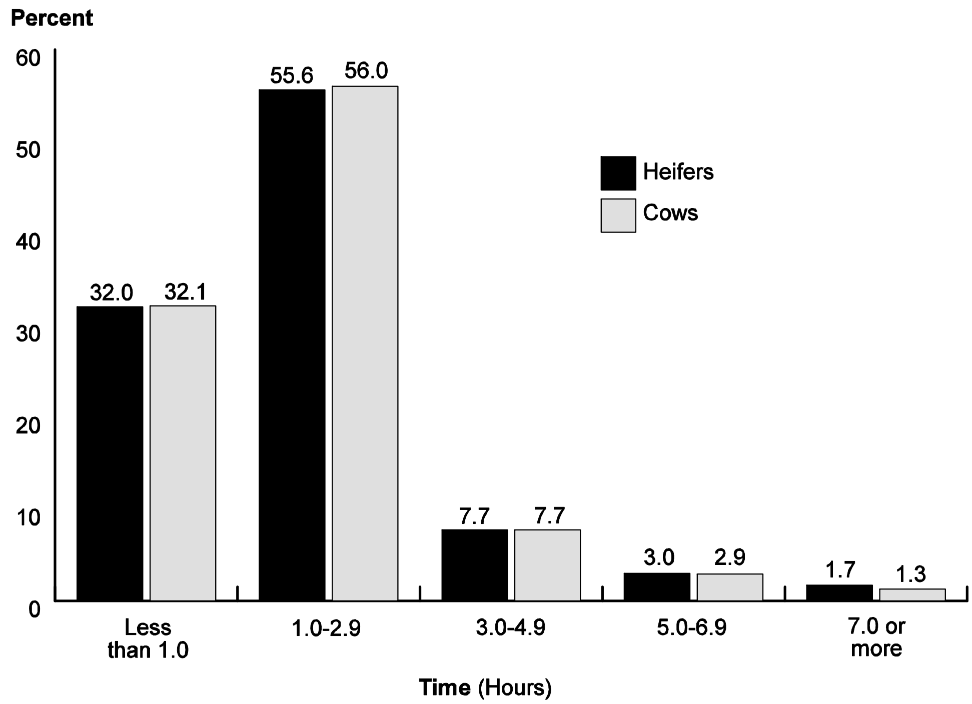
Abdominal contractions and straining typically mark the beginning of stage 2 labor. Once straining is observed, the animal should be assessed if she is not making good progress in delivery within 2 to 3 hours for heifers and 1 hour for cows.

Almost 9 of 10 operations reported that they wait less than 3 hours to assist heifers or cows that are observed to be straining but are not progressing in delivery of the calf (87.6 and 88.1 percent, respectively). Less than 2 percent of operations reported that they wait 7 or more hours before attending to heifers or cows that are straining but not progressing in delivery.

c. Percentage of operations by length of time producers would wait to examine or assist a heifer or cow that has begun to strain but is not progressing in delivery of the calf:

	Percent Operations			
	Heifers		**Cows**	
Time (Hours)	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 1.0	32.0	(2.9)	32.1	(2.9)
1.0 to 2.9	55.6	(3.0)	56.0	(3.0)
3.0 to 4.9	7.7	(1.5)	7.7	(1.5)
5.0 to 6.9	3.0	(1.2)	2.9	(1.3)
7.0 or more	1.7	(0.9)	1.3	(0.8)
Total	100.0		100.0	

Percentage of Operations by Length of Time Producers Would Wait to Examine or Assist a Heifer or Cow that has Begun to Strain but is not Progressing in Delivery of the Calf



About 95 percent of operations reported that they examine or assist heifers and cows within 3 hours of the water bag appearing at the vulva. Almost one-half of operations would assist heifers and cows within 1 hour of the water bag appearing at the vulva.

d. Percentage of operations by length of time producers would wait before examining or assisting a heifer or cow once the water bag appears at the vulva:

	Percent Operations			
	Heifers		Cows	
Time (Hours)	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 1.0	48.4	(2.8)	49.2	(2.8)
1.0 to 2.9	46.2	(2.8)	46.4	(2.8)
3.0 to 4.9	4.1	(1.1)	3.5	(1.0)
5.0 to 6.9	0.6	(0.5)	0.0	(--)
7.0 or more	0.7	(0.5)	0.9	(0.5)
Total	100.0		100.0	

5. Intervention

Implementation of the practices listed below is generally recommended when a dystocia or difficult calving necessitates intervention. More than 50 percent of all operations reported that they generally implemented recommended practices, except for calling a veterinarian to assist (12.9 percent) and tying or holding the tail out of the way (32.4 percent). A higher percentage of small operations (14.6 percent) than large operations (3.6 percent) would generally call a veterinarian to assist. A higher percentage of large operations would restrain the cow in a head catch or similar equipment; this might reflect the loose housing systems (such as freestall or drylot) more common on large operations, compared with the tie stall and stanchion facilities more common on small operations. A higher percentage of large operations than small operations would typically wash the perineum area with soap and water (74.8 and 48.8 percent, respectively); wear obstetrical gloves (87.1 and 62.5 percent, respectively); or use a lubricant (82.2 and 50.4 percent, respectively) while assisting with delivery.

a. Percentage of operations by practice generally implemented once a decision is made to intervene in calving, and by herd size:

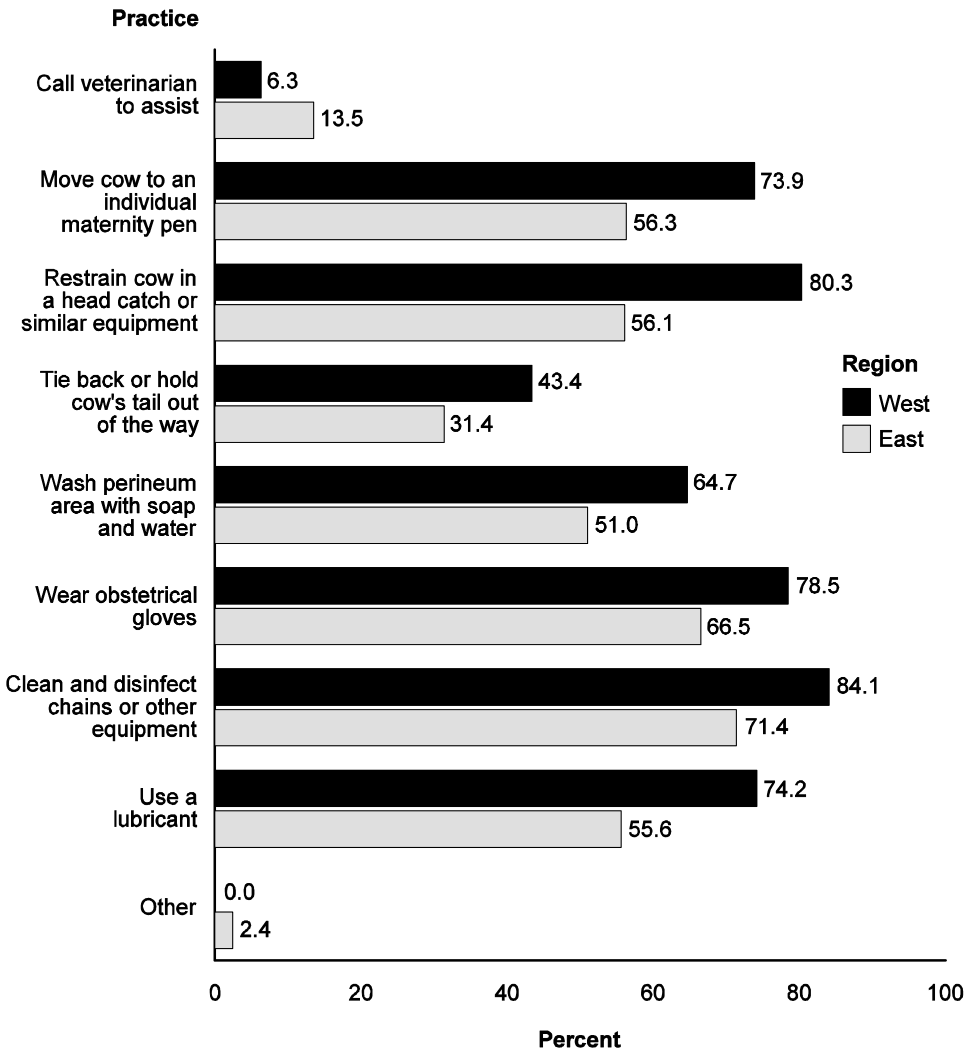
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Practice	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Call veterinarian to assist	14.6	(3.1)	10.6	(2.9)	3.6	(2.1)	12.9	(2.3)
Move cow to an individual maternity pen	54.4	(4.0)	64.4	(4.1)	69.0	(5.5)	57.8	(2.9)
Restrain cow in a head catch or similar equipment	55.1	(4.0)	58.4	(4.3)	91.7	(2.4)	58.3	(2.9)
Tie back or hold cow's tail out of the way	30.3	(3.7)	36.0	(4.3)	41.2	(6.3)	32.4	(2.8)
Wash perineum area with soap and water	48.8	(4.1)	55.9	(4.5)	74.8	(5.4)	52.2	(3.0)
Wear obstetrical gloves	62.5	(4.0)	76.2	(3.5)	87.1	(4.3)	67.5	(2.9)
Clean and disinfect chains or other equipment prior to use in the vagina or uterus	70.4	(3.7)	75.2	(4.0)	85.7	(4.5)	72.6	(2.7)
Use a lubricant	50.4	(4.1)	69.5	(4.1)	82.2	(5.1)	57.2	(3.0)
Other	3.0	(1.4)	0.3	(0.3)	0.3	(0.3)	2.2	(0.9)

The use of three recommended practices for calving interventions differed by region. A higher percentage of operations in the West region than in the East region would generally move the cow to an individual maternity pen (73.9 and 56.3 percent, respectively), restrain the cow in a head catch or similar equipment (80.3 and 56.1 percent, respectively), or use a lubricant (74.2 and 55.6 percent, respectively).

b. Percentage of operations by practice generally implemented once a decision is made to intervene in calving, by region:

	Percent Operations			
	Region			
	West		East	
Practice	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Call veterinarian to assist	6.3	(2.4)	13.5	(2.5)
Move cow to an individual maternity pen	73.9	(5.1)	56.3	(3.2)
Restrain cow in a head catch or similar equipment	80.3	(3.7)	56.1	(3.2)
Tie back or hold cow's tail out of the way	43.4	(5.6)	31.4	(3.0)
Wash perineum area with soap and water	64.7	(5.8)	51.0	(3.3)
Wear obstetrical gloves	78.5	(5.0)	66.5	(3.1)
Clean and disinfect chains or other equipment prior to use in the vagina or uterus	84.1	(4.3)	71.4	(2.9)
Use a lubricant	74.2	(5.2)	55.6	(3.2)
Other	0.0	(--)	2.4	(1.0)

Percentage of Operations by Practice Generally Implemented Once a Decision is Made to Intervene in Calving, by Region



Although the dam provides the best lubricant, during difficult deliveries additional lubricant can be helpful in delivering a healthy calf, as well as in protecting the dam from trauma. With the exception of water used alone, all the lubricants listed below may be helpful. The best choice is a commercial obstetrical lubricant mixed with water and used generously.

More than 50 percent of operations that reported generally using a lubricant during calving intervention used a commercial lubricant (57.5 percent), soap (56.2 percent), or water with other lubricant (51.8 percent). Less than 10 percent of operations used mineral oil, shortening, or water only as a lubricant.

c. For the 57.2 percent of operations that generally use a lubricant during calving intervention, percentage of operations by type of lubricant used:

Lubricant	**Percent Operations**	**Standard Error**
Mineral oil	8.4	(1.8)
Soap	56.2	(3.6)
Water with other lubricant	51.8	(3.8)
Water only	2.0	(1.1)
Commercial obstetrical lubricant (e.g., J-Lube)	57.5	(3.8)
Shortening (e.g., Crisco)	2.4	(1.1)
Other	1.0	(0.5)

Any instrument that is used to assist with a difficult delivery should be easy to sanitize, especially instruments that are used inside the vagina and uterus to deliver calves. Most operations (71.1 percent) used stainless-steel OB chains for pulling calves; these chains are easy to sanitize and are recommended for use. Almost 50 percent of operations (49.6 percent) used twine, while 22.1 percent used rope to pull calves. Stainless-steel OB chains were used on a higher percentage of medium and large operations compared with small operations. Alternatively, twine was used on a higher percentage of small operations than medium or large operations.

d. Percentage of operations by type of equipment used for pulling calves (direct contact with calf), and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Equipment Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Stainless-steel OB chains	65.5	(3.8)	81.5	(3.7)	90.6	(3.5)	71.1	(2.8)
Twine	56.5	(4.0)	37.7	(4.4)	21.5	(5.4)	49.6	(3.0)
Rope	23.2	(3.5)	19.4	(3.5)	21.4	(5.3)	22.1	(2.6)
Other	3.1	(1.3)	1.7	(0.7)	8.1	(3.5)	3.1	(0.9)
Any	99.4	(0.6)	100.0	(0.0)	100.0	(0.0)	99.6	(0.4)

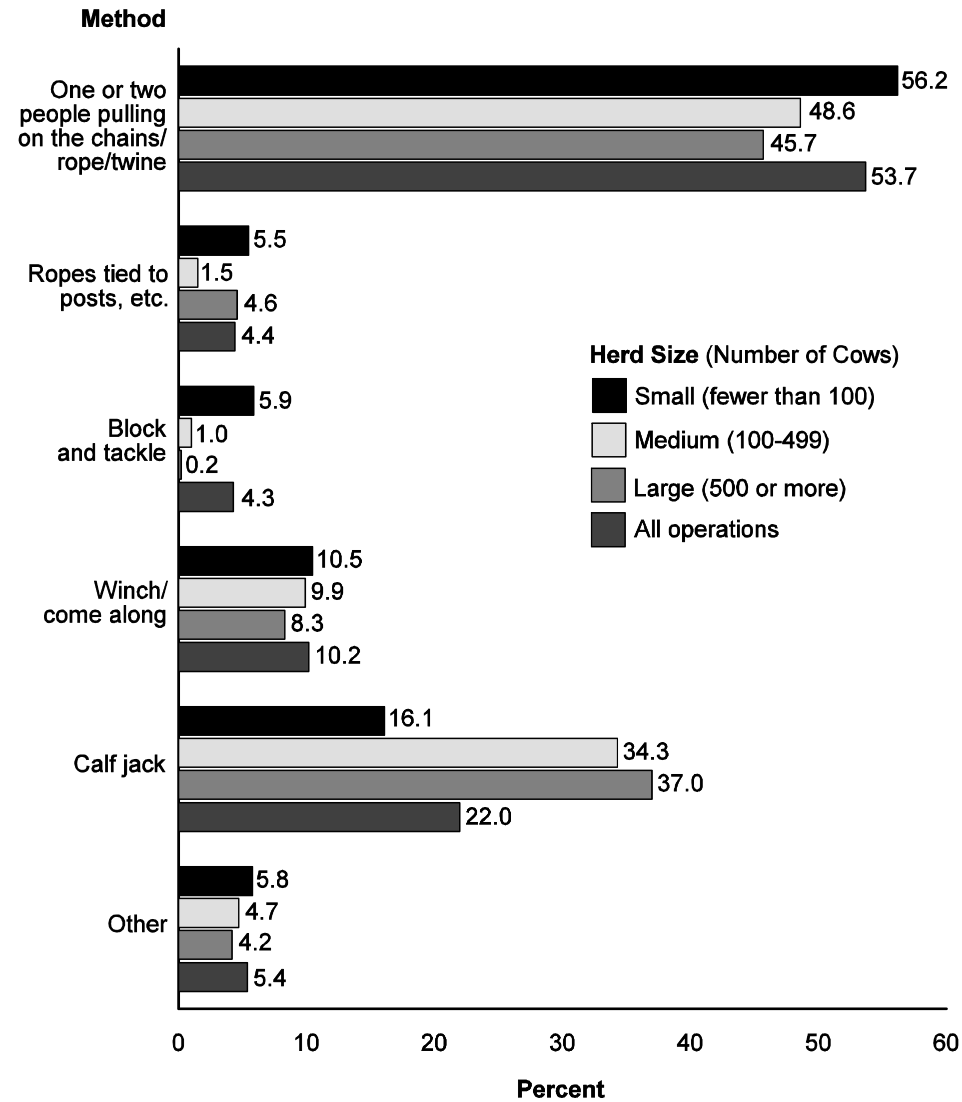
The amount of pressure exerted on the calf during an assisted delivery can cause injury or death to the cow and calf. Studies have reported that two strong people can exert a force of 400 to 600 lb while delivering a calf, whereas a calf jack can exert 2,000 lb of force. If two people cannot deliver a calf manually, then an alternative delivery method, such as a C-section for live calves or a fetotomy for dead calves, is usually recommended.

More than one-half of operations (53.7 percent) reported that one or two people pulling on the chains, rope, or twine was the method most commonly used to apply traction to deliver the calf. About one of five operations (22.0 percent) reported using a calf jack to apply traction. A block and tackle was used by a higher percentage of small operations compared with large operations (5.9 and 0.2 percent, respectively). A higher percentage of medium and large operations used a calf jack (34.3 and 37.0 percent, respectively) compared with small operations (16.1 percent).

e. Percentage of operations by method most commonly used to apply traction to deliver the calf, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
One or two people pulling on the chains/rope/twine	56.2	(4.0)	48.6	(4.4)	45.7	(6.3)	53.7	(3.0)
Ropes tied to posts, etc.	5.5	(2.1)	1.5	(0.8)	4.6	(2.4)	4.4	(1.4)
Block and tackle	5.9	(1.8)	1.0	(0.9)	0.2	(0.2)	4.3	(1.3)
Winch/come along	10.5	(2.7)	9.9	(2.6)	8.3	(3.3)	10.2	(2.0)
Calf jack	16.1	(2.8)	34.3	(4.1)	37.0	(5.9)	22.0	(2.2)
Other	5.8	(1.8)	4.7	(1.7)	4.2	(3.7)	5.4	(1.3)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Method Most Commonly Used to Apply Traction to Deliver the Calf, and by Herd Size



To reduce the possibility of injury to the dam during calving intervention, traction should be applied when the dam is straining. More than three in four operations (77.3 percent) reported that traction is generally applied in conjunction with the dam straining, while 22.7 percent reported that traction is generally applied continuously.

f. Percentage of operations by best description of how traction is generally applied during calving intervention:

Traction Application	Percent Operations	Standard Error
In conjunction with dam straining	77.3	(2.5)
Continuously	22.7	(2.5)
Total	100.0	

6. Veterinary assistance

Although 12.9 percent of operations would call a veterinarian to assist once a decision is made to intervene during a difficult calving (see table 5a. on p 61), almost all operations, regardless of herd size or region, would ever seek veterinary assistance for difficult calvings.

a. Percentage of operations that ever seek veterinary assistance for difficult deliveries, and by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
95.5	(1.5)	95.0	(1.5)	86.8	(4.4)	94.8	(1.1)

b. Percentage of operations that ever seek veterinary assistance for difficult deliveries, by region:

Percent Operations			
Region			
West		East	
Percent	Standard Error	Percent	Standard Error
86.6	(3.9)	95.6	(1.2)

More than 90 percent of operations that ever seek veterinary assistance for difficult deliveries reported they would seek assistance to help correct the calf's position for delivery (93.5 percent), while 85.6 percent of operations would seek veterinary assistance after applying traction for a specific amount of time with no evidence of progress.

c. For the 94.8 percent of operations that ever seek veterinary assistance for difficult deliveries, percentage of operations that would seek assistance for the following situations:

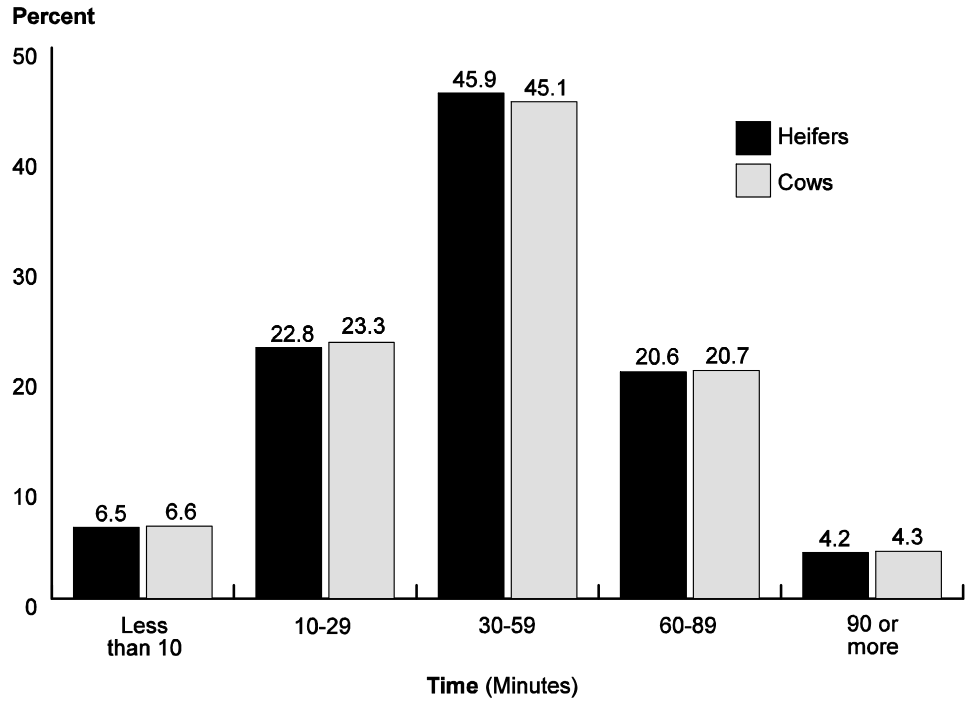
Situation	Percent Operations	Standard Error
Unable to correctly position calf for delivery	93.5	(1.4)
Applied traction for a specific amount of time without progress	85.6	(2.2)

The best chance of ending up with a live calf and a healthy dam after a difficult calving requires that the method being used be reassessed if no progress is made within 15 to 20 minutes. Longer intervention times, without veterinary assistance, can lead to death of the calf and possibly of the dam. The length of time operations intervened before calling for assistance was about the same for both heifers and cows. About 30 percent of operations reported that they would call for veterinary assistance within 30 minutes of intervening in a calving. The highest single percentage of operations would seek assistance within 30 to 59 minutes of intervening for both heifers and cows. About one-fourth of operations (24.8 percent for heifers and 25.0 percent for cows) would work to relieve the dystocia for 1 hour or more before calling for veterinary assistance.

d. For the 94.8 percent of operations that ever seek veterinary assistance for difficult deliveries, percentage of operations by length of time from beginning intervention during calving until calling for veterinary assistance, for heifers and for cows:

	Percent Operations			
	Heifers		Cows	
Time (Minutes)	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 10	6.5	(1.5)	6.6	(1.5)
10 to 29	22.8	(2.7)	23.3	(2.7)
30 to 59	45.9	(3.2)	45.1	(3.2)
60 to 89	20.6	(2.5)	20.7	(2.5)
90 or more	4.2	(1.1)	4.3	(1.1)
Total	100.0		100.0	

For the 94.8 Percent of Operations that Ever Seek Veterinary Assistance for Difficult Deliveries, Percentage of Operations by Length of Time from Beginning Intervention During Calving Until Calling for Veterinary Assistance, for Heifers and for Cows



Heifers generally require more assistance than cows at calving because of their immature frame size. A higher percentage of cows (79.4 percent) than heifers (69.0 percent) calved unassisted during the previous 12 months. A higher percentage of heifers than cows experienced severe dystocia (6.8 percent of heifers and 3.5 percent of cows) or mild dystocia (11.8 percent of heifers and 7.3 percent of cows).

e. Percentage of heifers and cows that calved during the previous 12 months, by calving difficulty:

Calving Difficulty	**Percent Heifers[1]**	**Std. Error**	**Percent Cows[2]**	**Std. Error**
Severe dystocia (surgical or mechanical extraction)	6.8	(0.7)	3.5	(0.3)
Mild dystocia	11.8	(0.8)	7.3	(0.5)
No dystocia, but assistance provided anyway	12.4	(1.0)	9.8	(0.9)
No assistance	69.0	(1.4)	79.4	(1.3)
Total	100.0		100.0	

[1]As a percentage of dairy cow replacements entering the milking herd in 2006.
[2]As a percentage of cows on the operation at the time of VS Initial Visit interview.

7. Stillbirths

NOTE: Stillbirths were reported on p 61 of Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007. The stillbirth estimates in Part I are slightly lower (6.5 percent of all calves) than those reported below.

Stillbirths are usually defined as calves that are born dead or die within 48 hours of birth. Analysis of DHIA records indicates that the percentage of calves that are stillborn has increased since the 1980s.

All medium and large operations (100.0 percent) had at least one stillborn calf during the previous 12 months, and almost all small operations (94.7 percent) had at least one stillborn calf. For all operations, 96.3 percent had one or more stillborn calves. Overall, 8.1 percent of calves were stillborn during the previous 12 months, with no difference in percentage of stillbirths by herd size.

a. Percentage of operations with stillborn calves and percentage of calves that were stillborn (including calves that were born dead or died within 48 hours of birth) during the previous 12 months, and by herd size:

	Percent							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Population	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Operations	94.7	(1.8)	100.0	(0.0)	100.0	(0.0)	96.3	(1.3)
Calves*	8.9	(0.4)	8.6	(0.4)	7.2	(0.5)	8.1	(0.3)

*Number of calves stillborn x 100 / number of calves born during 2006.

A higher percentage of operations in the West region (100.0 percent) had at least one stillbirth compared with operations in the East region (96.0 percent), although the difference was small. The West region had a lower percentage of stillborn calves than the East region, however (6.6 and 8.9 percent, respectively).

b. Percentage of operations with stillborn calves and percentage of calves that were stillborn (including calves that were born dead or died within 48 hours of birth) during the previous 12 months, by region:

	Percent			
	Region			
	West		**East**	
Population	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Operations	100.0	(0.0)	96.0	(1.4)
Calves*	6.6	(0.5)	8.9	(0.3)

*Number of calves stillborn x 100 / number of calves born during 2006.

The majority of stillborn calves were born dead (78.6 percent), while the remaining 21.4 percent were born alive but died within 48 hours of birth.

c. For the 8.1 percent of calves that were stillborn during the previous 12 months, percentage of stillborn calves by time of death:

Time of Death	Percent Calves*	Standard Error
Born dead	78.6	(1.4)
Born alive, but died within 48 hr	21.4	(1.4)
Total	100.0	

*As a percentage of stillborn calves.

8. Assistance for compromised calves

Calves that experience a dystocia are more likely to be stillborn. Calves that experience a dystocia but are born alive can be given assistance, such as supplemental oxygen, that increases their chances of survival. Depending on the environmental conditions, all the procedures listed below, with the exception of hanging the calf upside down, are considered beneficial to the health of the calf. Hanging the calf upside down, which was once promoted to assist in removing fluid from the calf's lungs, might actually be harmful for two reasons: most of the liquid comes from the abomasum and not the lungs, making the calf more susceptible to dehydration, and hanging the calf upside down increases pressure on the chest, making it more difficult for the calf to breathe. Calves that experience dystocia are likely to have low levels of oxygen in their blood (hypoxia), and their blood pH is frequently acidic (acidosis) instead of neutral. These impairments lead to other problems, such as decreased ability to nurse and decreased absorption of IgG, and can negatively affect temperature regulation. In many cases, the administration of oxygen to calves after dystocia may have the single largest impact on calf survival.

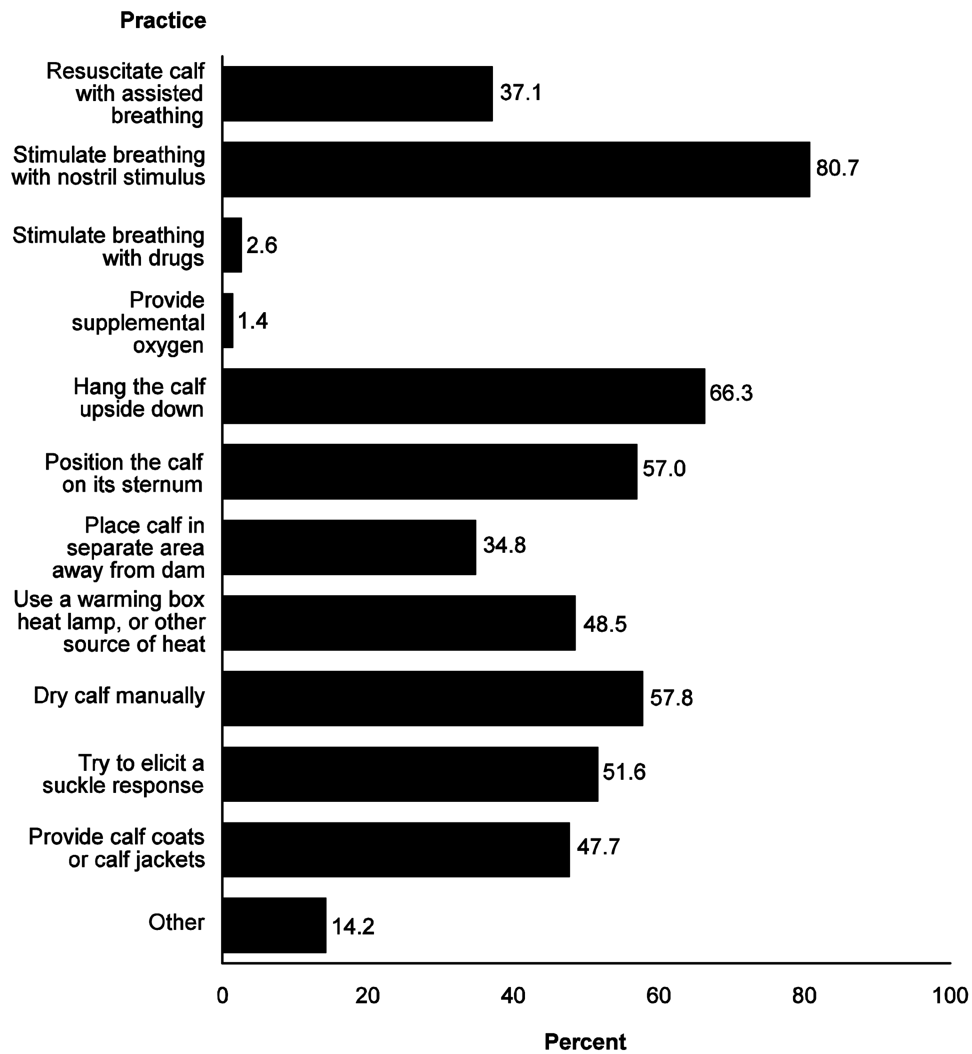
On 80.7 percent of operations, a calf that experienced a difficult birth would receive nostril stimulation to initiate breathing. Hanging the calf upside down would be performed on 66.3 percent of operations. Three of the practices that are simple to perform and do not require special equipment or materials—positioning the calf on its sternum, drying the calf manually with towels or a hair dryer, and trying to elicit a suckle response—were performed by at least one-half of operations. Few operations (1.4 percent) would provide supplemental oxygen. "Other" practices (14.2 percent of operations) would include allowing the dam to lick/stimulate the calf and feeding colostrum.

Use of some practices varied with the size of the operation. Almost two-thirds of large operations (62.5 percent) resuscitated the calf via assisted breathing, compared with slightly more than one-third of small and medium operations (35.0 and 36.6 percent, respectively). A higher percentage of small and medium operations (61.5 and 55.6 percent, respectively) than large operations (27.4 percent) dried the calf manually with towels, hair dryer, etc. Additionally, a higher percentage of small and medium operations (45.8 and 58.5 percent, respectively) provided calf coats or calf jackets compared with large operations (26.6 percent).

a. Percentage of operations by practice generally done within 1 hour after delivery for a calf that experienced a difficult birth, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Practice	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Resuscitate calf with assisted breathing	35.0	(3.9)	36.6	(4.3)	62.5	(5.9)	37.1	(2.9)
Stimulate breathing with nostril stimulus	77.3	(3.4)	88.3	(2.7)	87.7	(4.2)	80.7	(2.5)
Stimulate breathing with drugs (Dopram, etc.)	0.6	(0.5)	6.7	(2.4)	7.9	(3.4)	2.6	(0.7)
Provide supplemental oxygen	0.0	(--)	5.2	(2.2)	2.3	(2.1)	1.4	(0.6)
Hang the calf upside down	66.3	(3.8)	66.2	(4.3)	67.0	(6.0)	66.3	(2.8)
Position the calf on its sternum	54.3	(4.0)	63.4	(4.4)	61.2	(6.2)	57.0	(3.0)
Place the calf in separate area away from the dam	32.6	(3.8)	39.1	(4.5)	41.5	(6.0)	34.8	(2.9)
Use a warming box, heat lamp, or other source of heat during cold weather	45.7	(4.1)	59.3	(4.4)	36.6	(5.0)	48.5	(3.0)
Dry calf manually with towels, hair dryer, etc.	61.5	(3.8)	55.6	(4.5)	27.4	(5.3)	57.8	(2.8)
Try to elicit a suckle response	53.9	(4.0)	48.6	(4.4)	39.2	(6.4)	51.6	(3.0)
Provide calf coats or calf jackets after calf is dry	45.8	(4.1)	58.5	(4.3)	26.6	(4.9)	47.7	(3.0)
Other	16.9	(3.2)	7.7	(2.8)	10.7	(4.1)	14.2	(2.4)

Percentage of Operations by Practice Generally Done Within 1 Hour After Delivery for a Calf that Experienced a Difficult Birth



A higher percentage of operations in the West region (54.3 percent) generally resuscitated calves that experienced a difficult birth with assisted breathing compared with operations in the East region (35.5 percent). Alternatively, a higher percentage of operations in the East region dried calves manually with towels, hair dryer, etc. (60.1 percent) or provided calf coats or jackets after the calf was dry (50.5 percent), compared with 34.5 and 18.7 percent of operations in the West region, respectively.

b. Percentage of operations by practice generally done within 1 hour after delivery for a calf that experienced a difficult birth, by region:

	Percent Operations			
	Region			
	West		**East**	
Practice	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Resuscitate calf with assisted breathing	54.3	(5.4)	35.5	(3.1)
Stimulate breathing with nostril stimulus	84.1	(4.1)	80.4	(2.7)
Stimulate breathing with drugs (Dopram, etc.)	2.5	(1.4)	2.6	(0.8)
Provide supplemental oxygen	3.3	(2.0)	1.3	(0.6)
Hang the calf upside down	67.0	(5.9)	66.3	(3.1)
Position the calf on its sternum	60.2	(6.0)	56.7	(3.2)
Place the calf in separate area away from the dam	34.6	(5.9)	34.8	(3.1)
Use a warming box, heat lamp, or other source of heat during cold weather	38.7	(5.5)	49.4	(3.3)
Dry calf manually with towels, hair dryer, etc.	34.5	(5.5)	60.1	(3.0)
Try to elicit a suckle response	37.6	(5.7)	53.0	(3.2)
Provide calf coats or calf jackets after calf is dry	18.7	(4.4)	50.5	(3.3)
Other	6.5	(2.7)	15.0	(2.6)

C. Surgical Procedures

1. Dehorning

Removing the horns of dairy cattle reduces the risk of injury to other cattle and to people. The two major approaches for removing horns are breeding programs to produce animals without horns and manual removal. Cattle born without horns, referred to as polled, were previously suspected of having decreased productivity compared with horned cattle. It now appears that the tremendous amount of genetic selection, primarily for milk production, that has occurred in horned dairy breeds has made them appear superior in terms of productivity. With the same intensity of selection of polled cattle, productivity might not be a concern. Disbudding refers to removal of the horn bud in young cattle, whereas dehorning refers to removal of the horns of cattle. In the European Union, it is illegal to disbud or dehorn calves more than 14 days old without using a local anesthetic.

The Animal Welfare Committee of the American Veterinary Medical Association (AVMA) states the following: “Because castration and dehorning cause pain and discomfort, the AVMA recommends the use of procedures and practices that reduce or eliminate these effects, including the use of approved or AMDUCA-permissible clinically effective medications whenever possible.” AVMA also states that dehorning should be done at the youngest age possible and “disbudding is the preferred method of dehorning calves. Local anesthetic should be considered for other dehorning procedures.”

Overall, 94 percent of operations routinely dehorned heifer calves while they were on the operation during the previous 12 months. A lower percentage of large operations (64.3 percent) dehorned heifer calves than small or medium operations (97.3 and 92.6 percent, respectively). More than 95 percent of operations in the East region (95.6 percent) routinely dehorned heifer calves, compared with 77.6 percent of operations in the West region. Herd-size and regional differences are likely related to large operations moving calves to heifer-raising facilities when calves are still too young for disbudding/dehorning.

a. Percentage of operations that routinely dehorned heifer calves while on the operation during the previous 12 months, and by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
97.3	(1.6)	92.6	(2.8)	64.3	(6.3)	94.0	(1.4)

b. Percentage of operations that routinely dehorned heifer calves while on the operation during the previous 12 months, by region:

Percent Operations			
Region			
West		East	
Percent	Standard Error	Percent	Standard Error
77.6	(4.6)	95.6	(1.4)

For operations that routinely dehorned heifer calves during the previous 12 months, more than two-thirds (69.1 percent) used a hot iron; 28.2 percent used a tube, spoon, or gouge; and 16.3 percent used saws, wire, or Barnes dehorners. For operations that used a hot iron to dehorn calves, 13.8 percent used analgesics or anesthetics when dehorning calves. More than 90 percent of operations (94.0 percent) dehorned calves, and 17.7 percent of these operations used analgesics or anesthetics during the dehorning procedure.

c. Percentage of operations by dehorning method, and corresponding percentage of operations using that method that used analgesics/anesthetics:

Method	Percent Operations	Std. Error	Percent Operations that Used Analgesics/ Anesthetics	Std. Error
Hot iron	69.1	(2.8)	13.8	(2.6)
Caustic paste	9.2	(1.8)	14.2	(5.8)
Tube, spoon, or gouge	28.2	(2.9)	21.5	(5.1)
Saws, wire, or Barnes	16.3	(2.3)	21.5	(6.7)
Other	1.7	(0.9)	17.1	(16.5)
Any	94.0	(1.4)	17.7	(2.3)

Photo courtesy of "Dairy Herd Management"/"Bovine Veterinarian"

The majority of heifer calves on operations that routinely dehorned calves were dehorned by hot iron (67.5 percent of calves) at an average age of 7.6 weeks. Caustic paste was used on 12.2 percent of calves at 2.7 weeks of age. A similar percentage was observed for the tube, spoon, or gouge method, but the average age increased to 16.9 weeks. Saws, wire, or Barnes dehorners were used on 7.1 percent of heifer calves at an average age of 23.5 weeks.

d. For the 94.0 percent of operations that routinely dehorned heifer calves while on the operation during the previous 12 months, percentage of calves dehorned and average age at dehorning, by method used to dehorn calves:

Method	Percent Heifers*	Std. Error	Average Age (Weeks)	Std. Error
Hot iron	67.5	(3.1)	7.6	(0.4)
Caustic paste	12.2	(2.6)	2.7	(0.3)
Tube, spoon, or gouge	13.0	(1.7)	16.9	(1.2)
Saws, wire, or Barnes	7.1	(1.1)	23.5	(2.6)
Other	0.2	(0.1)	32.7	(6.9)
Total	100.0			

*Dairy heifer calves weaned during the previous 12 months.

Of the dehorning equipment used on operations, tubes, spoons, gouges, saws, wire, and Barnes dehorners commonly cause bleeding. More than 4 of 10 operations (42.0 percent) used dehorning equipment that causes bleeding. A higher percentage of small and medium operations (42.9 and 43.5 percent, respectively) used dehorning equipment that causes bleeding compared with large operations (18.9 percent).

e. For the 94.0 percent of operations that routinely dehorned heifer calves while on the operation during the previous 12 months, percentage of operations that dehorned heifer calves with equipment that can cause bleeding, and by herd size:

Percent Operations

Herd Size (Number of Cows)

Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
42.9	(4.0)	43.5	(4.6)	18.9	(5.7)	42.0	(3.1)

Disinfection of dehorning equipment that causes bleeding reduces the possibility of transmitting diseases such as bovine leukosis virus. Approximately one-half of operations (46.4 percent) disinfected dehorning equipment for each calf.

f. For the 42.0 percent of operations that routinely dehorned heifer calves with equipment that can cause bleeding, percentage of operations that chemically disinfected surgical dehorning equipment for each calf:

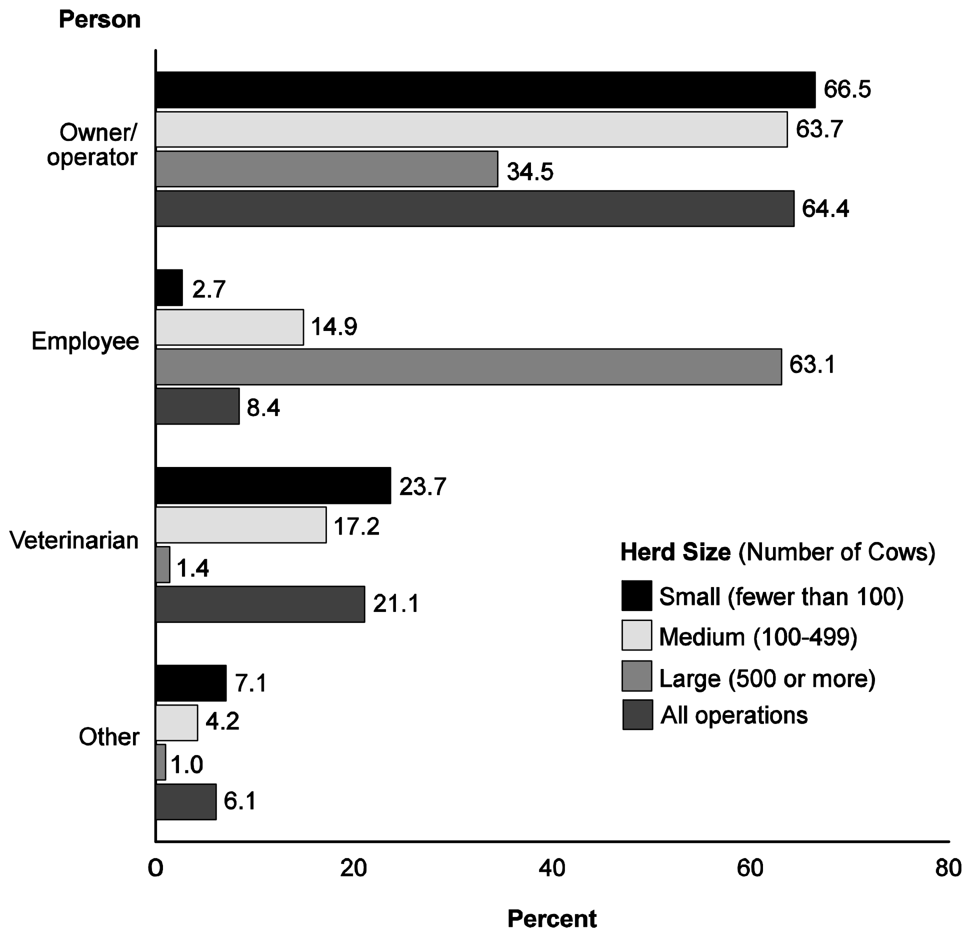
Percent Operations	**Standard Error**
46.4	(4.9)

On almost two-thirds of operations (64.4 percent), the owner/operator was identified as dehorning the majority of calves. The person who dehorned the majority of calves differed with operation size, however, with the owner/operator dehorning the majority of heifer calves on about two-thirds of small and medium operations (66.5 percent and 63.7 percent, respectively) but only about one-third of large operations (34.5 percent). An employee dehorned the majority of calves on 63.1 percent of large operations, compared with 2.7 percent of small operations and 14.9 percent of medium operations. Veterinarians performed the majority of dehorning on 23.7 percent of small operations, 17.2 percent of medium operations, and 1.4 percent of large operations.

g. For the 94.0 percent of operations that routinely dehorned heifer calves during the previous 12 months, percentage of operations by person who dehorned the majority of heifer calves on the operation, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Person	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Owner/operator	66.5	(3.8)	63.7	(4.2)	34.5	(7.5)	64.4	(2.9)
Employee	2.7	(1.1)	14.9	(2.9)	63.1	(7.4)	8.4	(1.1)
Veterinarian	23.7	(3.4)	17.2	(3.4)	1.4	(0.5)	21.1	(2.6)
Other	7.1	(2.2)	4.2	(1.8)	1.0	(0.6)	6.1	(1.6)
Total	100.0		100.0		100.0		100.0	

For the 94.0 Percent of Operations that Routinely Dehorned Heifer Calves During the Previous 12 Months, Percentage of Operations by Person Who Dehorned the Majority of Heifer Calves on the Operation, and by Herd Size



Employees dehorned the majority of heifer calves on a higher percentage of operations in the West region (33.4 percent) than in the East region (6.4 percent).

h. For the 94.0 percent of operations that routinely dehorned heifer calves during the previous 12 months, percentage of operations by person who dehorned the majority of heifer calves on the operation, by region:

	Percent Operations			
	Region			
	West		East	
Person	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Owner/operator	55.1	(6.8)	65.2	(3.1)
Employee	33.4	(5.5)	6.4	(1.1)
Veterinarian	11.5	(4.6)	21.8	(2.8)
Other	0.0	(--)	6.6	(1.8)
Total	100.0		100.0	

2. Extra teat removal

Extra teats on dairy cows can interfere with milking and lead to mastitis, and they are not acceptable in show cattle. As with dehorning, removal of extra teats should be done at an early age to facilitate a quick recovery.

About one-half of operations (50.3 percent) routinely removed extra teats from heifer calves during the previous 12 months. The percentage of operations that removed extra teats did not differ by herd size.

a. Percentage of operations that routinely removed extra teats from heifer calves during the previous 12 months, and by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
46.4	(4.0)	57.1	(4.4)	66.4	(6.2)	50.3	(3.0)

About one-fifth of operations (20.3 percent) that routinely removed extra teats from heifer calves removed the teats when the heifers were less than 12.0 weeks old, while one-third (32.2 percent) removed teats at 12.0 to 17.9 weeks of age. About 20 percent of operations removed extra teats from animals in each of the next two age categories (18.0 to 23.9 weeks and 24.0 to 29.9 weeks).

b. For the 50.3 percent of operations that routinely removed extra teats from heifer calves during the previous 12 months, percentage of operations by age at which extra teats were removed:

Age (Weeks)	**Percent Operations**	**Standard Error**
Less than 12.0	20.3	(3.4)
12.0 to 17.9	32.2	(3.8)
18.0 to 23.9	20.1	(3.4)
24.0 to 29.9	18.6	(3.5)
30.0 or more	8.8	(1.9)
Total	100.0	

One of 10 operations (10.6 percent) routinely used analgesia or anesthesia during extra teat removal, which is similar to usage for dehorning.

c. For the 50.3 percent of operations that routinely removed extra teats from heifer calves during the previous 12 months, percentage of operations that used analgesics or anesthesia while removing extra teats:

Percent Operations	**Standard Error**
10.6	(3.0)

3. Tail docking

Tail docking was initially promoted to reduce the incidence of leptospirosis in milking personnel in New Zealand, but subsequent research demonstrated leptospiral titers of milkers had no relationship with tail docking. Tail docking is currently prohibited and must not be performed as a routine management procedure in the European Union.

The AVMA is opposed to tail docking, and the American Association of Bovine Practitioners (AABP) states the following: “The AABP is not aware of sufficient scientific evidence in the literature to support tail docking in cattle. If it is deemed necessary for proper care and management of production animals in certain conditions, veterinarians should counsel clients on proper procedures, benefits and risks.”

Almost half of operations (48.6 percent) had one or more tail-docked cows. A higher percentage of operations in the West region (81.3 percent) had no tail-docked cows than in the East region (48.5 percent of operations). On about one of seven operations (14.6 percent), all cows had a docked tail.

a. Percentage of operations by percentage of tail-docked cows, and by region:

	Percent Operations					
	Region					
	West		East		All Operations	
Percent Cows	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
0	81.3	(4.3)	48.5	(3.2)	51.4	(2.9)
0.1 to 24.9	0.7	(0.7)	11.8	(2.0)	10.8	(1.9)
25.0 to 75.9	9.6	(3.7)	8.8	(1.7)	8.9	(1.6)
76.0 to 99.9	5.5	(1.9)	15.1	(2.4)	14.3	(2.2)
100.0	2.9	(1.5)	15.8	(2.2)	14.6	(2.0)
Total	100.0		100.0		100.0	

Overall, about 4 of 10 cows (38.8 percent) had a docked tail. A higher percentage of cows on medium operations (55.5 percent) than on small or large operations (27.1 and 34.5 percent, respectively) had a docked tail.

b. Percentage of tail-docked cows, and by herd size:

Percent Tail-Docked Cows*

Herd Size (Number of Cows)

Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
27.1	(3.2)	55.5	(3.6)	34.5	(4.3)	38.8	(2.4)

*As a percentage of cows on the operation at the time of VS Initial Visit interview.

The majority of operations that had tail-docked cows most commonly used a band to dock tails (87.2 percent); these operations represented 90.4 percent of tail-docked cows. About 1 of 10 operations did not know what procedure was used, which suggests the cattle were purchased with the tail already docked.

c. For the 48.6 percent of operations with tail-docked cows, percentage of operations (and percentage of tail-docked cows on those operations) by procedure most commonly used to dock tails:

Procedure	**Percent Operations**	**Standard Error**	**Percent Tail-Docked Cows***	**Standard Error**
Band	87.2	(2.9)	90.4	(2.9)
Surgical removal	2.0	(1.0)	5.2	(2.4)
Hot knife	0.0	(--)	0.0	(--)
Other	1.9	(0.9)	2.7	(1.2)
Unknown procedure	8.9	(2.7)	1.7	(1.2)
Total	100.0		100.0	

*Number of cows with the tail docked as a percentage of cows on the operation at the time of VS Initial Visit interview.

For operations with tail-docked cows, 61.0 percent of operations (accounting for 38.0 percent of tail-docked cows) performed tail-docking on the majority of animals when they were at least 2 years old. The tail was docked on almost 3 of 10 cows (28.1 percent) at less than 2 months of age. About 10 percent of operations docked tails when cattle were less than 2 months of age (10.2 percent) or from 2 months to less than 6 months old (10.5 percent).

d. For the 48.6 percent of operations with tail-docked cows, percentage of operations (and percentage of tail-docked cows on those operations) by age of the majority of cattle when the tail was docked:

Age	Percent Operations	Standard Error	Percent Tail-Docked Cows*	Standard Error
Less than 2 months	10.2	(2.0)	28.1	(5.0)
2 months to less than 6 months	10.5	(2.6)	17.1	(3.4)
6 months to less than 2 years	9.5	(2.0)	16.3	(3.5)
2 years or older	61.0	(4.0)	38.0	(4.9)
Unknown	8.8	(2.7)	0.5	(0.2)
Total	100.0		100.0	

*Number of cows with the tail docked as a percentage of cows on the operation at the time of VS Initial Visit interview.

The majority of operations (90.3 percent) did not routinely use analgesics or anesthetics for tail docking, compared with 1.1 percent that routinely used analgesics or anesthetics. Operations that routinely used analgesics or anesthetics represented 0.9 percent of tail-docked cows.

e. For the 48.6 percent of operations with tail-docked cows, percentage of operations (and percentage of tail-docked cows on those operations) by routine use of analgesia or anesthesia:

Analgesia or Anesthesia Use	Percent Operations	Standard Error	Percent Tail-Docked Cows*	Standard Error
Yes	1.1	(0.6)	0.9	(0.6)
Don’t know	8.6	(2.6)	1.3	(0.6)
No	90.3	(2.7)	97.8	(0.9)
Total	100.0		100.0	

*Number of cows with the tail docked as a percentage of cows on the operation at the time of VS Initial Visit interview.

4. Castration

Castration is considered necessary in the management of cattle. As with other surgical procedures of cattle, castration should be done at the youngest age possible. In the European Union, it is illegal to castrate calves over 6 months of age without using a local anesthetic. The AVMA recommends the preoperative use of nonsteroidal anti-inflammatory agents and the administration of local anesthetics to minimize pain associated with castration.

About two-fifths of operations (40.5 percent) routinely castrated bull calves on the operation during the previous 12 months. Because many dairy operations do not keep bull calves for more than a day or two, it is likely that many operations do not have bull calves long enough to castrate them. A higher percentage of small operations (45.7 percent) routinely castrated bull calves compared with large operations (16.9 percent).

a. Percentage of operations that routinely castrated bull calves while on the operation during the previous 12 months, and by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
45.7	(3.9)	32.0	(4.1)	16.9	(4.1)	40.5	(2.9)

Bands were used most commonly to castrate calves on 60.8 percent of operations, with 26.9 percent of operations using a knife and 12.2 percent using a burdizzo most commonly. Calves were castrated at an operation average age of 8.9 weeks, and 3.2 percent of operations that castrated calves routinely used analgesics or anesthesia.

b. For the 40.5 percent of operations that routinely castrated bull calves during the previous 12 months, percentage of operations by method most commonly used to castrate bull calves:

Method	**Percent Operations**	**Standard Error**
Burdizzo	12.2	(3.2)
Knife	26.9	(4.6)
Band	60.8	(4.9)
Other	0.1	(0.1)
Total	100.0	

c. For the 40.5 percent of operations that routinely castrated bull calves during the previous 12 months, operation average age of calves at castration:

Operation Average Age (Weeks)	**Standard Error**
8.9	(0.6)

d. For the 40.5 percent of operations that routinely castrated bull calves during the previous 12 months, percentage of operations that routinely used analgesics or anesthesia for castration:

Percent Operations	**Standard Error**
3.2	(1.7)

D. Hoof Health

1. Lameness

Lameness in dairy cattle can result from many causes, including infectious agents, such as *Fusobacterium necrophorus* and *Bacteroides melaninogenicus,* which cause foot rot; digital dermatitis (hairy heel warts), which is most likely caused by spirochetes; excessive intake of rapidly fermentable carbohydrates, leading to rumen acidosis and subsequent laminitis; and trauma. Lameness was the second leading health problem in dairy cows, affecting 14.0 percent of cows in 2006 (reported on p 84 of Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007).

Note: For the purposes of this report, an animal could have had more than one case of lameness (gait abnormality) if the animal recovered and became lame again during the previous 12 months.

Approximately 1 of 10 bred heifers (11.4 percent) and 1 of 4 cows (23.9 percent) were lame at least once during the previous 12 months. There were no herd-size differences in the operation average percent of bred heifers that were lame, but medium operations had a higher percentage of cows with lameness (30.8 percent) than small operations (21.1 percent).

a. Operation average percentage of lameness cases by cattle class during the previous 12 months, and by herd size:

	Operation Average Percent Lameness Cases							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Bred Heifers[1]	12.4	(3.5)	8.3	(1.2)	12.1	(2.8)	11.4	(2.5)
Cows[2]	21.1	(1.4)	30.8	(3.1)	28.4	(2.9)	23.9	(1.3)

[1]Number of cases as a percentage of dairy cow replacements entering the milking herd in 2006.
[2]Number of cases as a percentage of cows on the operation at the time of VS Initial Visit interview.

Lameness is much more common in cows than in heifers. While 3.6 percent of operations had no cases of lameness in cows, 41.3 percent of operations had no cases of lameness in heifers. Fewer than 1 of 20 operations (2.8 percent) had lameness cases in 50.0 percent or more bred heifers, while 12.0 percent of operations had lameness cases in 50.0 percent or more cows.

b. Percentage of operations by percentage of lameness cases occurring by cattle class on the operation during the previous 12 months:

	Percent Operations			
	Cattle Class			
	Bred Heifers		**Cows**	
Percent Lameness Cases in Bred Heifers[1] or Cows[2]	**Percent**	**Std. Error**	**Percent**	**Std. Error**
0	41.3	(3.1)	3.6	(1.1)
0.1 to 24.9	49.6	(3.0)	63.9	(2.7)
25.0 to 49.9	6.3	(1.7)	20.5	(2.3)
50.0 or more	2.8	(1.0)	12.0	(1.8)
Total	100.0		100.0	

[1]Number of cases as a percentage of dairy cow replacements entering the milking herd in 2006.
[2]Number of cases as a percentage of cows on the operation at the time of VS Initial Visit interview.

About 3 of 10 operations (28.7 percent) had at least 1 case of digital dermatitis in bred heifers while 70.2 percent of operations had at least 1 case in cows. A lower percentage of small operations had any digital dermatitis in bred heifers compared with medium and large operations. A higher percentage of large operations (95.0 percent) had any digital dermatitis in cows compared with medium and small operations (79.1 and 64.9 percent, respectively).

c. Percentage of operations with at least one case of digital dermatitis (hairy heel warts) in bred heifers or cows in the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Bred heifers	22.4	(3.2)	40.3	(4.6)	57.4	(6.7)	28.7	(2.6)
Cows	64.9	(3.9)	79.1	(3.8)	95.0	(2.4)	70.2	(2.9)

Digital dermatitis caused 61.8 percent of lameness cases in bred heifers and 49.1 percent of lameness cases in cows during the previous 12 months.

d. Percentage of cases of lameness due to digital dermatitis (hairy heel warts) in bred heifers and cows during the previous 12 months:

Percent Cases			
Bred Heifers[1]		**Cows**[2]	
Percent	**Standard Error**	**Percent**	**Standard Error**
61.8	(5.5)	49.1	(2.8)

[1]Number of cases as a percentage of dairy cow replacements entering the milking herd in 2006.
[2]Number of cases as a percentage of cows on the operation at the time of VS Initial Visit interview.

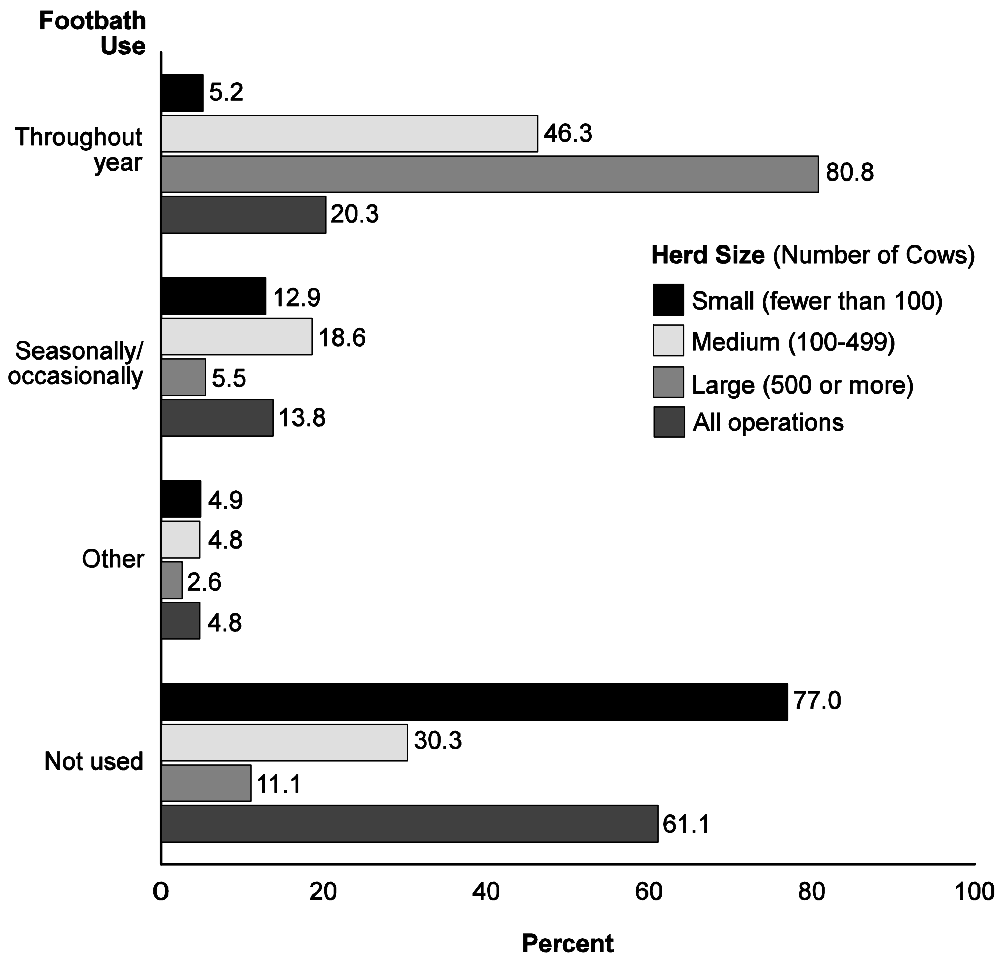
2. Footbath use

Footbaths are used to medicate the feet of cattle and aid in preventing lameness. The majority of operations (61.1 percent) used no footbaths during the previous 12 months. Of the 38.9 percent of operations that used footbaths, 20.3 percent of operations used a footbath throughout the year. Use of a footbath throughout the year increased as operation size increased, from 5.2 percent of small operations to 46.3 percent of medium operations and 80.8 percent of large operations. Conversely, the percentage of operations that did not use a footbath decreased as operation size increased, from 77.0 percent of small operations to 11.1 percent of large operations.

a. Percentage of operations by use of a footbath for cows during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Footbath Use	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Throughout year	5.2	(1.5)	46.3	(4.2)	80.8	(5.1)	20.3	(1.7)
Seasonally/ occasionally	12.9	(2.5)	18.6	(3.7)	5.5	(2.4)	13.8	(1.9)
Other	4.9	(2.1)	4.8	(2.1)	2.6	(2.2)	4.8	(1.5)
Not used	77.0	(3.3)	30.3	(3.9)	11.1	(4.2)	61.1	(2.6)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Use of a Footbath for Cows During the Previous 12 Months, and by Herd Size



A higher percentage of operations in the West region than in the East region (49.7 and 17.4 percent, respectively) used a footbath throughout the year. A higher percentage of operations in the East region used footbaths occasionally or not at all (14.9 and 62.8 percent, respectively) compared with the West region (3.1 and 43.4 percent, respectively).

b. Percentage of operations by use of a footbath for cows during the previous 12 months, by region:

	Percent Operations			
	Region			
	West		East	
Footbath Use	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Throughout year	49.7	(5.2)	17.4	(1.8)
Seasonally/ occasionally	3.1	(1.4)	14.9	(2.1)
Other	3.8	(2.1)	4.9	(1.7)
Not used	43.4	(5.0)	62.8	(2.8)
Total	100.0		100.0	

Photo courtesy of “Dairy Herd Management”/ “Bovine Veterinarian”

For operations that used footbaths, almost 8 of 10 cows (78.0 percent) were on operations that used footbaths throughout the year. Of cows on medium and large operations, the majority were on operations that used a footbath throughout the year (73.2 and 87.0 percent of cows, respectively). Almost 6 of 10 cows (57.0 percent) on small operations were on operations that used a footbath seasonally or occasionally.

c. For the 38.9 percent of operations that used footbaths during the previous 12 months, percentage of cows on those operations by footbath use, and by herd size:

	Percent Cows*							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Footbath Use	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Throughout year	29.1	(7.3)	73.2	(4.5)	87.0	(7.1)	78.0	(4.5)
Seasonally/ occasionally	57.0	(8.8)	21.5	(4.3)	10.6	(6.9)	17.7	(4.3)
Other	13.9	(5.9)	5.3	(2.3)	2.4	(2.2)	4.3	(1.6)
Total	100.0		100.0		100.0		100.0	

*As a percentage of cows on the operation at the time of VS Initial Visit interview.

For operations that used footbaths, the majority (66.6 percent) used copper sulfate most commonly as the footbath medication; these operations accounted for the majority of cows (63.6 percent). Footbath medications specified for the "Other" category, which represented 11.6 percent of operations and 18.0 percent of cows, were primarily a combination of the medications listed in the table.

d. For the 38.9 percent of operations that used footbaths during the previous 12 months, percentage of operations (and percentage of cows on those operations) by the footbath medication used most commonly:

Footbath Medication	**Percent Operations**	**Standard Error**	**Percent Cows***	**Standard Error**
Copper sulfate	66.6	(3.9)	63.6	(4.7)
Formalin/formaldehyde	10.9	(2.0)	16.4	(3.4)
Oxytetracycline	10.9	(3.3)	2.0	(0.6)
Hydrogen peroxide	0.0	(--)	0.0	(--)
Other	11.6	(2.3)	18.0	(4.1)
Total	100.0		100.0	

*As a percentage of cows on the operation at the time of VS Initial Visit interview.

3. Hoof trimming

Routine hoof trimming is important in identifying hoof disorders and maintaining proper hoof health. More than 80 percent of operations performed at least some hoof trimming, with a higher percentage of large operations and medium operations (99.4 and 95.6 percent, respectively) performing some trimming than small operations (79.4 percent).

a. Percentage of operations that trimmed any hooves during the previous 12 months, and by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
79.4	(3.4)	95.6	(1.7)	99.4	(0.6)	84.8	(2.4)

More than one-third of operations (38.2 percent) trimmed the hooves of all cows during the previous 12 months, while 15.2 percent of operations did not perform any hoof trimming.

b. Percentage of operations by percentage of cows that had their hooves trimmed at least once during the previous 12 months:

Percent Cows	Percent Operations	Standard Error
0	15.2	(2.4)
0.1 to 33.9	18.3	(2.4)
34.0 to 66.9	10.2	(1.7)
67.0 to 99.9	18.1	(2.2)
100.0	38.2	(2.9)
Total	100.0	

About three-fourths of operations (76.7 percent) used a professional hoof trimmer to do the majority of trimming. The owner or the operation's personnel performed the hoof trimming on 17.2 percent of operations.

c. For the 84.8 percent of operations that had cows' hooves trimmed during the previous 12 months, percentage of operations by the person who trimmed the majority of the hooves, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Person	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Professional hoof trimmer (not the operation's personnel)	72.3	(4.0)	85.9	(3.1)	80.3	(4.7)	76.7	(2.8)
Veterinarian (not the operation's personnel)	8.2	(2.7)	0.5	(0.3)	0.2	(0.2)	5.5	(1.8)
Owner or the operation's personnel	19.0	(3.5)	12.9	(3.1)	18.3	(4.6)	17.2	(2.4)
Other	0.5	(0.5)	0.7	(0.6)	1.2	(1.1)	0.6	(0.4)
Total	100.0		100.0		100.0		100.0	

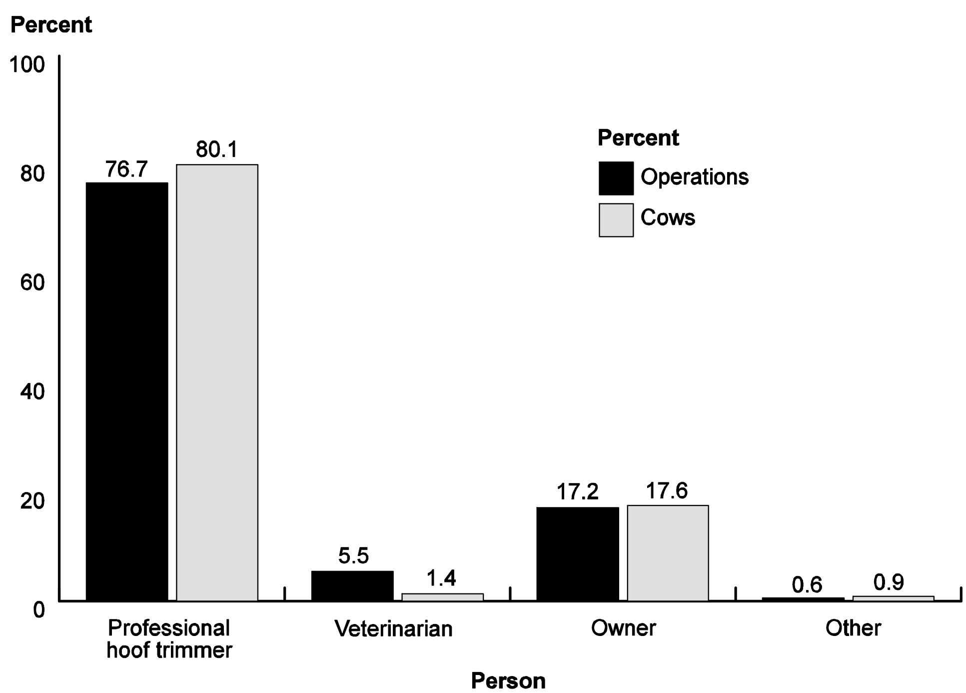
The majority of cows (80.1 percent) were on operations where cows' hooves were trimmed by a professional hoof trimmer during the previous 12 months. Almost 2 of 10 cows (17.6 percent) were on operations where the owner or the operation's personnel trimmed the majority of hooves. Veterinarians trimmed the hooves on 5.7 percent of cows on small operations compared with less than 1 percent of cows on medium or large operations.

d. For the 84.8 percent of operations that had cows' hooves trimmed during the previous 12 months, percentage of cows on those operations by the person who trimmed the majority of the hooves, and by herd size:

	Percent Cows*							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Person	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Professional hoof trimmer (not the operation's personnel)	74.7	(3.8)	85.2	(3.1)	79.3	(5.8)	80.1	(3.2)
Veterinarian (not the operation's personnel)	5.7	(2.0)	0.5	(0.4)	0.2	(0.2)	1.4	(0.4)
Owner or the operation's personnel	19.1	(3.4)	13.2	(3.1)	19.6	(5.8)	17.6	(3.1)
Other	0.5	(0.5)	1.1	(1.1)	0.9	(0.9)	0.9	(0.5)
Total	100.0		100.0		100.0		100.0	

*As a percentage of cows on the operation at the time of VS Initial Visit interview.

For the 84.8 Percent of Operations that had Cows' Hooves Trimmed During the Previous 12 Months, Percentage of Operations and Percentage of Cows on Those Operations by the Person Who Trimmed the Majority of the Hooves



Professional hoof trimmers made an average of 7.1 visits during the previous 12 months to operations to trim hooves or evaluate lame cows, while veterinarians made 1.1 visits. The number of visits made by professional hoof trimmers increased from 2.0 visits for small operations to 9.0 for medium and 44.5 visits for large operations.

e. For the 82.2 percent of operations visited by a professional hoof trimmer or veterinarian to trim hooves (as part of a routine trimming program) or to evaluate lame cows, operation average number of visits during the previous 12 months, and by herd size:

	Operation Average Number Visits							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Professional	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
Hoof trimmer	2.0	(0.2)	9.0	(0.5)	44.5	(4.0)	7.1	(0.5)
Veterinarian	1.3	(0.3)	0.7	(0.2)	0.2	(0.2)	1.1	(0.2)

E. Hemorrhagic Bowel Syndrome

1. Signs

Hemorrhagic bowel syndrome (HBS) is a fatal intestinal disease of milking cows and is characterized by sudden onset of bloody feces, with or without intestinal obstruction. Sudden death without prior signs is common. Both medical and surgical treatments have been relatively unsuccessful. A bloody bowel accompanied by a blood clot that obstructs the intestine may be observed at necropsy.

Results of the Dairy 2002 study suggest that management practices implemented to achieve high milk production, such as increased consumption of a high energy diet, might increase the risk of cattle developing HBS.

Overall, one-fifth of operations (19.7 percent) had at least one cow with signs of HBS on the operation during the previous 5 years. The percentage of operations that had at least one apparent HBS case increased with herd size, from 12.8 percent of small operations to 48.4 percent of large operations. In the West region, 33.2 percent of operations had at least one cow with signs of HBS during the previous 5 years, compared with 18.5 percent of operations in the East region.

a. Percentage of operations that had at least one cow with signs consistent with HBS on the operation during the previous 5 years, and by herd size:

Percent Operations

Herd Size (Number of Cows)

Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
12.8	(2.6)	31.7	(4.1)	48.4	(6.2)	19.7	(2.1)

b. Percentage of operations that had at least one cow with signs consistent with HBS on the operation during the previous 5 years, by region:

Percent Operations			
Region			
West		East	
Percent	Standard Error	Percent	Standard Error
33.2	(5.1)	18.5	(2.3)

For 19.3 percent of operations that had observed a cow with HBS signs during the previous 5 years, the first case occurred prior to 2000.

c. For the 19.7 percent of operations that had at least one cow with signs consistent with HBS during the previous 5 years, percentage of operations by year first suspected case of HBS occurred:

Year	Percent Operations	Standard Error
1999 or before	19.3	(5.7)
2000-01	13.9	(3.8)
2002-03	25.6	(5.0)
2004-05	22.0	(5.3)
2006-07*	19.2	(4.7)
Total	100.0	

*Through day of VS Second Visit interview.

For operations that had at least one cow with clinical signs consistent with HBS, less than 1 percent of cows (0.8 percent) had clinical signs during the previous 12 months, with no differences by herd size. The percentage of cows with signs consistent with HBS on all operations was 0.3 percent or less, depending on herd size.

d. For the 19.7 percent of operations that had at least one cow with signs consistent with HBS during the previous 5 years and for all operations, operation average percentage of cows that had signs of HBS during the previous 12 months, and by herd size:

Operation Average Percent Cows*

Herd Size (Number of Cows)

	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Population	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Operations with HBS	0.9	(0.3)	0.9	(0.3)	0.5	(0.1)	0.8	(0.2)
All Operations	0.1	(0.0)	0.3	(0.1)	0.2	(0.0)	0.2	(0.0)

*As a percentage of cows on the operation at the time of VS Initial Visit interview.

There were no regional differences in the operation average percentage of cows displaying clinical signs consistent with HBS.

e. For the 19.7 percent of operations that had at least one cow with signs consistent with HBS during the previous 5 years, operation average percentage of cows that had signs of HBS during the previous 12 months, by region:

Operation Average Percent Cows*

Region

West		**East**	
Percent	**Standard Error**	**Percent**	**Standard Error**
0.4	(0.1)	0.9	(0.2)

*As a percentage of cows on the operation at the time of VS Initial Visit interview.

2. Preventive measures

Almost one-third of operations that had cows with signs consistent with HBS during the previous 5 years (31.1 percent) had implemented preventive measures during that time specifically to reduce or eliminate HBS. There were no differences in the implementation of preventive measures by herd size or region.

a. For the 19.7 percent of operations that had at least one cow with signs of HBS during the previous 5 years, percentage of operations that implemented preventive measures during that time specifically to reduce or eliminate HBS, and by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
23.5	(8.5)	34.0	(6.6)	45.7	(7.9)	31.1	(4.9)

Even though the cause of HBS is unknown, multiple preventive measures are recommended based on current knowledge. With the exception of vaccination with an autogenous *Clostridium* type A vaccine, all other preventive measures listed were implemented by about 40 to 50 percent of operations that implemented some type of measure.

b. For the 31.1 percent of operations that implemented preventive measures for HBS within the previous 5 years, percentage of operations by measure used specifically to reduce or eliminate HBS:

Preventive Measure	Percent Operations	Standard Error
Vaccination with a commercial *Clostridium* type A vaccine	43.8	(8.0)
Vaccination with an autogenous *Clostridium* type A vaccine	13.5	(5.3)
Vaccination with a 7-way clostridial vaccine	50.5	(8.2)
Incorporated a feed additive (e.g., Omnigen AF®)	41.7	(8.0)
Changed feed ingredients/composition of ration	50.4	(8.4)
Changed forage management (chop size, source, etc.)	40.7	(8.1)

Of the operations that implemented preventive measures specifically to reduce or eliminate HBS, 60.1 percent perceived a great reduction (75 to 100 percent decrease) in HBS cases. An additional 20.1 percent of operations believed they had moderate reduction (50 to 74 percent decrease) in HBS cases, while 3.1 percent of operations experienced no reduction in HBS cases.

c. For the 31.1 percent of operations that implemented preventive measures for HBS within the previous 5 years, percentage of operations by perceived benefit from using the measures:

Perceived Benefit	**Percent Operations**	**Standard Error**
Great reduction in HBS cases (75-100 percent)	60.1	(8.1)
Moderate reduction in HBS cases (50-74 percent)	20.1	(6.7)
Reduction in HBS cases (25-49 percent)	11.6	(4.5)
Slight reduction in HBS cases (1-24 percent)	5.1	(2.5)
No reduction in HBS cases	3.1	(2.0)
Total	100.0	

F. Treatment Practices

1. General

Injections for dairy cows can be administered for a variety of reasons, including preventive measures, such as vaccination; treatment of disease (e.g., antibiotic injections); manipulation of the estrous cycle for improvements in breeding; and production enhancement using bovine somatotropin (bST).

Producers were asked to report the number of injections of any kind a dairy cow typically received during the previous 12 months. For all operations, the operation average number of injections typically received by a cow was 13.8, or an average of slightly more than 1 injection per month. The number of injections per cow increased as herd size increased, with cows on small operations receiving 6.4 injections and cows on large operations receiving 17.3 injections.

a. Operation average number of injections per cow during the previous 12 months, and by herd size:

Operation Average Number Injections

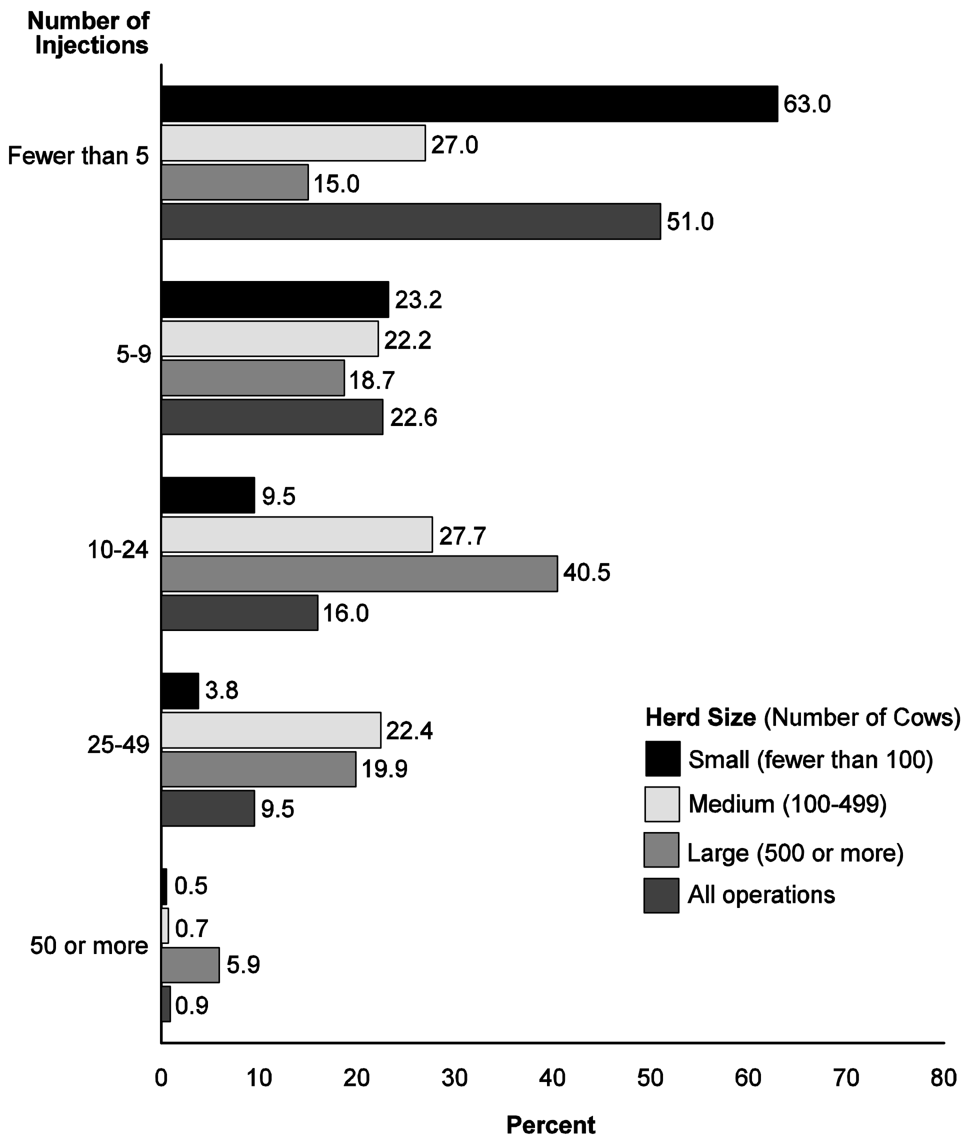
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
No.	**Std. Error**	**No.**	**Std. Error**	**No.**	**Std. Error**	**No.**	**Std. Error**
6.4	(0.7)	14.4	(1.0)	17.3	(1.6)	13.8	(0.8)

On about one-half of operations (51.0 percent), cows received fewer than five injections during the previous 12 months. In general, the number of injections a cow received increased with herd size; 63.0 percent of small operations gave fewer than five injections, compared with 27.0 percent of medium operations and 15.0 percent of large operations. About two-fifths of large operations (40.5 percent) gave 10 to 24 injections per cow during the previous 12 months, compared with 9.5 percent of small operations.

b. Percentage of operations by number of injections a cow typically received during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Number of Injections	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Fewer than 5	63.0	(3.9)	27.0	(4.1)	15.0	(4.7)	51.0	(2.9)
5 to 9	23.2	(3.5)	22.2	(3.5)	18.7	(4.8)	22.6	(2.6)
10 to 24	9.5	(2.2)	27.7	(4.0)	40.5	(6.4)	16.0	(1.9)
25 to 49	3.8	(1.3)	22.4	(3.7)	19.9	(4.3)	9.5	(1.4)
50 or more	0.5	(0.5)	0.7	(0.5)	5.9	(3.2)	0.9	(0.4)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Number of Injections a Cow Typically Received During the Previous 12 Months, and by Herd Size



A higher percentage of operations in the East region (52.7 percent) administered fewer than five injections to cows during the previous 12 months, compared with 32.9 percent of operations in the West region.

c. Percentage of operations by number of injections a cow typically received during the previous 12 months, by region:

	Percent Operations			
	Region			
	West		East	
Number of Injections	Percent	Std. Error	Percent	Std. Error
Fewer than 5	32.9	(5.6)	52.7	(3.2)
5 to 9	28.4	(5.4)	22.1	(2.7)
10 to 24	33.1	(5.5)	14.4	(2.0)
25 to 49	4.0	(1.9)	9.9	(1.5)
50 or more	1.6	(1.3)	0.9	(0.5)
Total	100.0		100.0	

Overall, 80.1 percent of cows were on operations that typically gave cows fewer than 25 injections during the previous 12 months, with 26.2 percent receiving fewer than 5 injections, 24.7 percent receiving 5 to 9 injections, and 29.2 percent receiving 10 to 24 injections. For small operations, the majority of cows were on operations on which cows typically received fewer than five injections (60.8 percent), compared with 21.0 percent of cows on medium operations and 11.7 percent of cows on large operations. In contrast, a higher percentage of cows on medium operations and on large operations (55.0 and 62.6 percent, respectively) typically received 10 or more injections than cows on small operations (15.4 percent).

d. Percentage of cows on operations by number of injections a cow typically received during the previous 12 months, and by herd size:

	Percent Cows*							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Number of Injections	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Fewer than 5	60.8	(3.9)	21.0	(3.4)	11.7	(4.3)	26.2	(2.7)
5 to 9	23.8	(3.5)	24.0	(3.7)	25.7	(7.5)	24.7	(3.8)
10 to 24	9.9	(2.2)	30.9	(4.3)	38.0	(7.1)	29.2	(3.6)
25 to 49	5.0	(1.7)	23.4	(3.7)	19.5	(4.5)	17.2	(2.4)
50 or more	0.5	(0.5)	0.7	(0.4)	5.1	(2.6)	2.7	(1.2)
Total	100.0		100.0		100.0		100.0	

*As a percentage of cows on the operation at the time of VS Initial Visit interview.

Almost 9 of 10 injections (89.1 percent) given to dairy cows were administered by farm personnel, with no differences observed by herd size.

e. Operation average percentage of injections administered by farm personnel, and by herd size:

Operation Average Percent Injections

Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
87.8	(1.9)	91.7	(1.7)	92.8	(1.9)	89.1	(1.4)

Photo courtesy of “Dairy Herd Management”/ “Bovine Veterinarian”

2. Injection route, purpose, and location
Note: The average number of injections a cow typically received for each operation was applied to every cow on that operation to calculate the number of injections by route, purpose, and location of administration.

There are three primary injection routes: intramuscular (IM), subcutaneous (SQ), and intravenous (IV). The selection and use of appropriate injection route and body location (or site) are important to both product efficacy and carcass quality at slaughter. In the 1990s, the National Cattlemen's Association (now the National Cattlemen's Beef Association, or NCBA) began conductin the Non-Fed Beef/Market Cow and Bull Quality Audits. Designed in part to evaluate the incidence of injection-site lesions, the audits include dairy cattle, which represent about 20 percent of all beef consumed in the United States. Injection-site lesions in the muscle cuts of the upper hip (sirloins and rounds) have decreased substantially since the first audits were conducted. In 2007, 11 percent of dairy cows had injection-site lesions, compared with 49 percent from 1998 to 2000. The 1999 audit estimated a loss of $1.46 per head due to trim loss associated with injection-site lesions. Although injection-site lesions are not a food-safety issue, the scar tissue affects meat quality. Scar tissue, which forms after IM injections, toughens muscle tissue, producing a product that may be unacceptable to consumers. Because muscle cuts of the upper hip (sirloins and rounds) are frequently marketed as whole cuts, injection lesions may not be noticed prior to retail sale. Producers are advised to follow Beef Quality Assurance guidelines and administer products labeled for IM injection in front of the shoulder—not in the hip or round.

Almost all operations (97.4 percent) administered IM injections during the previous 12 months. SQ and IV injections were administered on 69.1 and 70.3 percent of operations, respectively. A higher percentage of medium operations (84.6 percent) administered SQ injections compared with small operations (63.3 percent).

a. Percentage of operations that administered intramuscular (IM), subcutaneous (SQ), or intravenous (IV) injections, and by herd size:

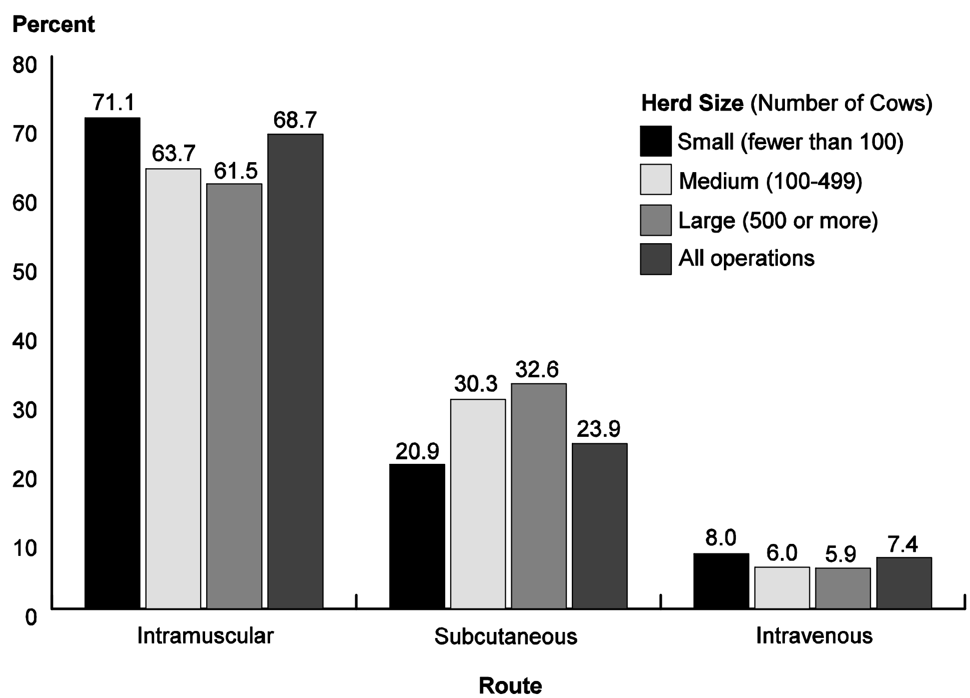
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Route	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Intramuscular	96.8	(1.1)	98.7	(0.8)	99.4	(0.6)	97.4	(0.8)
Subcutaneous	63.3	(4.0)	84.6	(3.2)	71.6	(6.0)	69.1	(2.9)
Intravenous	68.6	(3.8)	76.0	(3.6)	66.1	(6.3)	70.3	(2.8)

About two-thirds of injections (68.7 percent) were administered IM, compared with 23.9 percent administered SQ and 7.4 percent IV. There were no differences in injection route by herd size.

b. Operation average percentage of injections by injection route, and by herd size:

	Operation Average Percent Injections							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Route	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Intramuscular	71.1	(2.3)	63.7	(2.5)	61.5	(4.0)	68.7	(1.7)
Subcutaneous	20.9	(2.1)	30.3	(2.6)	32.6	(3.8)	23.9	(1.6)
Intravenous	8.0	(1.1)	6.0	(0.8)	5.9	(1.0)	7.4	(0.8)
Total	100.0		100.0		100.0		100.0	

Operation Average Percentage of Injections by Injection Route, and by Herd Size



Of IM injections administered on the operation, more than two-fifths (41.3 percent) were given for vaccination, while reproductive and antibiotic injections each accounted for about one-fourth of IM injections (27.3 and 23.1 percent, respectively).

c. For the 97.4 percent of operations that administered IM injections, operation average percentage of IM injections administered for the following purposes, and by herd size:

	Operation Average Percent IM Injections							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Purpose	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Antibiotic	24.7	(2.2)	18.9	(2.0)	22.3	(3.8)	23.1	(1.6)
Production enhancement (e.g., bST)	3.1	(1.3)	8.9	(2.1)	5.6	(1.4)	4.7	(1.1)
Reproduction	25.5	(2.1)	31.9	(2.8)	28.0	(2.4)	27.3	(1.6)
Vaccination	42.9	(2.8)	36.5	(2.8)	43.8	(3.2)	41.3	(2.1)
Other	3.8	(1.3)	3.8	(1.5)	0.3	(0.2)	3.6	(1.0)
Total	100.0		100.0		100.0		100.0	

The primary locations for IM injections were hind leg (45.3 percent) and neck (34.2 percent). A higher percentage of IM injections were administered in the neck on large operations (50.9 percent) compared with small or medium operations (11.8 and 16.5 percent, respectively). Conversely, a lower percentage of IM injections were administered in the hind leg on large operations (37.1 percent) than small operations (65.5 percent).

d. For the 97.4 percent of operations that administered IM injections, percentage of IM injections by location administered, and by herd size:

	Percent IM Injections							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Location	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Neck	11.8	(2.9)	16.5	(3.4)	50.9	(6.3)	34.2	(4.0)
Shoulder	3.3	(1.4)	3.0	(1.1)	1.3	(0.6)	2.1	(0.5)
Upper hip	16.3	(3.5)	17.4	(3.2)	8.3	(2.0)	12.4	(1.7)
Hind leg	65.5	(5.0)	50.2	(4.8)	37.1	(6.1)	45.3	(3.7)
Other	3.1	(1.4)	12.9	(4.6)	2.4	(1.1)	6.0	(1.8)
Total	100.0		100.0		100.0		100.0	

More than 4 of 10 production enhancement injections (41.4 percent) were given in “Other” locations. The most common production enhancement injection, bST (Posilac), is recommended to be given subcutaneously around the tailhead.

e. For the 97.4 percent of operations that administered IM injections, percentage of IM injections by location administered, by purpose of injection:

	Percent IM Injections									
	Purpose									
	Antibiotics		Production Enhance-ment		Repro-duction		Vaccination		Other	
Location	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Neck	41.6	(5.9)	20.5	(8.8)	28.3	(5.7)	47.5	(5.4)	5.3	(3.7)
Shoulder	2.9	(1.1)	8.7	(3.4)	1.6	(0.6)	1.4	(0.4)	0.3	(0.4)
Upper hip	14.5	(2.6)	8.6	(3.1)	11.7	(2.2)	12.5	(2.0)	19.7	(15.4)
Hind leg	39.9	(4.6)	20.8	(8.9)	58.1	(5.5)	37.6	(5.0)	73.3	(16.1)
Other	1.1	(0.6)	41.4	(9.4)	0.3	(0.2)	1.0	(0.3)	1.4	(1.2)
Total	100.0		100.0		100.0		100.0		100.0	

Almost all operations gave injections to heifers and cows (96.9 and 98.8 percent, respectively). More than 9 of 10 operations gave IM injections to heifers and cows (94.0 and 96.1 percent, respectively). Approximately 5 of 10 operations (51.6 percent) administered IV injections to heifers while 65.9 percent of operations administered IV injections to cows.

f. Percentage of operations that administered injections to heifers and cows during the previous 12 months, by injection route:

	Percent Operations							
	Injection Route							
	Intramuscular		Subcutaneous		Intravenous		Any	
Cattle Class	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Heifers	94.0	(1.4)	62.2	(3.0)	51.6	(3.0)	96.9	(1.1)
Cows	96.1	(1.0)	66.8	(3.0)	65.9	(2.9)	98.8	(0.6)

Cattle-handling facilities present on an operation dictate where the majority of animals are handled. This is reflected in the similarity of facility type used across injection routes for both heifers and cows. To restrain heifers for IM injections, most operations primarily used lock-up (30.4 percent of operations), tie stall/stanchion (28.8 percent), or chute/head gate (22.6 percent) facilities. These same types of facilities also were primarily used for SQ and IV injections for heifers. Less than 11 percent of operations gave any injections to heifers loose in freestalls, in a palpation rail, or in the parlor.

g. For the 96.9 percent of operations that administered IM, SQ, and/or IV injections to ***heifers***, percentage of operations by type of cattle-handling facility primarily used, by injection route:

	Percent Operations					
	Injection Route—Heifers					
	Intramuscular		Subcutaneous		Intravenous	
Cattle-handling Facility Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall/stanchion	28.8	(2.9)	24.2	(3.4)	36.3	(4.1)
Lock-up	30.4	(2.5)	36.4	(3.3)	31.6	(3.6)
Chute/head gate	22.6	(2.5)	23.4	(2.8)	20.1	(3.0)
Loose in freestall	10.2	(2.0)	7.5	(2.1)	5.7	(1.7)
Palpation rail	0.3	(0.1)	0.5	(0.2)	0.2	(0.2)
Parlor	5.5	(1.2)	4.3	(1.3)	2.4	(1.2)
Other	2.2	(1.1)	3.7	(1.7)	3.7	(1.6)
Total	100.0		100.0		100.0	

The majority of operations (59.0 percent) administered IM injections to cows in a tie stall/stanchion, while 17.4 percent of operations used the parlor and 12.4 percent used lock-ups. Tie stall/stanchion also was the primary facility used for administering SQ (52.4 percent of operations) or IV injections (64.0 percent of operations) to cows.

h. For the 98.8 percent of operations that administered IM, SQ, and/or IV injections to ***cows***, percentage of operations by type of cattle-handling facility primarily used, by injection route:

	Percent Operations					
	Injection Route—Cows					
	Intramuscular		**Subcutaneous**		**Intravenous**	
Cattle-handling Facility Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall/stanchion	59.0	(2.7)	52.4	(3.3)	64.0	(3.1)
Lock-up	12.4	(1.4)	17.0	(2.1)	11.5	(1.8)
Chute/head gate	5.3	(1.2)	7.6	(1.6)	11.9	(1.7)
Loose in freestall	4.1	(1.3)	2.7	(1.5)	4.7	(1.5)
Palpation rail	1.6	(0.5)	1.6	(0.5)	0.5	(0.2)
Parlor	17.4	(1.8)	18.5	(2.3)	5.0	(1.4)
Other	0.2	(0.2)	0.2	(0.2)	2.4	(1.0)
Total	100.0		100.0		100.0	

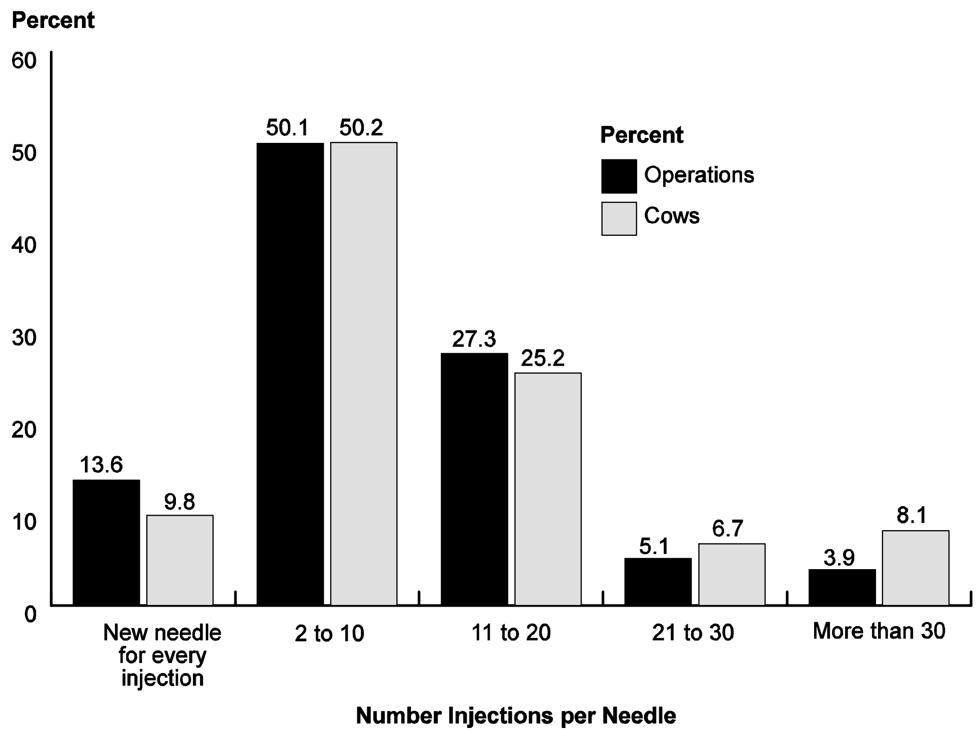
Using a new needle for each cow can decrease disease transmission and also reduce potential injury to the cow by minimizing the possibility of broken needles. About one of seven operations (13.6 percent) used a new needle for every injection during the previous 12 months; these operations represented 9.8 percent of all cows. The majority of operations (50.1 percent), representing 50.2 percent of cows, used each needle to give 2 to 10 injections. Approximately one-fourth of operations (27.3 percent), which represented 25.2 percent of cows, used each needle to give 11 to 20 injections. Although less than 4 percent of operations used needles for more than 30 injections, these operations represented 8.1 percent of cows, suggesting that this practice is more common on larger operations.

i. For the 98.8 percent of operations that administered IM, SQ, and/or IV injections to ***cows***, percentage of operations (and percentage of cows on those operations) by number of injections administered per needle by farm personnel during the previous 12 months:

Number Injections per Needle	Percent Operations	Standard Error	Percent Cows*	Standard Error
New needle for every injection	13.6	(2.2)	9.8	(1.6)
2 to 10	50.1	(3.0)	50.2	(4.0)
11 to 20	27.3	(2.8)	25.2	(3.2)
21 to 30	5.1	(1.1)	6.7	(1.9)
More than 30	3.9	(1.0)	8.1	(2.3)
Total	100.0		100.0	

*As a percentage of cows on the operation at the time of VS Initial Visit interview.

For the 98.8 Percent of Operations that Administered IM, SQ, and/or IV Injections to Cows, Percentage of Operations and Percentage of Cows* on Those Operations by Number of Injections Administered Per Needle by Farm Personnel During the Previous 12 Months



*As a percentage of cows on the operation at time of Initial VS interview.

3. Record keeping

Keeping a record of each treatment a cow receives is important to make sure that the appropriate length of therapy and withdrawal are followed. Overall, about three-fifths of operations (58.2 percent) reported keeping a written or computerized record for each cow that received a treatment requiring a withdrawal time. A higher percentage of large operations (94.4 percent) than small operations (51.7 percent) and medium operations (67.4 percent) reported keeping a written or computerized record of each treatment.

Percentage of operations that kept a written or computerized record for each cow that received a treatment requiring a withdrawal time before the cow could be sent to market, and by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
51.7	(4.0)	67.4	(4.2)	94.4	(2.4)	58.2	(3.0)

G. Nutrient Management

1. Housing facilities

Nutrient management systems are usually dependent on the type and design of cattle housing, land costs, ambient temperatures, precipitation amounts, and nutrient use. In general, the West region is more arid than the East region, with the East region having more cold weather and precipitation during the winter months.

Of the 92.3 percent of operations that housed weaned heifers, about one-third housed the heifers primarily in a multiple-animal inside area (34.6 percent), while one-fourth housed weaned heifers in a drylot/multiple-animal outside area (22.9 percent). A majority of small operations primarily housed weaned heifers in drylots/multiple-animal outside and multiple-animal inside areas (22.3 and 37.8 percent, respectively). More than 4 of 10 large operations primarily housed weaned heifers in a drylot/multiple-animal outside area (43.2 percent). The percentage of operations that did not house weaned heifers increased as herd size increased, with almost one-fourth of large operations not housing weaned heifers (24.8 percent).

a. Percentage of operations by primary housing facility/outside area used for ***weaned heifers*** during 2006, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Primary Housing Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall/ stanchion	6.7	(1.0)	4.6	(1.1)	0.5	(0.2)	5.9	(0.7)
Freestall	10.2	(1.1)	18.2	(1.8)	13.7	(2.2)	12.1	(0.9)
Individual pen/ hutch	6.3	(0.9)	3.0	(0.9)	1.9	(0.8)	5.3	(0.7)
Drylot/multiple-animal outside area	22.3	(1.4)	19.8	(1.8)	43.2	(2.7)	22.9	(1.1)
Multiple-animal inside area	37.8	(1.8)	29.8	(2.0)	10.1	(1.9)	34.6	(1.4)
Pasture	11.7	(1.1)	9.4	(1.2)	4.6	(1.0)	10.8	(0.9)
Not housed on operation	4.6	(0.7)	13.8	(1.6)	24.8	(2.4)	7.7	(0.7)
Other	0.4	(0.2)	1.4	(0.7)	1.2	(0.7)	0.7	(0.2)
Total	100.0		100.0		100.0		100.0	

Almost one-half of operations in the West region (46.2 percent) housed weaned heifers primarily in a drylot/multiple-animal outside area. Approximately 1 of 8 operations in the West housed weaned heifers in freestalls (12.7 percent), multiple-animal inside area (12.1 percent), or pasture (12.7 percent) or did not house weaned heifers on the operation (12.1 percent). About one-third of operations in the East region (36.4 percent) housed weaned heifers primarily in a multiple-animal inside area, while 20.9 percent of operations housed weaned heifers in a multiple-animal outside area.

b. Percentage of operations by primary housing facility/outside area used for ***weaned heifers*** during 2006, by region:

	Percent Operations			
	Region			
	West		**East**	
Primary Housing Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Tie stall/stanchion	0.4	(0.2)	6.4	(0.8)
Freestall	12.7	(2.0)	12.1	(0.9)
Individual pen/hutch	3.3	(1.2)	5.5	(0.7)
Drylot/multiple-animal outside area	46.2	(2.9)	20.9	(1.2)
Multiple-animal inside area	12.1	(1.9)	36.4	(1.5)
Pasture	12.7	(2.3)	10.7	(0.9)
Not housed on operation	12.1	(1.9)	7.3	(0.7)
Other	0.5	(0.3)	0.7	(0.2)
Total	100.0		100.0	

Almost one-half of operations (49.2 percent) housed lactating cows primarily in a tie stall/stanchion facility. About 1 of 3 operations (32.6 percent) housed cows in freestalls. The use of tie stall/stanchion facilities decreased from 63.0 percent for small operations to 0.7 percent for large operations. Alternatively, a higher percentage of medium and large operations housed lactating cows in freestalls (67.5 and 72.6 percent, respectively) compared with small operations (19.0 percent). Almost one-fourth of large operations housed lactating cows primarily in drylots/multiple-animal outside areas (24.2 percent).

c. Percentage of operations by primary housing facility/outside area used for ***lactating cows*** during 2006, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Primary Housing Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall/ stanchion	63.0	(1.6)	15.7	(1.9)	0.7	(0.3)	49.2	(1.3)
Freestall	19.0	(1.3)	67.5	(2.1)	72.6	(2.3)	32.6	(1.1)
Individual pen	0.1	(0.0)	0.3	(0.2)	0.2	(0.1)	0.1	(0.1)
Drylot/multiple-animal outside area	3.4	(0.6)	4.1	(0.7)	24.2	(2.3)	4.6	(0.5)
Multiple-animal inside area	3.5	(0.7)	3.3	(0.7)	0.8	(0.5)	3.4	(0.6)
Pasture	10.8	(1.1)	8.8	(1.2)	1.0	(0.3)	9.9	(0.8)
Other	0.2	(0.1)	0.3	(0.2)	0.5	(0.4)	0.2	(0.1)
Total	100.0		100.0		100.0		100.0	

Almost one-half of operations in the West region housed lactating cows primarily in freestall housing (49.7 percent), while 29.8 percent of operations housed cows in drylot/multiple-animal outside areas and 15.0 percent housed cows on pasture. The majority of operations in the East region housed lactating cows primarily in tie stall/stanchions (53.1 percent). A lower percentage of operations in the East region housed cows in freestalls (31.2 percent) compared with the West region. Pasture was the primary housing type for lactating cows on about 1 of 10 operations in the East region (9.4 percent).

d. Percentage of operations by primary housing facility/outside area used for ***lactating cows*** during 2006, by region:

	Percent Operations			
	Region			
	West		**East**	
Primary Housing Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Tie stall/stanchion	1.3	(0.5)	53.1	(1.4)
Freestall	49.7	(2.9)	31.2	(1.1)
Individual pen	0.8	(0.5)	0.1	(0.0)
Drylot/multiple-animal outside area	29.8	(2.6)	2.6	(0.5)
Multiple-animal inside area	2.6	(0.9)	3.4	(0.6)
Pasture	15.0	(2.7)	9.4	(0.9)
Other	0.8	(0.5)	0.2	(0.1)
Total	100.0		100.0	

2. Manure-handling methods

The method used to handle the majority of manure in weaned-heifer housing areas varied among operations. About one-fourth of operations (23.5 percent) used an alley scraper to handle the majority of manure, while 22.6 percent of operations used bedded pack (manure pack), 17.5 percent scraped the drylot, 15.4 percent left manure on pasture, and 14.6 percent used a gutter cleaner. A higher percentage of small and medium operations than large operations left manure from weaned-heifer housing areas on pasture or used a bedded pack. Compared with medium and small operations, a higher percentage of large operations scraped drylots. More than 1 of 10 large operations flushed the alley with recycled water (10.6 percent), which was higher than the percentage of small operations (0.0 percent). Alley scrapers were used on a higher percentage of medium operations (40.1 percent) compared with small operations (17.1 percent).

a. For the 92.3 percent of operations that housed weaned heifers, percentage of operations by method used to handle the majority of manure in ***weaned-heifer housing*** areas, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Handling Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Manure left on pasture	17.4	(2.8)	12.6	(3.0)	3.1	(1.7)	15.4	(2.1)
Drylot scraped	17.0	(3.1)	12.7	(2.9)	41.0	(6.3)	17.5	(2.3)
Gutter cleaner	19.3	(3.4)	4.4	(2.4)	0.0	(--)	14.6	(2.5)
Alley scraper (mechanical or tractor)	17.1	(3.1)	40.1	(4.6)	33.3	(6.4)	23.5	(2.5)
Alley flush with fresh water	0.0	(--)	0.0	(--)	0.0	(--)	0.0	(--)
Alley flush with recycled water	0.0	(--)	1.2	(0.8)	10.6	(4.1)	0.9	(0.3)
Slotted floor	1.1	(0.7)	2.8	(1.5)	0.9	(0.7)	1.5	(0.6)
Bedded pack (manure pack)	23.0	(3.4)	25.4	(4.0)	7.2	(2.8)	22.6	(2.6)
Manure vacuum	0.0	(--)	0.1	(0.1)	0.0	(--)	0.0	(0.0)
Other	5.1	(2.0)	0.7	(0.7)	3.9	(2.2)	4.0	(1.4)
Total	100.0		100.0		100.0		100.0	

Because the West region has a higher percentage of large herds than the East region, differences in manure-handling methods in weaned-heifer housing areas by region were similar to differences by herd size. Almost one-half of operations in the West region (46.3 percent) scraped drylots, compared with 14.6 percent of operations in the East region. A similar percentage of operations in both regions used an alley scraper for handling the majority of manure—26.0 percent in the West region and 23.3 percent in the East region. About 1 in 10 operations in the West region (9.2 percent) flushed alleys with recycled water. A higher percentage of operations in the East region than in the West region used gutter cleaners or bedded packs.

b. For the 92.3 percent of operations that housed weaned heifers, percentage of operations by method used to handle the majority of manure in ***weaned-heifer housing*** areas, by region:

	Percent Operations			
	Region			
	West		**East**	
Handling Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Manure left on pasture	11.1	(3.1)	15.8	(2.3)
Drylot scraped	46.3	(5.5)	14.6	(2.5)
Gutter cleaner	0.0	(--)	16.0	(2.7)
Alley scraper (mechanical or tractor)	26.0	(5.2)	23.3	(2.7)
Alley flush with fresh water	0.0	(--)	0.0	(--)
Alley flush with recycled water	9.2	(3.3)	0.1	(0.1)
Slotted floor	0.0	(--)	1.7	(0.7)
Bedded pack (manure pack)	5.5	(2.6)	24.3	(2.8)
Manure vacuum	0.0	(--)	0.0	(0.0)
Other	1.9	(1.5)	4.2	(1.5)
Total	100.0		100.0	

Almost one-third of operations that housed weaned heifers primarily in a freestall/multiple-animal inside area (31.8 percent) used an alley scraper to handle the majority of manure in weaned-heifer housing areas. Bedded packs were used by 22.7 percent of operations that housed heifers primarily in freestall/multiple-animal inside areas. For operations that housed weaned heifers in a drylot/multiple-animal outside area, 33.8 percent scraped the drylot and 30.7 percent used a bedded pack to handle the majority of manure. Of operations that used pasture as the primary housing type for weaned heifers, 54.4 percent of operations left the majority of manure on the pasture and 19.5 percent used a bedded pack for the manure.

c. For the 92.3 percent of operations that housed weaned heifers, percentage of operations by method used to handle the majority of manure in ***weaned-heifer housing*** areas, by primary housing type for ***weaned heifers****:*

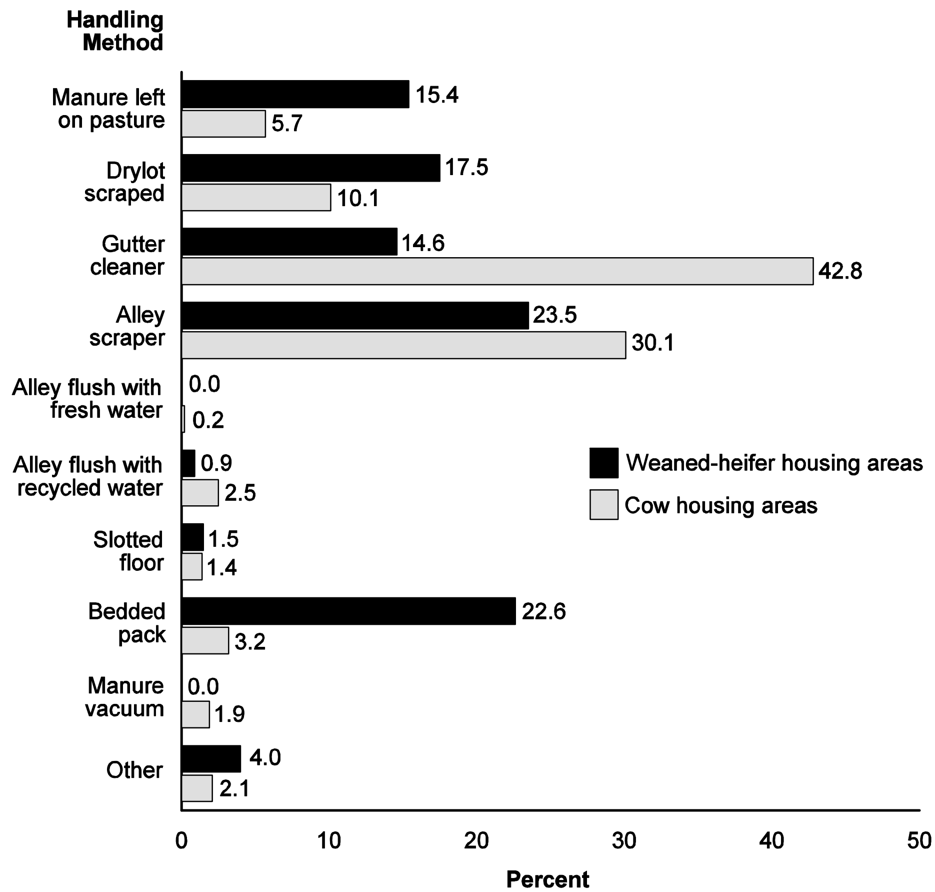
	Percent Operations					
	Primary Housing Type					
	Freestall/ Multiple-animal Inside Area		Drylot/ Multiple-animal Outside Area		Pasture	
Handling Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Manure left on pasture	10.5	(2.5)	14.2	(4.0)	54.4	(10.3)
Drylot scraped	14.0	(3.1)	33.8	(6.1)	3.6	(1.7)
Gutter cleaner	12.9	(3.3)	5.6	(2.5)	11.5	(9.4)
Alley scraper (mechanical or tractor)	31.8	(4.1)	13.0	(4.0)	9.0	(5.1)
Alley flush with fresh water	0.0	(--)	0.0	(--)	0.0	(--)
Alley flush with recycled water	0.6	(0.4)	2.1	(1.1)	0.0	(--)
Slotted floor	3.1	(1.3)	0.0	(--)	0.0	(--)
Bedded pack (manure pack)	22.7	(3.6)	30.7	(5.8)	19.5	(8.6)
Manure vacuum	0.1	(0.0)	0.0	(--)	0.0	(--)
Other	4.3	(2.1)	0.6	(0.5)	2.0	(2.0)
Total	100.0		100.0		100.0	

In areas used to house cows, more than two-fifths of operations (42.8 percent) used a gutter cleaner to handle the majority of manure, while 30.1 percent used an alley scraper. A higher percentage of small operations (58.5 percent) used a gutter cleaner to handle the majority of manure in cow housing areas, compared with 11.1 percent of medium operations and 0.0 percent of large operations. Because gutter cleaners are the primary manure-handling method for tie stall/stanchion facilities, their increased use on small operations was expected (see table 1c on p 125). The majority of medium operations (64.1 percent) used an alley scraper to handle the majority of manure in cow housing areas. About 3 of 10 large operations used an alley scraper (33.5 percent), scraped drylots (30.1 percent), or flushed alleys with recycled water (27.4 percent).

d. Percentage of operations by method used to handle the majority of manure in ***cow housing*** areas, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Handling Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Manure left on pasture	6.0	(1.7)	6.2	(2.2)	0.6	(0.6)	5.7	(1.3)
Drylot scraped	8.7	(2.0)	8.7	(2.0)	30.1	(5.8)	10.1	(1.5)
Gutter cleaner	58.5	(3.9)	11.1	(3.3)	0.0	(--)	42.8	(3.0)
Alley scraper (mechanical or tractor)	17.2	(2.8)	64.1	(4.3)	33.5	(4.6)	30.1	(2.4)
Alley flush with fresh water	0.0	(--)	0.5	(0.4)	1.4	(1.3)	0.2	(0.1)
Alley flush with recycled water	0.0	(--)	2.9	(1.3)	27.4	(5.7)	2.5	(0.5)
Slotted floor	1.6	(0.9)	1.4	(1.0)	0.5	(0.2)	1.4	(0.6)
Bedded pack (manure pack)	3.4	(1.6)	3.4	(1.5)	0.0	(--)	3.2	(1.2)
Manure vacuum	2.5	(1.6)	0.3	(0.2)	1.5	(1.3)	1.9	(1.1)
Other	2.1	(1.1)	1.4	(1.1)	5.0	(2.6)	2.1	(0.8)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Method Used to Handle the Majority of Manure in Weaned-heifer* and Cow Housing Areas



*For operations that housed weaned heifers.

The highest percentages of operations in the West region scraped drylots (38.2 percent), used an alley scraper (23.4 percent), or flushed alleys with recycled water (21.0 percent) to handle the majority of manure in cow housing areas. In the East region, gutter cleaners (47.0 percent of operations) and alley scrapers (30.7 percent) were the primary manure-handling methods in cow housing areas.

e. Percentage of operations by method used to handle the majority of manure in ***cow housing*** areas, by region:

	Percent Operations			
	Region			
	West		**East**	
Handling Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Manure left on pasture	6.1	(2.5)	5.6	(1.4)
Drylot scraped	38.2	(5.9)	7.3	(1.5)
Gutter cleaner	0.0	(0.0)	47.0	(3.2)
Alley scraper (mechanical or tractor)	23.4	(5.1)	30.7	(2.6)
Alley flush with fresh water	1.7	(1.2)	0.1	(0.1)
Alley flush with recycled water	21.0	(4.4)	0.7	(0.3)
Slotted floor	1.2	(1.2)	1.5	(0.7)
Bedded pack (manure pack)	2.8	(2.0)	3.2	(1.3)
Manure vacuum	1.5	(1.1)	1.9	(1.2)
Other	4.1	(2.1)	2.0	(0.9)
Total	100.0		100.0	

The percentage of operations by primary housing type for lactating cows and manure-handling methods was predictable because facility designs are usually associated with specific manure-handling methods. More than 8 of 10 tie stall/stanchion operations (82.5 percent) used a gutter cleaner to handle the majority of manure in cow housing areas. The predominant manure-handling method used by 72.1 percent of freestall operations was an alley scraper, and 50.3 percent of operations that housed cows in a drylot/multiple-animal outside area scraped the drylot. Of operations that used pasture as the primary housing facility/outside area for lactating cows, 40.7 percent used gutter cleaners and 27.3 percent left manure on pasture as the handling method for the majority of manure. Those pasture operations that used gutter cleaners as the method for handling the majority of manure in cow housing areas likely house cattle indoors during a particular season or inclement weather.

f. Percentage of operations by method used to handle the majority of manure in ***cow housing*** areas, by primary housing type for ***lactating cows***:

	Percent Operations							
	Primary Housing Type							
	Tie stall/ stanchion		Freestall		Drylot/ Multiple-animal Outside Area		Pasture	
Handling Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Manure left on pasture	2.7	(1.6)	1.4	(1.1)	12.4	(8.0)	27.3	(8.6)
Drylot scraped	3.1	(1.5)	11.6	(2.8)	50.3	(12.8)	11.6	(5.4)
Gutter cleaner	82.5	(3.8)	1.2	(0.8)	0.0	(--)	40.7	(11.6)
Alley scraper (mechanical or tractor)	4.3	(2.0)	72.1	(3.5)	2.1	(1.5)	11.4	(4.8)
Alley flush with fresh water	0.0	(--)	0.4	(0.3)	1.2	(1.2)	0.0	(--)
Alley flush with recycled water	0.0	(--)	6.2	(1.3)	1.4	(1.4)	2.2	(2.2)
Slotted floor	0.7	(0.7)	3.1	(1.5)	0.0	(--)	0.0	(--)
Bedded pack (manure pack)	0.0	(--)	1.3	(0.8)	32.6	(14.3)	6.8	(6.4)
Manure vacuum	3.7	(2.3)	0.5	(0.3)	0.0	(--)	0.0	(--)
Other	3.0	(1.5)	2.2	(1.1)	0.0	(--)	0.0	(--)
Total	100.0		100.0		100.0		100.0	

More than 75 percent of operations left manure on pasture or scraped a drylot as a manure-handling method for weaned-heifer and cow housing areas. Bedded packs were used in heifer areas on 60.6 percent of operations and in cow areas on 40.0 percent of operations. Alley scrapers were used by a similar percentage of operations for heifer (47.3 percent) and cow (54.9 percent) housing areas. Gutter cleaners were more frequently used in cow housing than in heifer housing (58.0 and 23.6 percent, respectively). Less than 10 percent of operations used alley flush with fresh or recycled water, slotted floor, or a manure vacuum for managing manure.

g. Percentage of operations by all manure-handling methods used in weaned-heifer and cow housing areas:

	Percent Operations			
	Weaned-heifer Housing Area*		Cow Housing Area	
Handling Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Manure left on pasture	88.5	(1.9)	85.3	(2.3)
Drylot scraped	75.3	(3.1)	82.5	(2.5)
Gutter cleaner	23.6	(2.8)	58.0	(2.5)
Alley scraper (mechanical or tractor)	47.3	(3.1)	54.9	(2.9)
Alley flush with fresh water	1.0	(0.4)	1.5	(0.4)
Alley flush with recycled water	3.5	(0.7)	5.0	(0.8)
Slotted floor	4.9	(1.2)	6.2	(1.2)
Bedded pack (manure pack)	60.6	(3.0)	40.0	(2.9)
Manure vacuum	0.6	(0.2)	1.5	(0.8)
Other	6.5	(1.7)	5.3	(1.5)

*For operations that housed weaned heifers.

3. Waste storage and treatment systems

To store or treat waste, more than one-half of operations used a manure pack inside a barn (56.1 percent), while more than 40 percent used a manure spreader to store manure (46.1 percent) or outside storage for solid manure not in drylot or pen (42.5 percent). A higher percentage of small and medium operations stored manure in a spreader (50.4 and 44.0 percent, respectively) or as a manure pack inside a barn (55.8 and 63.4 percent, respectively), compared with large operations (9.7 and 31.0 percent, respectively). Conversely, a lower percentage of small operations stored manure untreated in an earthen basin (24.4 percent), compared with medium operations (45.7 percent), or in a treatment lagoon that was not mechanically aerated (3.2 percent), compared with medium and large operations (12.3 and 49.7 percent, respectively). A higher percentage of large operations (36.2 percent) used a solid separator than medium or small operations (3.2 and 0.3 percent, respectively).

a. Percentage of operations by waste storage and/or treatment system used, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
System	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Stored in manure spreader	50.4	(3.9)	44.0	(4.3)	9.7	(3.7)	46.1	(2.9)
Below-floor slurry or deep pit	8.5	(2.0)	18.3	(3.2)	18.8	(4.3)	11.6	(1.6)
Slurry stored in tank	9.6	(2.2)	21.6	(3.6)	11.7	(3.4)	12.7	(1.8)
Slurry or liquid manure stored in earthen basin and NOT treated	24.4	(3.3)	45.7	(4.2)	43.1	(6.2)	30.9	(2.6)
Treatment lagoon–NOT mechanically aerated	3.2	(0.9)	12.3	(2.7)	49.7	(6.2)	8.5	(1.1)
Treatment lagoon–mechanically aerated	1.0	(0.6)	0.6	(0.4)	18.7	(4.9)	2.1	(0.5)
Manure pack (inside barn)	55.8	(3.9)	63.4	(4.2)	31.0	(4.4)	56.1	(2.9)
Outside storage for solid manure NOT in drylot or pen	44.0	(4.0)	32.4	(3.9)	65.2	(5.9)	42.5	(3.0)
Outside storage for solid manure within drylot or pen	24.0	(3.4)	20.9	(3.6)	29.1	(5.5)	23.5	(2.5)
Storage of solid manure in a building without cattle access	2.7	(1.1)	9.2	(2.3)	8.6	(4.0)	4.7	(1.0)
Storage of solid manure with picket dam	3.1	(1.3)	3.1	(1.1)	3.9	(2.3)	3.2	(0.9)
Composted	11.3	(2.7)	6.6	(2.1)	26.4	(5.4)	11.1	(2.0)
Collection of methane/biogas	0.0	(--)	0.2	(0.2)	0.9	(0.5)	0.1	(0.0)
Solid separator	0.3	(0.3)	3.2	(1.0)	36.2	(6.1)	3.4	(0.5)
Other system	4.5	(1.7)	2.9	(1.5)	7.4	(2.9)	4.3	(1.2)

A higher percentage of operations in the West region compared with the East region stored or treated manure in a treatment lagoon, mechanically aerated or not; in outside storage, either within a drylot or pen or outside the pen; or with a solid separator system. A lower percentage of operations in the West region used a manure spreader (7.5 percent) or manure pack (12.4 percent) to store manure, compared with operations in the East region (49.9 and 60.4 percent, respectively).

b. Percentage of operations by waste storage and/or treatment system used, by region:

	Percent Operations			
	Region			
	West		**East**	
System	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Stored in manure spreader	7.5	(2.5)	49.9	(3.1)
Below-floor slurry or deep pit	16.9	(3.8)	11.1	(1.7)
Slurry stored in tank	11.8	(3.9)	12.8	(2.0)
Slurry or liquid manure stored in earthen basin and NOT treated	44.1	(5.4)	29.7	(2.8)
Treatment lagoon–NOT mechanically aerated	49.5	(5.4)	4.5	(1.0)
Treatment lagoon–mechanically aerated	15.6	(4.0)	0.7	(0.4)
Manure pack (inside barn)	12.4	(3.3)	60.4	(3.1)
Outside storage for solid manure NOT in drylot or pen	65.5	(5.6)	40.2	(3.2)
Outside storage for solid manure within drylot or pen	43.1	(5.1)	21.6	(2.7)
Storage of solid manure in a building without cattle access	13.7	(4.0)	3.8	(1.0)
Storage of solid manure with picket dam	7.5	(3.0)	2.7	(1.0)
Composted	17.0	(3.9)	10.5	(2.1)
Collection of methane/biogas	0.5	(0.4)	0.1	(0.0)
Solid separator	28.8	(4.9)	0.9	(0.3)
Other system	4.0	(2.0)	4.3	(1.3)

Approximately 4 of 10 operations (42.0 percent) stored and/or treated only solid manure, while 58.0 percent stored and treated both solid and liquid manure. Storage and treatment of manure differed by herd size. The percentage of operations that stored and treated only solid manure decreased as herd size increased, from 52.4 percent of small operations to 0.2 percent of large operations.

c. Percentage of operations that stored and/or treated solid manure only or both solid and liquid manure, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Manure Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Solid only	52.4	(3.9)	24.5	(3.7)	0.2	(0.1)	42.0	(2.9)
Both solid and liquid	47.6	(3.9)	75.5	(3.7)	99.8	(0.1)	58.0	(2.9)
Total	100.0		100.0		100.0		100.0	

Almost all operations in the West region (96.0 percent) stored and/or treated both solid and liquid manure, compared with 54.3 percent of operations in the East region.

d. Percentage of operations that stored and/or treated solid manure only or both solid and liquid manure, by region:

	Percent Operations			
	Region			
	West		**East**	
Manure Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Solid only	4.0	(1.7)	45.7	(3.1)
Both solid and liquid	96.0	(1.7)	54.3	(3.1)
Total	100.0		100.0	

More than 4 of 10 operations (43.0 percent) used a manure spreader to store the majority of solid manure. About one-fifth of operations used a manure pack (19.6 percent) or outside storage not in drylot or pen (19.0 percent) as the storage or treatment system for the majority of solid manure. A higher percentage of small and medium operations (48.5 and 37.7 percent, respectively) than large operations (4.1 percent) stored solid manure in a manure spreader. A higher percentage of large operations used outside storage for solid manure either outside of (45.8 percent) or within a drylot or pen (22.0 percent) compared with medium (21.3 and 6.6 percent, respectively) or small operations (15.6 and 9.6 percent, respectively).

e. Percentage of operations by waste storage and/or treatment system used for the majority of ***solid*** manure, and by herd size:

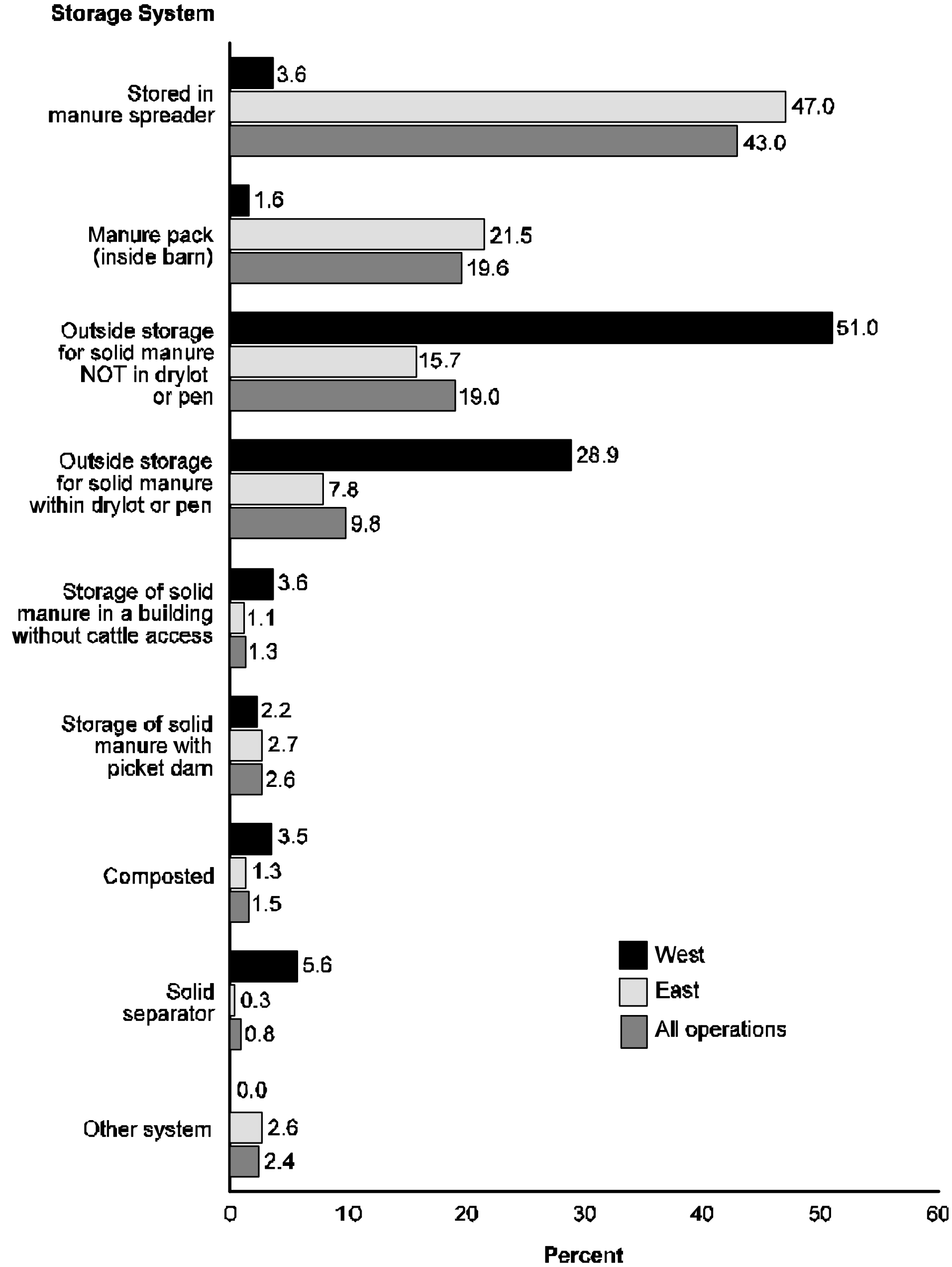
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
System	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Stored in manure spreader	48.5	(4.2)	37.7	(4.9)	4.1	(3.3)	43.0	(3.2)
Manure pack (inside barn)	18.1	(3.2)	27.2	(4.4)	9.6	(3.2)	19.6	(2.5)
Outside storage for solid manure NOT in drylot or pen	15.6	(2.7)	21.3	(3.6)	45.8	(7.1)	19.0	(2.1)
Outside storage for solid manure within drylot or pen	9.6	(2.2)	6.6	(2.1)	22.0	(5.7)	9.8	(1.7)
Storage of solid manure in a building without cattle access	0.8	(0.5)	3.1	(1.2)	0.7	(0.3)	1.3	(0.5)
Storage of solid manure with picket dam	3.5	(1.7)	0.0	(0.0)	2.9	(2.2)	2.6	(1.2)
Composted	1.0	(0.9)	1.9	(1.1)	6.0	(2.8)	1.5	(0.7)
Solid separator	0.0	(0.0)	1.2	(0.7)	7.7	(3.7)	0.8	(0.3)
Other system	2.9	(1.6)	1.0	(0.8)	1.2	(0.7)	2.4	(1.2)
Total	100.0		100.0		100.0		100.0	

More than one-half of operations in the West region (51.0 percent) stored solid manure outside but not in a drylot or pen. Almost 3 of 10 operations in the West region (28.9 percent) stored solid manure outside within a drylot or pen. In the East region, the majority of solid manure was stored in a manure spreader on 47.0 percent of operations and as a manure pack on 21.5 percent of operations.

f. Percentage of operations by waste storage and/or treatment system used for the majority of ***solid*** manure, by region:

	Percent Operations			
	Region			
	West		**East**	
System	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Stored in manure spreader	3.6	(2.0)	47.0	(3.4)
Manure pack (inside barn)	1.6	(1.6)	21.5	(2.7)
Outside storage for solid manure NOT in drylot or pen	51.0	(6.1)	15.7	(2.2)
Outside storage for solid manure within drylot or pen	28.9	(5.3)	7.8	(1.8)
Storage of solid manure in a building without cattle access	3.6	(1.9)	1.1	(0.5)
Storage of solid manure with picket dam	2.2	(1.6)	2.7	(1.3)
Composted	3.5	(2.1)	1.3	(0.8)
Solid separator	5.6	(2.7)	0.3	(0.2)
Other system	0.0	(0.0)	2.6	(1.3)
Total	100.0		100.0	

Percentage of Operations by Waste Storage and/or Treatment System Used for the Majority of Solid Manure, and by Region



Almost one-half of operations that stored and/or treated liquid or slurry manure stored the majority of manure in an earthen basin without treatment (49.4 percent). More than 10 percent of operations stored liquid or slurry manure in a tank (16.7 percent), in a below-floor slurry or deep pit (13.4 percent), or in a treatment lagoon that was not mechanically aerated (11.8 percent). Compared with large operations, a higher percentage of small operations used a below-floor slurry or deep pit. Compared with large operations, a higher percentage of small and medium operations stored slurry or liquid manure that was not treated in an earthen basin. A treatment lagoon—mechanically aerated or not—was used on a higher percentage of large operations compared with medium or small operations.

g. For the 58.0 percent of operations that stored and/or treated both solid and liquid manure, percentage of operations by waste storage and treatment system used for the majority of ***liquid or slurry*** manure, and by herd size:

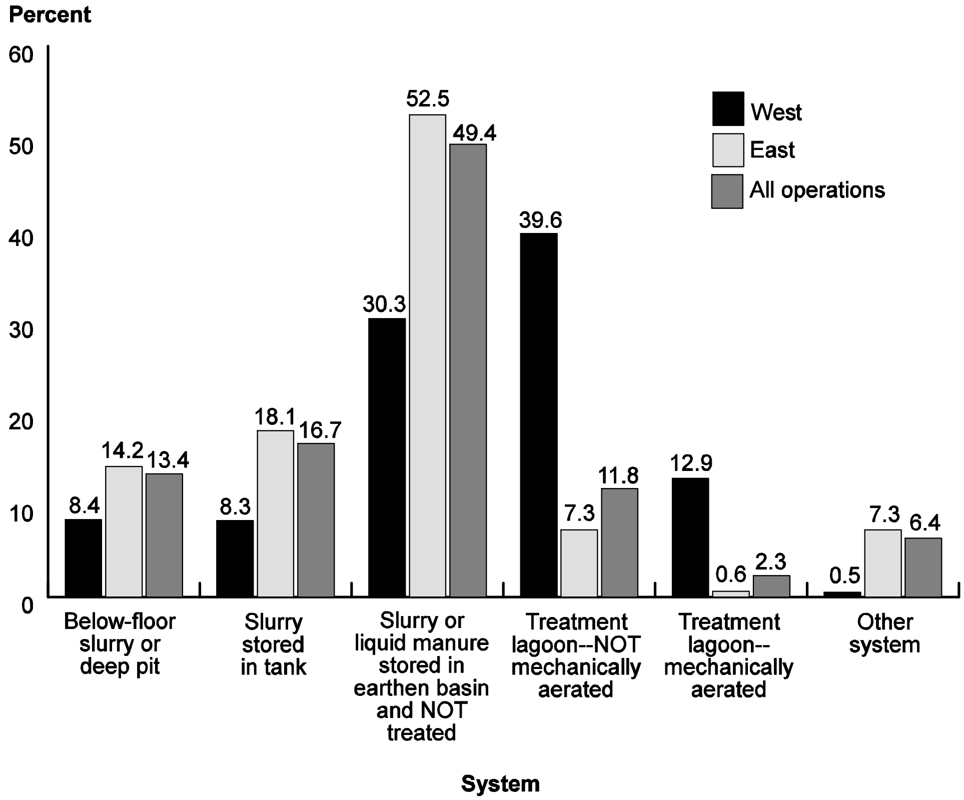
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
System	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Below-floor slurry or deep pit	16.6	(4.0)	11.2	(3.2)	3.0	(1.4)	13.4	(2.5)
Slurry stored in tank (either above or below ground)	17.3	(4.2)	18.4	(3.9)	7.5	(2.6)	16.7	(2.7)
Slurry or liquid manure stored in earthen basin and NOT treated	50.6	(5.5)	53.8	(5.0)	26.9	(5.1)	49.4	(3.6)
Treatment lagoon–NOT mechanically aerated	5.1	(1.6)	13.5	(3.5)	44.5	(6.6)	11.8	(1.7)
Treatment lagoon–mechanically aerated	1.1	(0.6)	0.5	(0.5)	15.4	(5.2)	2.3	(0.7)
Other system	9.3	(3.6)	2.6	(1.9)	2.7	(1.4)	6.4	(2.1)
Total	100.0		100.0		100.0		100.0	

A higher percentage of operations in the West region used treatment lagoons, either not mechanically aerated (39.6 percent of operations) or mechanically aerated (12.9 percent), for the majority of liquid or slurry manure, compared with operations in the East region (7.3 and 0.6 percent, respectively). More than one-half of operations in the East region (52.5 percent) stored the majority of liquid or slurry manure untreated in an earthen basin, compared with 30.3 percent of operations in the West region.

h. For the 58.0 percent of operations that stored and/or treated both solid and liquid manure, percentage of operations by waste storage and treatment system used for the majority of ***liquid or slurry*** manure, by region:

	Percent Operations			
	Region			
	West		East	
System	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Below-floor slurry or deep pit	8.4	(3.3)	14.2	(2.9)
Slurry stored in tank (either above or below ground)	8.3	(3.9)	18.1	(3.1)
Slurry or liquid manure stored in earthen basin and NOT treated	30.3	(4.5)	52.5	(4.1)
Treatment lagoon–NOT mechanically aerated	39.6	(5.6)	7.3	(1.7)
Treatment lagoon–mechanically aerated	12.9	(4.1)	0.6	(0.4)
Other system	0.5	(0.5)	7.3	(2.5)
Total	100.0		100.0	

For the 58.0 Percent of Operations that Stored and/or Treated Both Solid and Liquid Manure, Percentage of Operations by Waste Storage and Treatment System Used for the Majority of Liquid or Slurry Manure, and by Region



4. Maximum manure storage capacity

Producers were asked the following: "Assuming your facility was completely emptied of manure and was operating at full animal capacity, how many days could you operate and store manure before the manure had to be removed from the storage facility?" Overall, 27.7 percent of operations had fewer than 7 days of manure storage capacity and 59.5 percent had 90 days or more. Manure storage capacity tended to increase as herd size increased. For example, the percentage of operations that had 90 days or more of manure storage capacity ranged from 53.9 percent of small operations to 87.6 percent of large operations.

Percentage of operations by maximum manure storage capacity (in days), and by herd size (table revised 6/11/2009):

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Capacity (Days)	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Fewer than 7	32.6	(3.7)	21.7	(3.6)	0.2	(0.2)	27.7	(2.7)
7 to 29	8.2	(2.4)	4.1	(1.8)	6.3	(3.4)	7.1	(1.7)
30 to 59	2.4	(0.9)	4.0	(1.5)	2.9	(1.5)	2.9	(0.7)
60 to 89	2.9	(1.2)	2.6	(1.3)	3.0	(2.0)	2.8	(0.9)
90 to 179	10.8	(2.2)	16.7	(3.2)	15.7	(4.5)	12.6	(1.7)
180 to 364	26.4	(3.4)	37.4	(4.3)	32.3	(5.7)	29.5	(2.6)
365 or more	16.7	(3.0)	13.5	(3.0)	39.6	(6.3)	17.4	(2.2)
Total	100.0		100.0		100.0		100.0	

Photo courtesy of Dr. Jason Lombard

5. Manure use

Almost all operations applied manure—solid or liquid or both—to land either owned or rented (99.1 percent). A higher percentage of large operations sold manure or received other compensation, gave manure away, or used composted manure as bedding compared with small operations.

a. Percentage of operations by method of manure use, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Applied manure to land either owned or rented	99.5	(0.5)	99.6	(0.4)	93.8	(3.4)	99.1	(0.4)
Sold manure or received other compensation	4.9	(1.7)	7.2	(2.1)	28.9	(5.8)	7.1	(1.3)
Gave manure away	13.9	(2.7)	20.7	(3.5)	32.3	(5.5)	16.8	(2.0)
Used composted manure as bedding	3.5	(1.9)	1.7	(0.8)	35.7	(5.8)	5.1	(1.4)
Other	0.3	(0.3)	2.3	(1.1)	2.0	(1.8)	0.9	(0.4)

A higher percentage of operations in the West region sold manure or received other compensation (20.6 percent), gave manure away (44.8 percent), or used composted manure as bedding (26.4 percent) compared with operations in the East region.

b. Percentage of operations by method of manure use, by region:

	Percent Operations			
	Region			
	West		**East**	
Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Applied manure to land either owned or rented	94.5	(2.7)	99.6	(0.4)
Sold manure or received other compensation	20.6	(4.5)	5.7	(1.4)
Gave manure away	44.8	(5.2)	14.0	(2.2)
Used composted manure as bedding	26.4	(4.5)	3.1	(1.4)
Other	4.6	(2.4)	0.5	(0.3)

For operations that used solid or liquid manure, the majority of manure, whether solid or liquid, was applied to land either rented or owned.

c. Percentage of operations by method of use for the majority of manure, by manure type:

	Percent Operations			
	Manure Type			
	Solid		**Liquid or Slurry**	
Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Applied manure to land either owned or rented	97.4	(0.6)	98.6	(0.5)
Sold manure or received other compensation	0.8	(0.4)	0.3	(0.2)
Gave manure away	0.6	(0.3)	0.6	(0.3)
Used composted manure as bedding	0.7	(0.3)	0.0	(--)
Other	0.5	(0.2)	0.5	(0.3)
Total	100.0		100.0	

6. Manure application

More than 9 of 10 operations (91.5 percent) used a broadcast/solid spreader to apply manure to land. Surface application was used by 34.6 percent of small operations, 57.5 percent of medium operations, and 40.3 percent of large operations. More than one-half of large operations (56.5 percent) used irrigation/sprinkler to apply manure, compared with only 1.3 percent of small and 11.6 percent of medium operations.

a. For the 99.1 percent of operations that applied manure to land, percentage of operations by manure application method used, and by herd size:

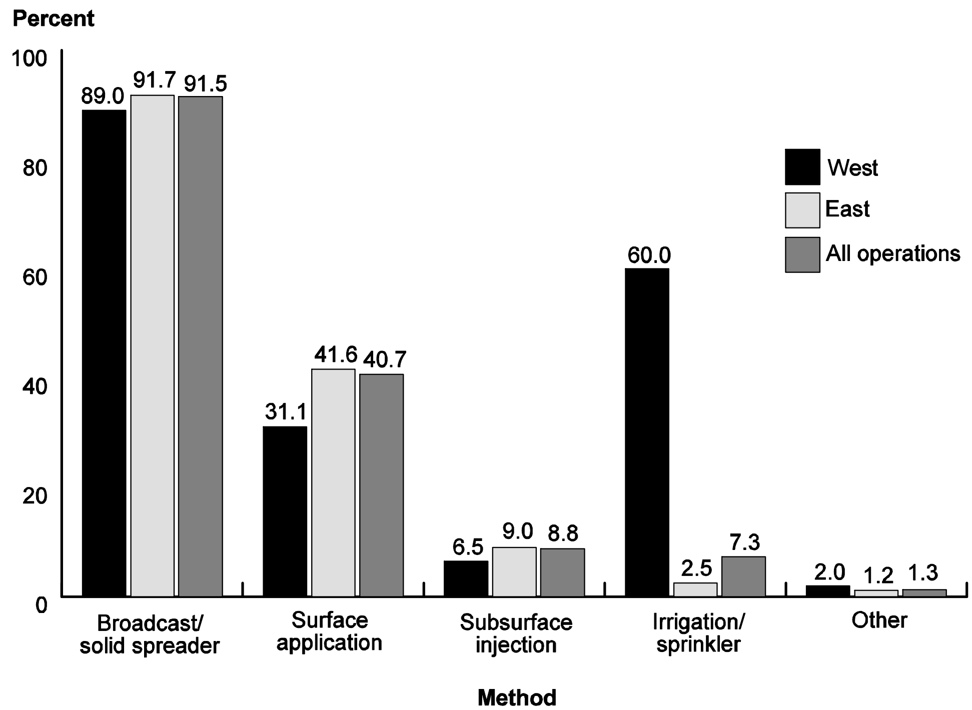
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Broadcast/ solid spreader	92.4	(2.2)	90.2	(2.8)	86.8	(4.2)	91.5	(1.7)
Surface application	34.6	(3.7)	57.5	(4.2)	40.3	(5.4)	40.7	(2.8)
Subsurface injection	5.5	(1.7)	16.4	(3.3)	14.3	(3.5)	8.8	(1.5)
Irrigation/ sprinkler	1.3	(0.5)	11.6	(2.1)	56.5	(6.3)	7.3	(0.8)
Other	1.0	(0.9)	1.7	(0.8)	2.4	(1.6)	1.3	(0.7)

A higher percentage of operations in the West region applied manure using irrigation/sprinkler compared with operations in the East region.

b. For the 99.1 percent of operations that applied manure to land, percentage of operations by manure application method used, by region:

	Percent Operations			
	Region			
	West		**East**	
Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Broadcast/solid spreader	89.0	(3.6)	91.7	(1.8)
Surface application	31.1	(5.8)	41.6	(3.1)
Subsurface injection	6.5	(2.5)	9.0	(1.6)
Irrigation/sprinkler	60.0	(5.1)	2.5	(0.5)
Other	2.0	(1.4)	1.2	(0.7)

For the 99.1 Percent of Operations that Applied Manure to Land, Percentage of Operations by Manure Application Method Used, and by Region



Overall, 22.0 percent of operations that applied manure to land always or almost always incorporated it into the soil within 24 hours of application, with 52.7 percent of large operations using this practice. Manure was sometimes incorporated within 24 hours on 42.0 percent of operations, and 36.0 percent of operations never incorporated manure into the soil.

c. For the 99.1 percent of operations that applied manure to land, percentage of operations by frequency that manure was incorporated into soil within 24 hours after application, including subsurface injection, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Frequency	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Always or almost always	18.5	(2.8)	24.1	(3.8)	52.7	(6.3)	22.0	(2.2)
Sometimes	43.2	(4.0)	41.4	(4.5)	31.3	(5.6)	42.0	(3.0)
Never	38.3	(4.0)	34.5	(4.1)	16.0	(5.0)	36.0	(2.9)
Total	100.0		100.0		100.0		100.0	

A higher percentage of operations in the West region (40.1 percent) always or almost always incorporated manure into the soil within 24 hours of application, compared with operations in the East region (20.3 percent). A higher percentage of operations in the East region (37.5 percent) than in the West region (19.4 percent) never incorporated manure into the soil.

d. For the 99.1 percent of operations that applied manure to land, percentage of operations by frequency that manure was incorporated into soil within 24 hours after application, including subsurface injection, by region:

	Percent Operations			
	Region			
	West		East	
Frequency	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Always or almost always	40.1	(5.3)	20.3	(2.4)
Sometimes	40.5	(5.2)	42.2	(3.2)
Never	19.4	(4.1)	37.5	(3.2)
Total	100.0		100.0	

Photo Courtesy of “Dairy Herd Management”/ “Bovine Veterinarian”

About one-fourth of operations analyzed manure for nitrogen, phosphorus, or potassium during the previous 12 months. A lower percentage of small operations analyzed manure (less than 18.0 percent) compared with medium or large operations (42.9 and 60.3 percent, respectively).

e. For the 99.1 percent of operations that applied manure to land, percentage of operations that analyzed manure for the following nutrients during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Nutrient	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Nitrogen	17.9	(3.0)	42.9	(4.4)	60.3	(6.0)	26.9	(2.4)
Phosphorus	17.3	(2.9)	42.9	(4.4)	60.3	(6.0)	26.4	(2.3)
Potassium	17.3	(2.9)	42.9	(4.4)	60.3	(6.0)	26.4	(2.3)

There were no regional differences in the percentage of operations that analyzed nutrient content of manure.

f. For the 99.1 percent of operations that applied manure to land, percentage of operations that analyzed manure for the following nutrients during the previous 12 months, by region:

	Percent Operations			
	Region			
	West		**East**	
Nutrient	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Nitrogen	39.4	(5.0)	25.7	(2.5)
Phosphorus	39.4	(5.0)	25.2	(2.5)
Potassium	39.4	(5.0)	25.2	(2.5)

The criteria operations used most commonly to determine frequency and quantity of manure application were based on soil quality improvement (70.7 percent of operations) and manure volume/acreage available (70.3 percent of operations). About 50 percent of operations used crop requirement for nitrogen or phosphorous to determine application rate and frequency, even though only about one-fourth of operations reported analyzing manure for these nutrients during the previous 12 months (see table 6e. on p 151). The only herd-size difference was that a higher percentage of medium operations (61.6 percent) than small operations (44.3 percent) used the crop phosphorus requirement in determining manure application rates. Criteria used for determining how much or how frequently manure is applied to the land did not differ by region.

g. For the 99.1 percent of operations that applied manure to land, percentage of operations by criteria used to determine how much or how frequently manure is applied to the land, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Criteria	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Crop nitrogen requirement	52.9	(4.1)	65.2	(4.4)	58.6	(6.4)	56.3	(3.0)
Crop phosphorus requirement	44.3	(4.1)	61.6	(4.4)	52.9	(6.2)	49.2	(3.1)
Manure volume/acreage available	69.3	(3.8)	75.1	(3.9)	61.8	(6.5)	70.3	(2.8)
Soil quality improvement	73.1	(3.6)	65.5	(4.4)	65.5	(6.4)	70.7	(2.8)
Other	6.8	(2.1)	5.4	(2.3)	2.7	(1.3)	6.2	(1.5)

Manure was applied to land fewer than 100 feet from surface water on 24.4 percent of operations and 1,000 feet or more on 30.8 percent of operations. A higher percentage of operations in the West region applied manure 1,000 feet or more from surface water (52.1 percent) compared with 28.8 percent of operations in the East region. Alternatively, a higher percentage of operations in the East region applied manure 200 to 499 feet from surface water (21.8 percent) compared with the West region (4.5 percent).

h. For the 99.1 percent of operations that applied manure to land, percentage of operations by minimum distance (in feet) between location of manure application and surface water, such as a lake, pond, stream, or river, and by region:

	Percent Operations					
	Region					
	West		**East**		**All Operations**	
Distance (Feet)	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Fewer than 100	23.4	(4.7)	24.5	(2.7)	24.4	(2.5)
100 to 199	14.6	(3.8)	16.9	(2.3)	16.7	(2.2)
200 to 499	4.5	(2.3)	21.8	(2.7)	20.3	(2.5)
500 to 999	5.4	(2.4)	8.0	(1.8)	7.8	(1.7)
1,000 or more	52.1	(5.3)	28.8	(3.1)	30.8	(2.9)
Total	100.0		100.0		100.0	

More than 9 of 10 operations (94.2 percent) spread solid manure on land, whereas about two-thirds of operations (66.3 percent) applied liquid manure. The percentage of operations that applied liquid manure increased as herd size increased, from 56.9 percent of small operations to 94.6 percent of large operations.

i. Percentage of all operations that applied solid or liquid manure to land, and by herd size:

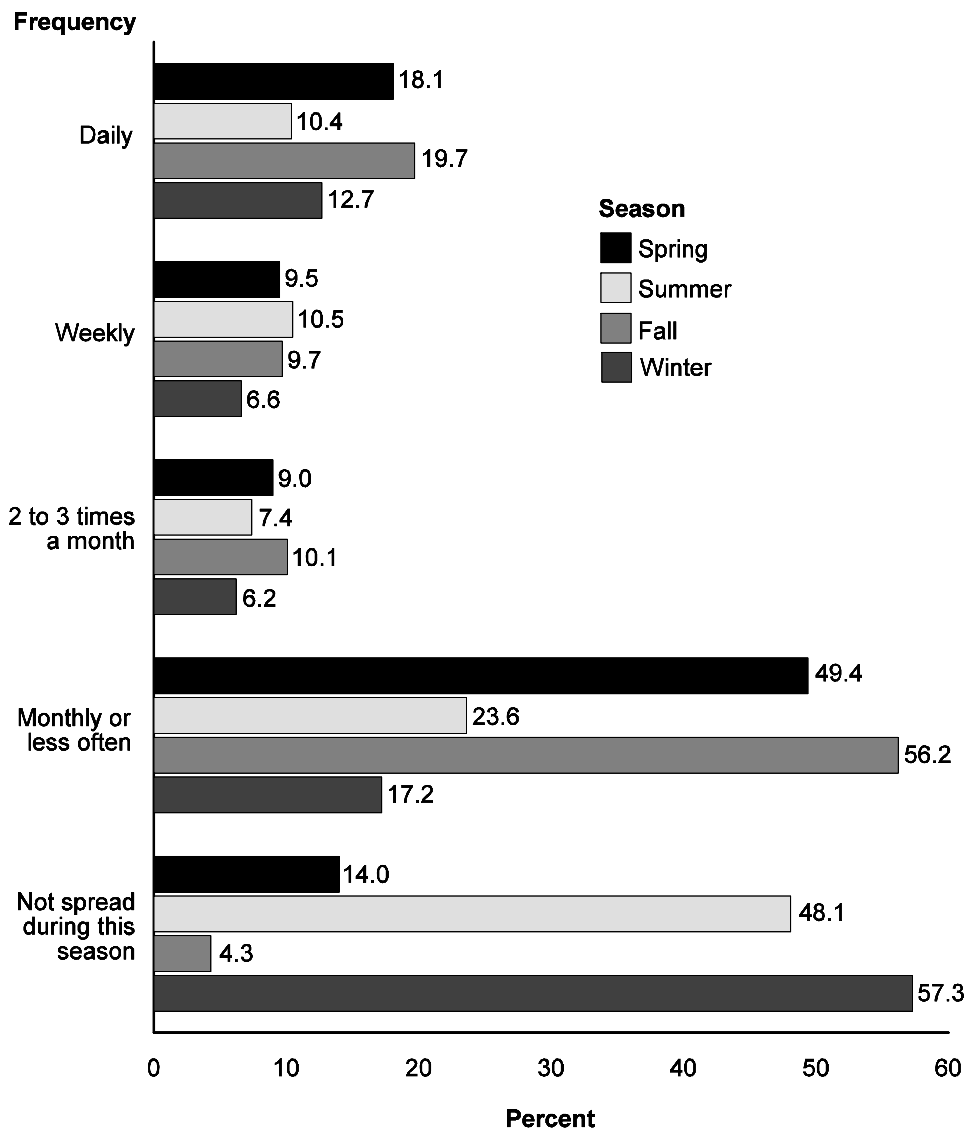
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Manure Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Solid	93.9	(2.2)	96.1	(1.8)	89.5	(4.0)	94.2	(1.6)
Liquid	56.9	(4.0)	84.8	(3.4)	94.6	(3.0)	66.3	(2.9)

Operations spread liquid or slurry manure more often during spring or fall than summer or winter. About 50 percent of operations did not apply liquid manure during the summer (48.1 percent) or winter (57.3 percent).

j. For the 66.3 percent of operations that applied ***liquid*** manure to land, percentage of operations by frequency that liquid manure was applied to owned or rented land, by season:

	Percent Operations							
	Season							
	Spring		**Summer**		**Fall**		**Winter**	
Frequency	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Daily	18.1	(2.7)	10.4	(2.1)	19.7	(2.8)	12.7	(2.4)
Weekly	9.5	(2.0)	10.5	(2.2)	9.7	(2.0)	6.6	(1.8)
2 to 3 times a month	9.0	(1.6)	7.4	(1.3)	10.1	(1.7)	6.2	(1.4)
Monthly or less often	49.4	(3.4)	23.6	(2.4)	56.2	(3.4)	17.2	(2.2)
Not spread during this season	14.0	(2.7)	48.1	(3.4)	4.3	(1.0)	57.3	(3.3)
Total	100.0		100.0		100.0		100.0	

For the 66.3 Percent of Operations that Applied Liquid Manure to Land, Percentage of Operations by Frequency that Liquid Manure was Applied to Owned or Rented Land, by Season

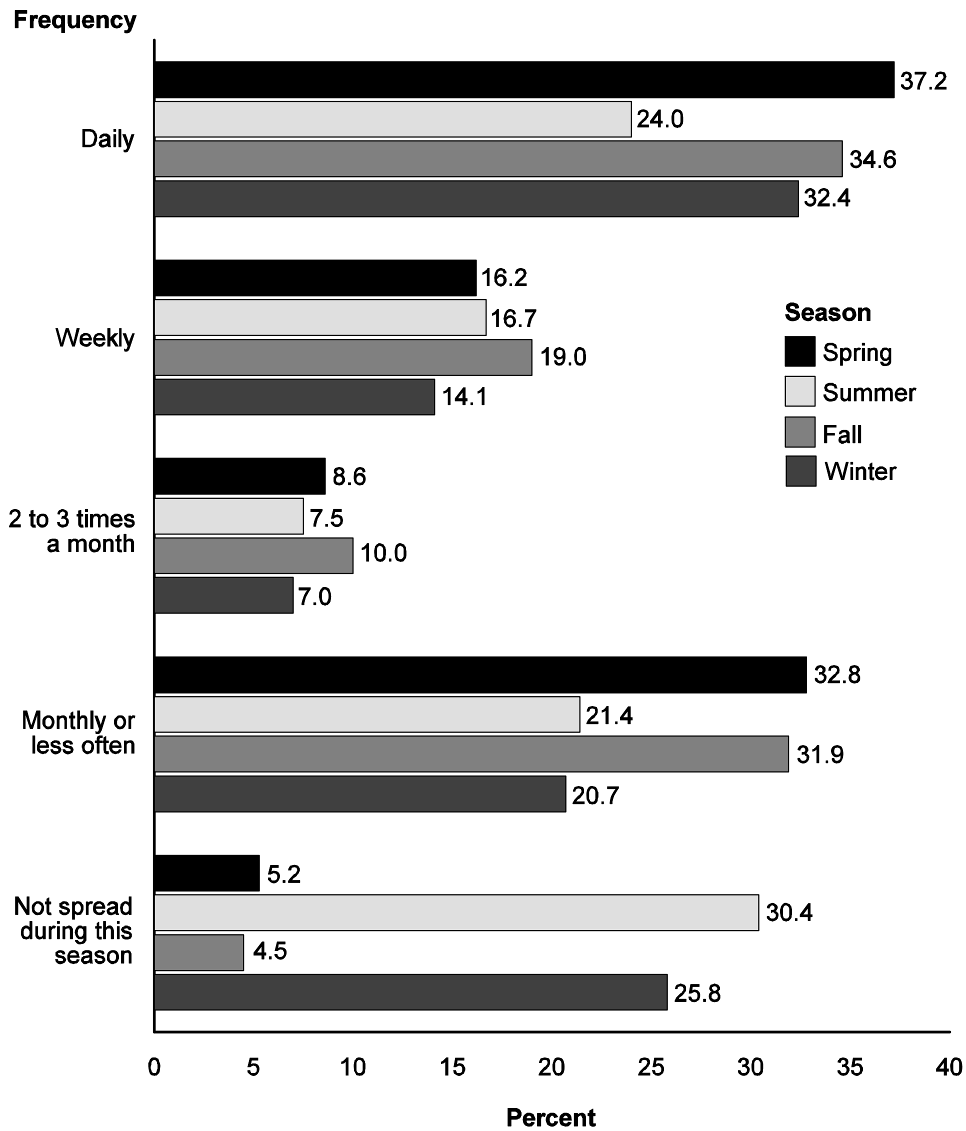


Operations also spread solid manure more commonly in spring or fall than summer or winter. During spring, 37.2 percent of operations spread solid manure on a daily basis. About 30 percent of operations did not spread solid manure in summer (30.4 percent) or winter (25.8 percent).

k. For the 94.2 percent of operations that applied ***solid*** manure to land, percentage of operations by frequency that solid manure was applied to owned or rented land, by season:

	Percent Operations							
	Season							
	Spring		**Summer**		**Fall**		**Winter**	
Frequency	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Daily	37.2	(3.0)	24.0	(2.7)	34.6	(3.0)	32.4	(2.9)
Weekly	16.2	(2.3)	16.7	(2.5)	19.0	(2.5)	14.1	(2.2)
2 to 3 times a month	8.6	(1.6)	7.5	(1.5)	10.0	(1.7)	7.0	(1.5)
Monthly or less often	32.8	(2.7)	21.4	(2.2)	31.9	(2.6)	20.7	(2.1)
Not spread during this season	5.2	(1.1)	30.4	(2.8)	4.5	(1.1)	25.8	(2.4)
Total	100.0		100.0		100.0		100.0	

For the 94.2 Percent of Operations that Applied Solid Manure to Land, Percentage of Operations by Frequency that Solid Manure was Applied to Owned or Rented Land, by Season



The practice of spreading manure on growing crops and then feeding those crops to livestock can spread disease from pathogens in the manure. Pathogens on dairy operations that potentially could be spread through grazing on manure-fertilized forages include *E. coli* O157:H7, *Salmonella* spp., and *Mycobacterium avium* subspecies *paratuberculosis* (MAP). Of these pathogens, MAP appears to be the most persistent, surviving for 6 months on pasture. Some methods and additives for ensiling forages appear to decrease the survival of MAP. The general recommendation is to avoid spreading manure on growing plants that will be grazed by cattle. In the case of MAP, to which young cattle appear to be more susceptible, grazing on fertilized pasture by cattle less than 1 year old is not recommended.

About one-half of operations (52.2 percent) applied manure to pasture or hay crops during the growing season. Almost two-thirds of all operations applied manure to any actively growing crops. Manure was applied to forage to be ensiled or any crops on 57.0 and 85.1 percent, respectively, of large operations.

l. Percentage of all operations that applied manure to actively growing plants by crop type, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Crop	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Pasture or hay	52.6	(4.0)	52.4	(4.4)	46.1	(6.1)	52.2	(2.9)
Forage to be ensiled	23.9	(3.3)	31.7	(3.9)	57.0	(6.3)	28.0	(2.5)
Other forage	10.9	(2.5)	16.9	(3.3)	26.1	(5.8)	13.4	(1.9)
Grain or oilseed	9.6	(2.2)	11.2	(2.5)	19.2	(5.0)	10.7	(1.7)
Other	5.3	(2.0)	0.1	(0.1)	3.1	(2.2)	3.9	(1.4)
Any	63.7	(3.9)	60.8	(4.4)	85.1	(4.2)	64.4	(2.9)

A higher percentage of operations in the West region applied manure to forage to be ensiled (47.9 percent), other forage crops (27.7 percent), or any crops (79.4 percent) compared with operations in the East region (26.1, 12.0, and 62.9 percent, respectively).

m. Percentage of all operations that applied manure to actively growing plants by crop type, by region:

	Percent Operations			
	Region			
	West		East	
Crop	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Pasture or hay	49.7	(5.0)	52.4	(3.2)
Forage to be ensiled	47.9	(5.3)	26.1	(2.7)
Other forage	27.7	(5.2)	12.0	(2.0)
Grain or oilseed	15.7	(4.1)	10.2	(1.8)
Other	2.1	(1.7)	4.0	(1.5)
Any	79.4	(4.1)	62.9	(3.1)

7. Written nutrient management plan

About one-third of small operations (35.1 percent) had a written plan addressing nutrient management compared with 62.1 percent of medium and 62.7 percent of large operations.

a. Percentage of operations that had a written nutrient management plan addressing topics such as land treatment practices or manure storage structures, and by herd size:

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
35.1	(3.8)	62.1	(4.4)	62.7	(5.9)	43.6	(2.9)

A higher percentage of operations in the West region (67.7 percent) had a written nutrient management plan than in the East region (41.3 percent).

b. Percentage of operations that had a written nutrient management plan addressing topics such as land treatment practices or manure storage structures, by region:

Percent Operations			
Region			
West		East	
Percent	Standard Error	Percent	Standard Error
67.7	(4.9)	41.3	(3.1)

Of the operations that had a written nutrient management plan, 9 of 10 operations (89.2 percent) developed the plan in cooperation with the USDA Natural Resource Conservation Service (NRCS) or a local conservation district. Compared with medium and large operations, a higher percentage of small operations (78.0 percent) developed a plan as part of a USDA voluntary cost-share program. A higher percentage of large operations developed a plan to help satisfy a State or local regulatory requirement (86.9 percent) compared with small operations (53.7 percent).

c. For the 43.6 percent of operations that had a written nutrient management plan, percentage of operations that developed or implemented the plan in cooperation with Federal, State, or local agencies or requirements, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Plan Was…	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Developed in cooperation with the USDA Natural Resource Conservation Service (NRCS) or a local conservation district	92.2	(3.2)	88.0	(3.4)	75.9	(6.2)	89.2	(2.2)
Implemented to help satisfy a State or local regulatory requirement	53.7	(6.6)	71.0	(5.0)	86.9	(6.7)	62.9	(4.2)
Part of USDA voluntary cost-share program	78.0	(4.7)	51.2	(5.3)	34.5	(6.6)	64.5	(3.6)

A higher percentage of operations in the West region (88.4 percent) than in the East region (58.9 percent) implemented a written nutrient management plan to help satisfy a State or local regulatory requirement. A higher percentage of operations in the East region developed a plan in cooperation with the USDA NRCS or a local conservation district (92.0 percent) or as part of a USDA voluntary cost-share program (71.3 percent) compared with operations in the West region (71.4 and 20.9 percent, respectively).

d. For the 43.6 percent of operations that had a written nutrient management plan, percentage of operations that developed or implemented the plan in cooperation with Federal, State, or local agencies or requirements, by region:

	Percent Operations			
	Region			
	West		**East**	
Plan Was…	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Developed in cooperation with the USDA Natural Resource Conservation Service (NRCS) or a local conservation district	71.4	(7.0)	92.0	(2.3)
Implemented to help satisfy a State or local regulatory requirement	88.4	(5.2)	58.9	(4.7)
Part of USDA voluntary cost-share program	20.9	(4.8)	71.3	(3.9)

8. Waste-management consultant

More than 20 percent of operations consulted with an agronomist/crop consultant (45.2 percent), NRCS personnel (32.8 percent), or a private nutrient management consultant (23.8 percent) about waste management on their operations during the previous 12 months. Almost two-thirds (63.9 percent) of operations contacted a waste management consultant during the previous 12 months. Compared with small operations, a higher percentage of large operations consulted with a private nutrient management consultant, State or local department of natural resources or department of agriculture, consulting nutritionist, or environmental engineering consultant. Any consultant was used on a higher percentage of medium operations (82.3 percent) than small operations (56.2 percent).

a. Percentage of operations that consulted with the following people about waste management for their operations during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Consultant	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
University/extension personnel	15.0	(2.8)	24.2	(4.0)	29.4	(5.4)	18.2	(2.2)
Private nutrient management consultant	18.7	(3.0)	31.2	(4.1)	49.3	(6.1)	23.8	(2.4)
Natural Resource Conservation Service (NRCS) personnel	27.6	(3.4)	45.2	(4.2)	41.2	(5.9)	32.8	(2.6)
State or local department of natural resources personnel	4.1	(1.4)	14.4	(2.6)	31.2	(5.5)	8.4	(1.2)
State or local department of agriculture personnel	9.1	(2.1)	18.9	(3.4)	30.4	(5.2)	12.9	(1.7)
Agronomist/crop consultant	40.5	(3.9)	56.7	(4.4)	50.7	(5.8)	45.2	(2.9)
Consulting nutritionist	12.3	(2.5)	19.8	(3.6)	35.6	(6.0)	15.7	(2.0)
Environmental engineering consultant	3.4	(1.4)	10.6	(2.9)	30.7	(5.2)	7.0	(1.3)
Private veterinary practitioner	2.2	(0.9)	5.7	(1.8)	9.4	(3.8)	3.5	(0.8)
Other	1.2	(1.0)	1.2	(0.6)	0.3	(0.2)	1.2	(0.7)
Any	56.2	(3.9)	82.3	(3.5)	74.6	(5.6)	63.9	(2.8)

A higher percentage of operations in the West region consulted with State or local departments of natural resources (19.8 percent) or agriculture personnel (32.3 percent) compared with operations in the East region
(7.3 and 11.0 percent, respectively). A higher percentage of operations in the East region consulted with an agronomist/crop consultant (46.7 percent) compared with the West region (28.8 percent).

b. Percentage of operations that consulted with the following people about waste management for their operations during the previous 12 months, by region:

	Percent Operations			
	Region			
	West		**East**	
Consultant	**Percent**	**Std. Error**	**Percent**	**Std. Error**
University/extension personnel	16.0	(3.6)	18.4	(2.4)
Private nutrient management consultant	29.8	(4.9)	23.2	(2.5)
Natural Resource Conservation Service (NRCS) personnel	38.0	(5.1)	32.3	(2.8)
State or local department of natural resources personnel	19.8	(4.1)	7.3	(1.3)
State or local department of agriculture personnel	32.3	(5.3)	11.0	(1.8)
Agronomist/crop consultant	28.8	(4.8)	46.7	(3.1)
Consulting nutritionist	19.0	(4.5)	15.3	(2.1)
Environmental engineering consultant	14.2	(3.4)	6.3	(1.3)
Private veterinary practitioner	3.9	(2.2)	3.5	(0.8)
Other	1.0	(1.0)	1.2	(0.7)
Any	67.1	(6.0)	63.6	(3.1)

9. Knowledge of concentrated animal feeding operation classification

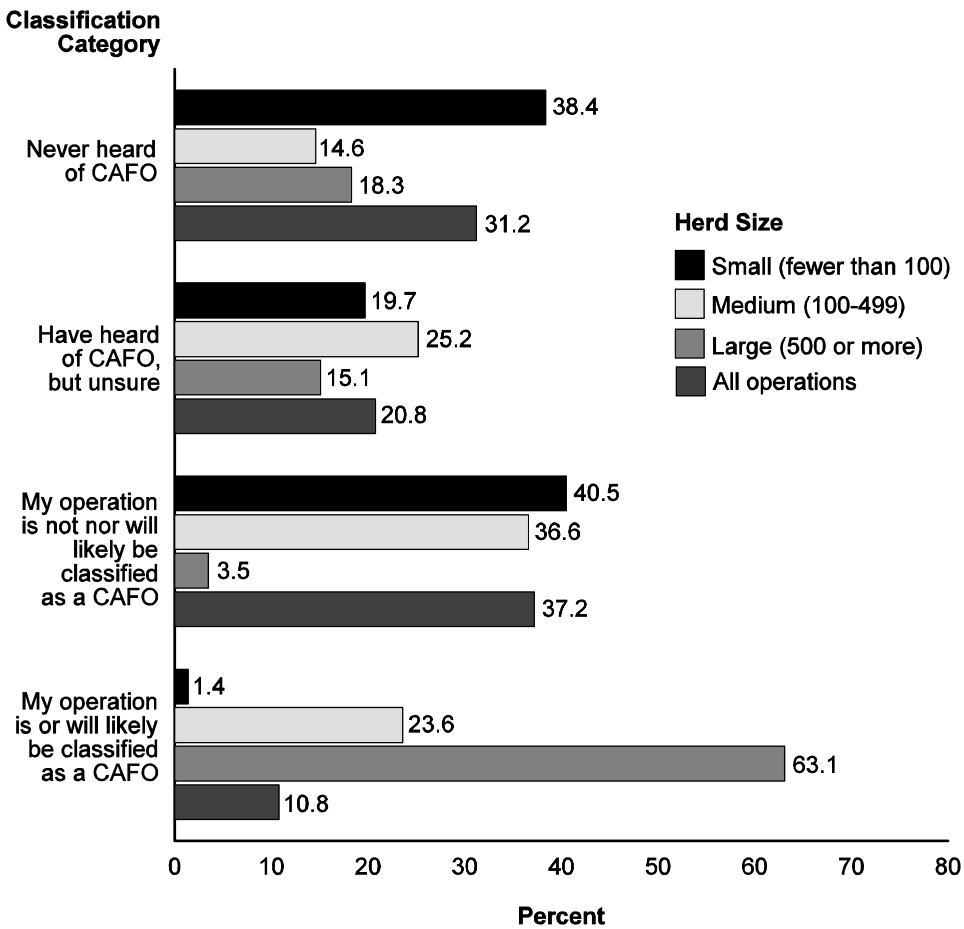
The Environmental Protection Agency (EPA) has guidelines to determine whether an operation should be classified as a concentrated animal feeding operation (CAFO). An operation with 200 to 699 mature cows can be designated a CAFO by the permitting authority or by regulatory definition if the operation meets one of the medium category discharge criteria. Large CAFOs have at least 700 mature cows, with no other criteria. Additionally, an operation that is not classified as a CAFO by size can be designated a CAFO by the permitting authority if the operation is a significant contributor of pollutants to surface water.

Producers were asked how their operation is or would be classified under current Federal EPA guidelines regarding CAFOs. A higher percentage of small and medium operations were not nor would likely be classified as CAFOs (40.5 and 36.6 percent, respectively) compared with large operations (3.5 percent). Almost two-thirds of large operations (63.1 percent) were or would likely be classified as CAFOs, compared with 23.6 percent of medium operations and 1.4 percent of small operations. Overall, 37.2 percent of operations were not considered to be CAFOs and 10.8 percent were considered to be CAFOs.

a. Percentage of operations by actual or perceived classification under current Federal EPA guidelines regarding concentrated animal feeding operations (CAFOs), and by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Classification Category	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Never heard of CAFO	38.4	(3.9)	14.6	(3.3)	18.3	(5.1)	31.2	(2.8)
Have heard of CAFO, but unsure	19.7	(3.5)	25.2	(4.1)	15.1	(4.9)	20.8	(2.7)
My operation is not nor will likely be classified as a CAFO	40.5	(3.7)	36.6	(4.2)	3.5	(1.4)	37.2	(2.8)
My operation is or will likely be classified as a CAFO	1.4	(0.8)	23.6	(3.7)	63.1	(6.3)	10.8	(1.3)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Actual or Perceived Classification Under Current Federal EPA Guidelines Regarding Concentrated Animal Feeding Operations (CAFOs), and by Herd Size



A higher percentage of operations in the West region were or were likely to be classified as CAFOs than in the East region (35.2 and 8.5 percent, respectively).

b. Percentage of operations by actual or perceived classification under current Federal EPA guidelines regarding concentrated animal feeding operations (CAFOs), by region:

	Percent Operations			
	Region			
	West		**East**	
Classification Category	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Never heard of CAFO	21.8	(4.7)	32.1	(3.1)
Have heard of CAFO, but unsure	14.5	(4.0)	21.3	(2.9)
My operation is not nor will likely be classified as a CAFO	28.5	(4.4)	38.1	(3.0)
My operation is or will likely be classified as a CAFO	35.2	(4.8)	8.5	(1.3)
Total	100.0		100.0	

Section II: Methodology

A. Needs Assessment

NAHMS develops study objectives by exploring existing literature and contacting industry members and other stakeholders about their informational needs and priorities during a needs-assessment phase. The objective of the needs assessment for the NAHMS Dairy 2007 study was to conduct a national survey to collect information from U.S. dairy producers and other dairy specialists about what they perceived to be the most important dairy health and productivity issues. A driving force of the needs assessment was the desire of NAHMS researchers to receive as much input as possible from a variety of producers, industry experts and representatives, veterinarians, extension specialists, universities, and dairy organizations. Information was collected via focus groups and through a Needs-Assessment Survey.

Focus group teleconferences and meetings were held to help determine the focus of the study.

Teleconference, March 30, 2006
National Johne's Working Group

Meeting, Louisville, KY, April 2, 2006
National Johne's Working Group
National Institute for Animal Agriculture

Meeting, Louisville, KY, April 3, 2006
National Milk Producers Federation Animal Health Committee

Teleconference, December 15, 2006
Bovine Alliance on Management and Nutrition

In addition, a Needs-Assessment Survey was designed to ascertain the top three management issues, diseases/disorders, and producer incentives from producers, veterinarians, extension personnel, university researchers, and allied industry groups. The survey, created in SurveyMonkey, was available online from early February through late April 2006. The survey was promoted via electronic newsletters, magazines, and Web sites. Organizations/magazines promoting the study included Vance Publishing's "Dairy Herd Management–Dairy Alert," "Dairy Today," "Hoard's Dairyman," NMC, "Journal of the American Veterinary Medical Association," and the American Association of Bovine Practitioners. E-mail messages requesting input were also sent to cooperative members of the National Milk Producers Federation as well as State and Federal personnel. A total of 313 people completed the questionnaire.

Respondents to the needs assessment represented the following affiliations:

- University/extension personnel—23 percent of respondents,
- Producers—22 percent,
- Veterinarians/consultants—20 percent,
- Federal or State government personnel—15 percent,
- Nutritionists—8 percent,
- Allied industry personnel—8 percent, and
- Other—4 percent.

CEAH Focus Group meeting
Fort Collins, CO, May 18, 2006

Draft objectives for the Dairy 2007 study, based on input from teleconferences, face-to-face meetings, and the online survey, were developed prior to the focus group meeting. Attendees included producers, university/extension personnel, veterinarians, and government personnel. The day-long meeting culminated in the formulation of eight objectives for the study:

- Describe trends in dairy cattle health and management practices,
- Evaluate management factors related to cow comfort and removal rates,
- Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease-prevention practices,
- Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVDV),
- Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens,
- Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis* (Johne's disease),
- Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices, and
- Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns.

B. Sampling and Estimation

1. State selection

The preliminary selection of States to be included in the study was done in February 2006, using the National Agricultural Statistics Service (NASS) January 27, 2006, "Cattle Report." A goal for NAHMS national studies is to include States that account for at least 70 percent of the animals and producer population in the United States. The initial review of States identified 16 major States representing 82.0 percent of the milk cow inventory and 79.3 percent of the operations with milk cows (dairy herds). The States were California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Washington, and Wisconsin.

A memo identifying these 16 States was provided in March 2006 to the USDA:APHIS:VS:CEAH Director and, in turn, the VS Regional Directors. Each Regional Director sought input from the respective States about being included in or excluded from the study. Virginia expressed interest in participating and was included, bringing the total number of States to 17.

2. Operation selection

The list sampling frame was provided by NASS. Within each State a stratified random sample was selected. The size indicator was the number of milk cows for each operation. NASS selected a sample of dairy producers in each State for making the January 1 cattle estimates. The list sample from the January 2006 survey was used as the screening sample. Among those producers reporting 1 or more milk cows on January 1, 2006, a total of 3,554 operations were selected in the sample for contact in January 2007 during Phase I. Operations with 30 or more dairy cows that had participated in Phase I were invited to participate in data collection for Phase II. A total of 1,077 operations agreed to be contacted by Veterinary Medical Officers (VMOs) to determine whether to complete Phase II.

3. Population inferences

a. Phase I: General Dairy Management Report

Inferences cover the population of dairy producers with at least 1 milk cow in the 17 participating States. As of January 1, 2007, these States accounted for 82.0 percent (7,432,000 head) of milk cows and 79.3 percent (62,110) of operations with milk cows in the United States. (See Appendix II for respective data on individual States.) All respondent data were statistically weighted to reflect the population from which they were selected. The inverse of the probability of selection for each operation was the initial selection weight. This selection weight was adjusted for nonresponse within each State and size group to allow for inferences back to the original population from which the sample was selected.

b. Phase II: VS Initial and Second Visits

For operations eligible for Phase II data collection (those with 30 or more dairy cows), weights were adjusted to account for operations that did not want to continue to Phase II. In addition, weights were adjusted for nonresponse to the questionnaire in each visit. The 17-State target population of operations with 30 or more dairy cows represented 82.5 percent of dairy cows and 84.7 percent of dairy operations (Appendix II).

C. Data Collection

1. Phase I: General Dairy Management Report

From January 1 to 31, 2007, NASS enumerators administered the General Dairy Management Report questionnaire. The interview took slightly more than 1 hour.

2. Phase II: VS Initial Visit

From February 26 to April 30, 2007, Federal and State Veterinary Medical Officers (VMOs) and/or Animal Health Technicians (AHTs) collected data from producers during an interview that lasted approximately 2 hours.

3. Phase II: VS Second Visit

From May 1 to August 31, 2007, Federal and State VMOs and/or AHTs collected data from producers during an interview that lasted approximately 2 hours.

D. Data Analysis

1. Validation and estimation

a. Phase I: Validation—General Dairy Management Report

Initial data entry and validation for the General Dairy Management Report were performed in individual NASS State offices. Data were entered into a SAS data set. NAHMS national staff performed additional data validation on the entire data set after data from all States were combined.

b. Phase II: Validation—VS Initial and Second Visit Questionnaires

After completing the VS Initial and Second Visit questionnaires, data collectors sent them to their respective State NAHMS Coordinators, who reviewed the questionnaire responses for accuracy and sent them to NAHMS. Data entry and validation were completed by NAHMS staff using SAS.

E. Sample Evaluation

The purpose of this section is to provide various performance measurement parameters. Historically, the term "response rate" has been used as a catchall parameter, but there are many ways to define and calculate response rates. Therefore, the table below presents an evaluation based upon a number of measurement parameters, which are defined with an "x" in categories that contribute to the measurement.

1. Phase I: General Dairy Management Report (GDMR)

A total of 3,554 operations were selected for the survey. Of these operations, 3,304 (93.0 percent) were contacted. There were 2,519 operations that provided usable inventory information (70.9 percent of the total selected and 76.2 percent of those contacted). In addition, there were 2,194 operations (61.7 percent) that provided "complete" information for the questionnaire. Of operations that provided complete information and were eligible to participate in Phase II of the study (2,067 operations), 1,077 (52.1 percent) consented to be contacted for consideration/discussion about further participation.

			Measurement Parameter		
Response Category	Number Operations	Percent Operations	Contacts	Usable[1]	Complete[2]
Survey complete and VMO consent	1,077	30.3	x	x	x
Survey complete, refused VMO consent	990	27.9	x	x	x
Survey complete, ineligible[3] for VMO	127	3.6	x	x	x
No dairy cows on January 1, 2007	214	6.0	x	x	
Out of business	111	3.1	x	x	
Out of scope	6	0.2			
Refusal of GDMR	785	22.1	x		
Office hold (NASS elected not to contact)	126	3.5			
Inaccessible	118	3.3			
Total	3,554	100.0	3,304	2,519	2,194
Percent of total operations			93.0	70.9	61.7
Percent of total operations weighted[4]			94.0	74.1	59.6

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—fewer than 30 head of milk cows on January 1, 2007.
[4]Weighted response—the rate was calculated using the initial selection weights.

2. Phase II: VS Initial Visit

There were 1,077 operations that agreed to be contacted by a VMO during Phase I. Of these 1,077 operations, 582 (54.0 percent) agreed to continue in Phase II of the study and completed the VS Initial Visit questionnaire; 380 (35.3 percent) refused to participate. Approximately 10 percent of the 1,077 operations were not contacted, and 0.4 percent were ineligible because they had no dairy cows at the time they were contacted.

			Measurement Parameter		
Response Category	**Number Operations**	**Percent Operations**	**Contacts**	**Usable[1]**	**Complete[2]**
Survey complete	582	54.0	x	x	x
Survey refused	380	35.3	x		
Not contacted	111	10.3			
Ineligible[3]	4	0.4	x	x	
Total	1,077	100.0	966	586	582
Percent of total operations			89.7	54.4	54.0
Percent of total operations weighted[4]			87.5	50.8	50.4

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—no dairy cows at time of interview, which occurred from February 26 through April 30, 2007
[4]Weighted response—the rate was calculated using the turnover weights.

3. Phase II: VS Second Visit

Of the 582 operations that completed the VS Initial Visit Questionnaire, 519 (including one operation that did not complete the VS Initial Visit on time) completed the VS Second Visit questionnaire; 47 (8.1 percent) refused to participate. Approximately 3 percent of the 583 operations were not contacted, and 0.3 percent were ineligible because they had no dairy cows at the time of the VS Second Visit.

			Measurement Parameter		
Response Category	**Number Operations**	**Percent Operations**	**Contacts**	**Usable[1]**	**Complete[2]**
Survey complete	519	89.0	x	x	x
Survey refused	47	8.1	x		
Not contacted	15	2.6			
Ineligible[3]	2	0.3	x	x	
Total	583	100.0	568	521	519
Percent of total operations			97.4	89.4	89.0
Percent of total operations weighted[4]			98.1	90.6	90.3

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—no dairy cows at time of interview, which occurred from May 1 through August 31, 2007.
[4]Weighted response—the rate was calculated using the turnover weights.

Appendix I: Sample Profile

A. Responding Operations

1. Number of responding operations, by herd size

	Number of Responding Operations		
Herd Size (Number of Cows)	**Phase I: General Dairy Management Report**	**Phase II: VS Initial Visit**	**Phase II: VS Second Visit**
Fewer than 100	1,028	233	211
100 to 499	691	215	188
500 or more	475	134	120
Total	2,194	582	519

2. Number of responding operations, by region

	Number of Responding Operations		
Region	**Phase I: General Dairy Management Report**	**Phase II: VS Initial Visit**	**Phase II: VS Second Visit**
West	426	108	93
East	1,768	474	426
Total	2,194	582	519

Appendix II: U.S. Milk Cow Population and Operations

		Number of Milk Cows, January 1, 2007* (Thousand Head)		Number of Operations 2006*		Average Herd Size	
Region	**State**	**Milk cows on operations with 1 or more head**	**Milk cows on operations with 30 or more head**	**Operations with 1 or more head**	**Operations with 30 or more head**	**Operations with 1 or more head**	**Operations with 30 or more head**
West	California	1,790	1,788.2	2,200	1,920	813.6	931.4
	Idaho	502	501.0	800	620	627.5	808.1
	New Mexico	360	358.9	450	180	800.0	1,993.9
	Texas	347	344.2	1,300	660	266.9	521.5
	Washington	235	234.3	790	540	297.5	433.9
	Total	3,234	3,226.6	5,540	3,920	583.8	823.1
East	Indiana	166	154.4	2,100	1,150	79.0	134.3
	Iowa	210	203.7	2,400	1,870	87.5	108.9
	Kentucky	93	86.5	2,000	1,180	46.5	73.3
	Michigan	327	320.5	2,700	1,910	121.1	167.8
	Minnesota	455	441.3	5,400	4,800	84.3	91.9
	Missouri	114	108.3	2,600	1,400	43.8	77.4
	New York	628	612.3	6,400	5,100	98.1	120.1
	Ohio	274	252.1	4,300	2,400	63.7	105.0
	Pennsylvania	550	536.3	8,700	7,000	63.2	76.6
	Vermont	140	137.2	1,300	1,100	107.7	124.7
	Virginia	100	97.0	1,300	820	76.9	118.3
	Wisconsin	1,245	1,213.9	14,900	12,800	83.6	94.8
	Total	4,302	4,163.5	54,100	41,530	79.5	100.3
Total (17 States)		7,536	7,390.1	59,640	45,450	126.4	162.6
Percent of U.S.		82.5	82.5	79.5	84.7		
Total U.S. (50 States)		9,132.0	8,958.5	74,980	53,680	121.8	166.9

*Source: NASS Cattle report, February 1, 2008, and NASS Farms, Land in Farms, and Livestock Operations 2007 Summary report, February 1, 2008. An operation is any place having one or more head of milk cows, excluding cows used to nurse calves, on hand at any time during the year.

Appendix III: Study Objectives and Related Outputs

1. Describe trends in dairy cattle health and management practices
- Part II: Changes in the U.S. Dairy Cattle Industry 1991-2007, March 2008
- Part V: Changes in Dairy Cattle Health and Management in the United States, 1991-2007, expected spring 2009

2. Evaluate management factors related to cow comfort and removal rates
- Dairy Facilities and Cow Comfort on U.S. Dairy Operations, 2007, Interpretive Report, expected spring 2009

3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices
- Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
- Off-Site Heifer Raising on U.S. Dairy Operations, 2007, info sheet, November 2007
- Colostrum Feeding and Management on U.S. dairy Operations, 1991-2007, info sheet, March 2008
- **Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, January 2009**
- Calf Health and Management Practices on U.S. Dairy Operations, 2007, Interpretive Report, expected spring 2009
- Calving Management on U.S. Dairy Operations, 2007, info sheet, February 2009

4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVD)
- Bovine Viral Diarrhea (BVD) Detection in Bulk Tank Milk and BVD Management Practices in the United States, 1996-2007, info sheet, October 2008

5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens
- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
- Milking Procedures on U.S. Dairy Operations, 2007, info sheet, September 2008

6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis*
- Johne’s Disease on U.S. Dairies, 1991-2007 info sheet, April 2008

7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices
- Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
- Biosecurity Practices on U.S. Dairy operations, 2002-07, Interpretive Report, expected spring 2009

8. Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns
- Antibiotic Use on U.S. Dairy Operations, 2002-07, info sheet, September 2008
- *Listeria* and *Salmonella* in Bulk Tank Milk on U.S. Dairy Operations, 2002-07, info sheet, expected spring 2009
- *Salmonella* and *Campylobacter* on U.S. Dairy Operations, 2002-07, info sheet, expected spring 2009
- Food Safety Pathogens Isolated from U.S. Dairy Operations, 2007, Interpretive Report, expected spring 2009

Additional informational sheets
- Dairy Cattle Identification Practices in the United States, 2007, info sheet, November 2007
- Reproduction Practices on U.S. Dairy Operations, 2007, info sheet, February 2009
- Bovine Leukosis Virus (BLV) on U.S. Dairy Operations, 2007, info sheet, September 2008
- Dairy Cattle Injection Practices in the United States, 2007, info sheet, February 2009
- Methicillin-Resistant *Staphylococcus aureus* (MRSA) Isolation from Bulk Tank Milk in the United States, 2007, info sheet, expected spring 2009

United States
Department of
Agriculture

Animal and
Plant Health
Inspection
Service

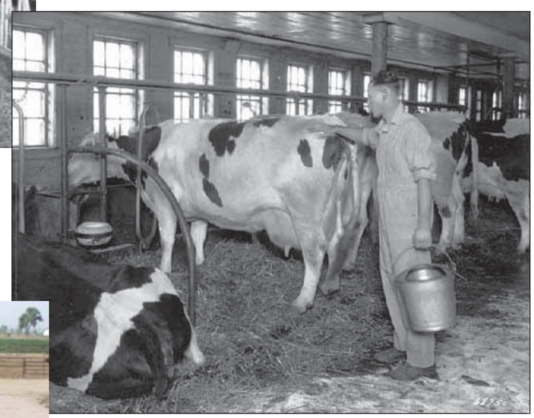
Veterinary
Services

National
Animal Health
Monitoring
System

July 2009

Dairy 2007

Part V: Changes in Dairy Cattle Health and Management Practices in the United States, 1996-2007



USDA-APHIS-VS-CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov
#519.0709

Cover photograph of man with pail courtesy of Hibbard Studio Photo, Minnesota Historical Society. Other photographs courtesy of Dr. Jason Lombard.

Selected Highlights of Trends in the U.S. Dairy Industry

This report is Part V of the NAHMS Dairy 2007 study and provides an in-depth look at changes in the U.S. dairy industry from 1996 to 2007, as identified from three NAHMS studies: Dairy 1996, Dairy 2002, and Dairy 2007.

Here are a few highlights from the fifth report of the Dairy 2007 study:

The percentage of operations that had employees increased from 47.2 percent in 2002 to 75.7 percent in 2007. This increase was primarily driven by the percentage of small operations (fewer than 100 cows) with employees, which doubled from 32.2 percent in 2002 to 65.6 percent in 2007.

Dairy producers' familiarity with Johne's disease, *Mycoplasma* mastitis, and hemorrhagic bowel syndrome (HBS) increased from 2002 to 2007. However, the majority of producers remain unfamiliar with heartwater, screwworm, bluetongue, vesicular stomatitis, and HBS.

Participation in a Johne's disease control or certification programs and testing for Johne's has increased since 1996. Approximately one-third of operations participated in a program and /or testing in 2007.

As facilities change with the ever-increasing size of dairy operations, the use of concrete as the predominant flooring type has decreased from 85.8 percent of operations in 1996 to 51.1 percent in 2007. In 2007, pasture was the predominant flooring for lactating cows on 10.1 percent of operations and for 5.1 percent of cows. Dirt was the predominant flooring on 5.4 percent of operations and 20.0 percent of cows in 2007, which likely reflects the use of drylots on large operations.

The percentage of operations in which milkers wore gloves to milk all cows increased from 32.9 percent in 2002 to 55.2 percent in 2007. The percentage of cows on operations in which milkers wore gloves increased from 48.7 percent in 2002 to 76.8 percent in 2007.

The percentage of operations that used automatic takeoffs increased from 36.0 percent in 2002 to 45.4 percent in 2007.

The percentage of operations that administered dry-cow intramammary antibiotics at dry-off was about 90 percent in 2007.

Antibiotic use in preweaned heifers remained unchanged from 2002 to 2007.

For mastitis treatment, the percentage of operations that used cephalosporin increased from 2002 to 2007 (33.3 and 44.5 percent, respectively), while the use of noncephalosporin beta-lactam and macrolide antibiotics to treat mastitis decreased from 2002 to 2007.

More than 9 of 10 operations routinely dehorned calves in 1996 and 2007. The percentage of operations that used hot iron/electric dehorners increased from 1996 to 2007, while the percentage of operations that used a tube, spoon, gouges, saws, wire, and Barnes dehorners decreased.

Lameness in bred heifers and cows continues to be a challenge for dairy producers. The percentage of operations with cases of lameness in bred heifers increased from 36.5 percent in 2002 to 58.7 percent in 2007. The percentage of operations that had 50.0 percent or more cows affected with lameness increased from 5.0 percent in 1996 to 12.0 percent in 2007. With this increase in lameness, a higher percentage of operations used footbaths and routine hoof trimming in 2007 than in 1996.

The percentage of operations in which at least one cow showed clinical signs consistent with HBS doubled from 2002 to 2007 (9.1 and 19.7 percent, respectively).

There were no changes between 2002 and 2007 in methods used to handle the majority of manure in weaned heifer or cow housing areas. Manure storage remained relatively unchanged from 2002 to 2007. Surface application of liquid manure increased between 1996 and 2007. Written nutrient management plans were implemented by a higher percentage of operations in 2007 compared with 2002.

Acknowledgments

This report has been prepared from material received and analyzed by the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS) via three national studies conducted between 1996 and 2007. All three studies focused on health management and animal health practices on U.S. dairy operations.

The Dairy 1996, Dairy 2002, and Dairy 2007 studies were cooperative efforts among State and Federal agricultural statisticians, animal health officials, university researchers, and extension personnel. We want to thank the National Agricultural Statistics Service (NASS) enumerators, State and Federal veterinary medical officers (VMOs), and animal health technicians (AHTs) who visited the farms and collected the data. Their hard work and dedication to the National Animal Health Monitoring System (NAHMS) are invaluable. The roles of the producer, Area Veterinarian in Charge (AVIC), NAHMS Coordinator, VMO, AHT, and NASS enumerator were critical in providing quality data for Dairy 2007 reports. Our appreciation also goes to the personnel at the Centers for Epidemiology and Animal Health (CEAH) for their efforts in study design, data validation, estimate generation, and report distribution. Additional support was afforded by the generous contributions of collaborators for the NAHMS dairy studies, including:

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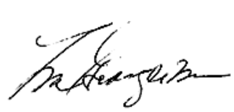
- Quality Milk Production Services;
- Tetracore, Inc.;
- University of Pennsylvania, New Bolton Center;
- University of Wisconsin, Madison; and
- Wisconsin Veterinary Diagnostic Laboratory.

All participants are to be commended, particularly the producers whose voluntary efforts made the NAHMS dairy studies possible.



Larry M. Granger
Director
Centers for Epidemiology and Animal Health

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Contacts for further information:
Questions or comments on data analysis: Dr. Jason Lombard (970) 494-7000
Information on reprints or other reports: Ms. Abby Fienhold (970) 494-7000
E-mail: NAHMS@aphis.usda.gov

Feedback

Feedback, comments, and suggestions regarding Dairy 2007 study reports are welcomed. Please forward correspondence via e-mail at: NAHMS@aphis.usda.gov, or you may submit feedback via online survey at: http://nahms.aphis.usda.gov (Click on “FEEDBACK on NAHMS reports.”)

Table of Contents

Introduction

The National Animal Health Monitoring System (NAHMS) is a nonregulatory program of the Animal and Plant Health Inspection Service (APHIS), a branch of the U.S. Department of Agriculture (USDA). Designed to help meet the animal health information needs of a variety of stakeholders, NAHMS has collected data on dairy health and management practices through four previous studies.

The NAHMS 1991–92 National Dairy Heifer Evaluation Project (NDHEP) provided the dairy industry's first national information on the health and management of dairy cattle in the United States. Just months after the study's first results were released in 1993, cases of acute bovine viral diarrhea (BVD) surfaced in the United States following a 1993 outbreak in Canada. NDHEP information on producer vaccination and biosecurity practices helped officials address the risk of disease spread and target educational efforts on vaccination protocols. When an outbreak of human illness related to *Escherichia coli* O157:H7 was reported in 1993 in the Pacific Northwest, NDHEP data on the bacteria's prevalence in dairy cattle helped officials define public risks as well as research needs. This baseline picture of the industry also helped identify additional research and educational needs in various production areas, such as feed management and weaning age.

Information from the NAHMS Dairy 1996 study helped the U.S. dairy industry identify educational needs and prioritize research efforts on such timely topics as antibiotic use; Johne's disease; digital dermatitis; bovine leukosis virus (BLV); and potential foodborne pathogens, including *E. coli*, *Salmonella*, and *Campylobacter.*

Two major goals of the Dairy 2002 study were to describe management strategies that prevent and reduce Johne's disease and to determine management factors associated with *Mycoplasma* and *Listeria* in bulk-tank milk. The study also described levels of participation in quality assurance programs, the incidence of digital dermatitis, animal-waste handling systems used on U.S. dairy operations, and industry changes since the NDHEP in 1991 and the Dairy 1996 study.

The Dairy 2007 study provides valuable information to participants, stakeholders, and the industry as a whole. Dairy operations and cows in these States represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. Results are presented in a variety of publications, including the following reports:

- Part 1: Reference of Dairy Cattle Health and Management Practices in the United States, 2007 (October 2007)—The first in a series of reports containing national information from the NAHMS Dairy 2007 study, this report contains data collected from 2,194 dairy operations.

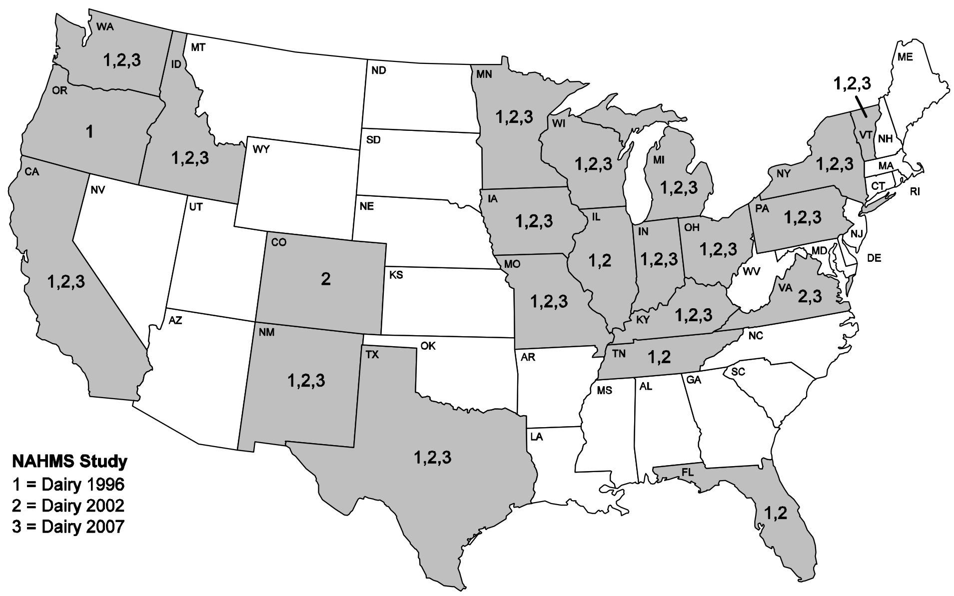
- Part II: Changes in the U.S. Dairy Cattle Industry, 1991–2007 (March 2008)—This report presents trends in the dairy industry by providing national estimates of animal-health management practices for comparable populations from the NAHMS 1991–92 NDHEP, Dairy 1996, Dairy 2002, and Dairy 2007 studies.

- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007 (September 2008)—This report presents national information from 582 operations with 30 or more dairy cows, a subset of the 2,194 operations described in Part I. State and Federal veterinary medical officers (VMOs) and animal health technicians (AHTs) conducted questionnaire interviews with producers and collected biological samples for analysis between February 26 and April 30, 2007.

- Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007 (February 2009)—This report presents national information from 519 operations with 30 or more dairy cows, a subset of the 582 operations described in Part III. State and Federal VMOs and AHTs conducted questionnaire interviews with producers and collected biological samples for analysis between May 1 and August 31, 2007.

This report, Part V: Changes in Dairy Cattle Health and Management Practices in the United States, 1996–2007 provides national estimates of dairy cattle health and management practices for comparable populations from the NAHMS Dairy 1996, Dairy 2002, and Dairy 2007 studies. For the 2002 and 2007 studies, data were collected via two VMO surveys. Due to ongoing educational efforts, producers' awareness and recognition of some diseases have increased and may be partially responsible for some changes observed in this report.

States Participating in NAHMS 1996, 2002, and 2007 Dairy Studies



Terms Used in This Report

Antibiotics: Chemical substances produced by microorganisms that kill or inhibit the growth of other microorganisms. For the purpose of this report, antibiotics are synonymous with antimicrobials.

Antimicrobial: Any substance that kills or inhibits the growth of microorganisms.

Cow: Female dairy bovine that has calved at least once.

Heifer: Female dairy bovine that has not yet calved.

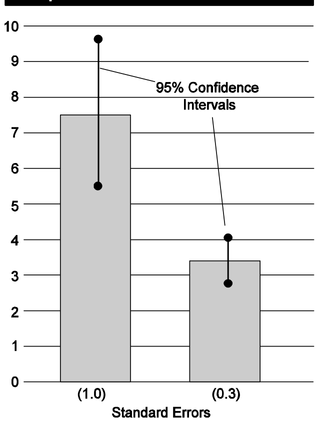
Herd size: Herd size is based on January 1 dairy cow inventory for each study year. Small herds are those with fewer than 100 head; medium herds are those with 100 to 499 head; and large herds are those with 500 or more head.

Operation: Premises with at least 30 dairy cows on January 1 of each study year.

Operation average: A single value for each operation is summed over all operations reporting divided by the number of operations reporting. For instance, operation average number of visits (p 72) is calculated by summing reported average number of visits over all operations divided by the number of operations.

Population estimates: The estimates in this report make inference to all of the operations with 30 or more dairy cows in the target population (see Methodology section, p 89). Data from the operations responding to the survey are weighted to reflect their probability of selection during sampling and to account for any survey nonresponse.

Examples of a 95% Confidence Interval



Precision of population estimates: Estimates in this report are provided with a measure of precision called the standard error. A 95-percent confidence interval can be created with bounds equal to the estimate plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean 95 out of 100 times. In the example to the left, an estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). The second estimate of 3.4 shows a standard error of 0.3 and results in limits of 2.8 and 4.0. Alternatively, the 90-percent confidence interval would be created by multiplying the standard error by 1.65 instead of 2. Most estimates in this report are rounded to the nearest tenth. If rounded to 0, the standard error was reported (0.0). If there were no reports of the event, no standard error was reported (—).

Preweaned: Prior to removal from a liquid ration. Previous studies used the term unweaned to mean preweaned.

Sample profile: Information that describes characteristics of the operations from which data were collected.

Section I: Population Estimates

A. Disease Familiarity and Biosecurity Practices

1. Producer familiarity with disease

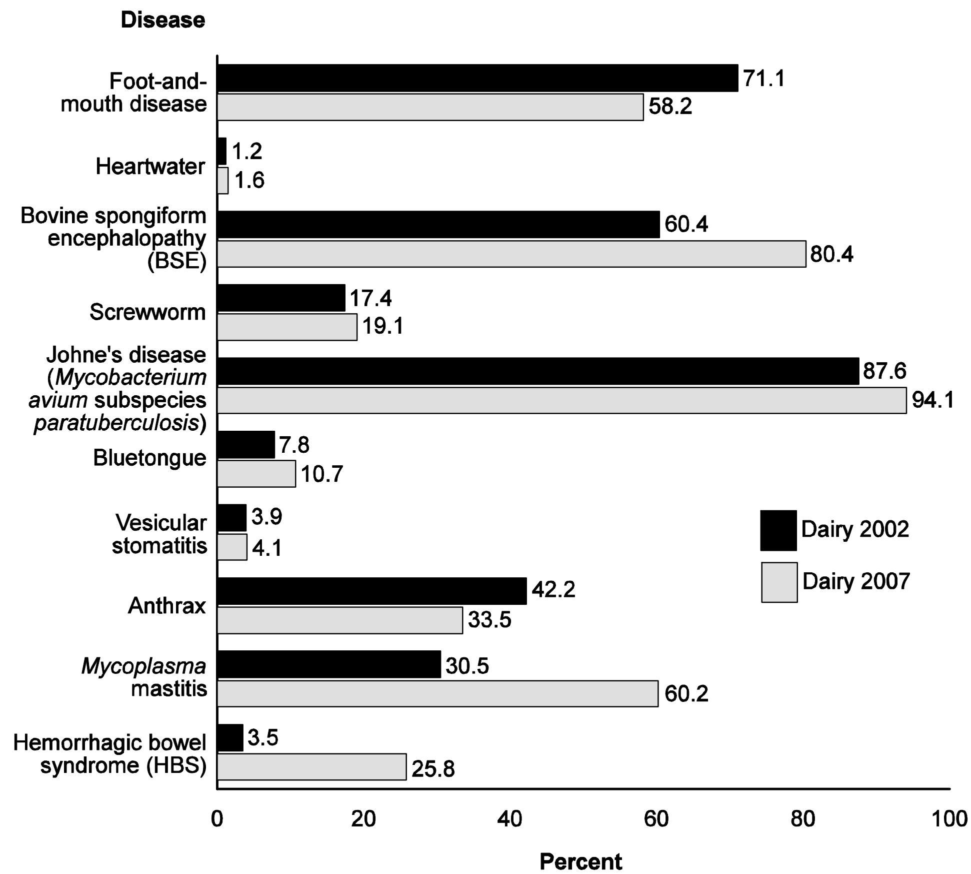
Familiarity with various diseases is an important part in developing an effective biosecurity plan. By being familiar with different diseases, producers are able to implement biosecurity practices specifically designed to prevent the introduction of a particular disease. Disease familiarity may also help limit the spread of a disease should it be introduced into the herd.

Producer familiarity with diseases varied by disease. Most producers at least knew some basics about foot-and-mouth disease, bovine spongiform encephalopathy (BSE), Johne's disease, and *Mycoplasma* mastitis; however, the majority of producers were unfamiliar with heartwater, screwworm, bluetongue, vesicular stomatitis, and hemorrhagic bowel syndrome (HBS). In 2002, nearly twice the percentage of operations were fairly knowledgeable about foot-and-mouth disease compared with operations in 2007 (16.5 and 8.9 percent, respectively). In contrast, the percentage of operations fairly knowledgeable about Johne's disease, *Mycoplasma* mastitis, and HBS increased from 2002 to 2007.

Percentage of operations by level of familiarity with specific cattle diseases:

	Percent Operations							
	Level of Familiarity							
	Fairly Knowledge-able		Knew Some Basics		Recognized the Name, Not Much Else		Had Not Heard of It Before	
	Dairy 2002	Dairy 2007	Dairy 2002	Dairy 2007	Dairy 2002	Dairy 2007	Dairy 2002	Dairy 2007
Disease	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**
Foot-and-mouth disease	16.5 (1.5)	8.9 (1.2)	54.6 (2.1)	49.3 (2.9)	28.1 (1.9)	40.7 (2.9)	0.8 (0.3)	1.1 (0.7)
Heartwater	0.3 (0.2)	0.6 (0.3)	0.9 (0.3)	1.0 (0.4)	3.7 (0.7)	4.5 (1.0)	95.1 (0.8)	93.9 (1.1)
Bovine spongiform encephalopathy (BSE)	13.9 (1.5)	19.6 (2.0)	46.5 (2.2)	60.8 (2.7)	38.0 (2.1)	18.8 (2.2)	1.6 (0.5)	0.8 (0.6)
Screwworm	5.9 (1.0)	4.0 (0.8)	11.5 (1.2)	15.1 (1.9)	45.1 (2.2)	37.4 (2.6)	37.5 (2.2)	43.5 (2.7)
Johne's disease (*Mycobacterium avium* subspecies *paratuberculosis*)	45.3 (2.1)	57.9 (2.9)	42.3 (2.1)	36.2 (2.8)	11.4 (1.4)	4.4 (1.2)	1.0 (0.3)	1.5 (0.6)
Bluetongue	2.6 (0.6)	2.2 (0.9)	5.2 (0.8)	8.5 (1.2)	40.7 (2.0)	41.0 (2.8)	51.5 (2.1)	48.3 (2.8)
Vesicular stomatitis	1.1 (0.3)	0.7 (0.3)	2.8 (0.5)	3.4 (0.8)	12.9 (1.3)	14.1 (1.7)	83.2 (1.4)	81.8 (1.9)
Anthrax	9.6 (1.2)	5.1 (1.2)	32.6 (2.0)	28.4 (2.6)	54.0 (2.2)	56.3 (2.8)	3.8 (0.8)	10.2 (1.8)
Mycoplasma mastitis	8.7 (1.0)	20.3 (1.8)	21.8 (1.7)	39.9 (2.8)	46.6 (2.2)	30.4 (2.8)	22.9 (2.0)	9.4 (1.8)
Hemorrhagic bowel syndrome (HBS)	1.0 (0.2)	8.2 (1.1)	2.5 (0.4)	17.6 (1.9)	8.7 (1.3)	22.6 (2.3)	87.8 (1.3)	51.6 (2.7)

Percentage of Operations that were Fairly Knowledgeable or Knew Some Basics About Specific Cattle Diseases



2. Information sources in case of a foreign animal disease outbreak

An outbreak of foreign animal disease in the United States could be catastrophic. Knowing where producers would turn for information in the event of a foreign animal disease outbreak is critical to planning for the control of the disease.

Most producers in 2002 and 2007 indicated they would contact their private veterinarian for disease information if a foreign animal disease outbreak occurred in the United States. Other information sources would also be used, but not to the extent of the private veterinarian. There were no changes in the percentage of operations that were very likely to use a specific information source between 2002 and 2007.

Percentage of operations by likelihood of using the following information sources if an outbreak of foreign animal disease occurred in the United States (e.g., foot-and-mouth disease):

	Percent Operations											
	Likelihood											
	Very Likely				Somewhat Likely				Not Likely			
	Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Information Source	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Other dairy producers	40.5	(2.1)	41.4	(2.8)	34.5	(2.0)	37.8	(2.7)	25.0	(1.9)	20.8	(2.3)
Private veterinarian	92.8	(1.1)	93.6	(1.3)	6.6	(1.1)	5.4	(1.3)	0.6	(0.3)	1.0	(0.5)
Extension agent	34.2	(2.0)	32.5	(2.7)	36.9	(2.1)	38.9	(2.9)	28.9	(2.0)	28.6	(2.5)
Dairy organization or cooperative	30.3	(1.9)	30.7	(2.6)	41.8	(2.1)	42.3	(2.8)	27.9	(1.9)	27.0	(2.6)
Magazines	41.8	(2.1)	39.0	(2.8)	44.7	(2.1)	49.4	(2.8)	13.5	(1.5)	11.6	(1.5)
Internet	19.0	(1.6)	23.1	(2.2)	27.4	(1.9)	28.8	(2.6)	53.6	(2.1)	48.1	(2.8)
State Veterinarian's office	34.7	(2.1)	26.7	(2.4)	31.3	(2.0)	37.4	(2.8)	34.0	(2.1)	35.9	(2.9)
U.S. Department of Agriculture	25.1	(1.8)	22.6	(2.4)	38.1	(2.2)	42.5	(2.8)	36.8	(2.1)	34.9	(2.7)
Television/ newspapers	30.7	(2.1)	25.8	(2.5)	35.2	(2.0)	38.8	(2.8)	34.1	(2.0)	35.4	(2.6)
Other	3.7	(0.9)	4.7	(1.2)	0.8	(0.3)	2.4	(1.0)	95.5	(1.0)	92.9	(1.6)

3. Resource contacts

Almost all producers in 2002 and 2007 (97.9 and 98.6 percent, respectively) would contact their private veterinarian if they suspected that an animal on their operation had a foreign animal disease. Approximately 4 of 10 operations would use the State Veterinarian's office as a resource. These responses highlight the continuing need to educate veterinary practitioners on how to identify and handle suspected foreign animal diseases on livestock operations.

Percentage of operations that would contact the following resources if an animal on the operation was suspected of having foot-and-mouth disease or another foreign animal disease:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Resource	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Extension agent/university	25.4	(1.8)	20.8	(2.3)
State Veterinarian's office	43.9	(2.2)	35.7	(2.6)
U.S. Department of Agriculture	25.5	(1.8)	21.8	(2.3)
Private veterinarian	97.9	(0.7)	98.6	(0.5)
Feed company or milk cooperative representative	28.0	(1.9)	25.7	(2.3)
Other	3.3	(0.7)	4.1	(1.3)

4. Employees and visitors

Employees or visitors—especially those who have contact with animals off the operation—can introduce disease agents via their boots, clothing, vehicles, or other equipment. As people travel more frequently to parts of the world that have animal diseases not present in the United States, the risk of inadvertent or intentional introduction of disease agents onto U.S. livestock operations increases. Establishing written policies or guidelines pertaining to visitor and employee animal contacts and travel is an important step in reducing the risk of disease introduction.

The percentage of operations that had employees increased from 47.2 percent in 2002 to 75.7 percent in 2007. The percentage of small operations with employees doubled from 32.2 percent in 2002 to 65.6 percent in 2007.

a. Percentage of operations that had employees*, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
	Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Dairy 2002	32.2	(2.5)	84.2	(2.4)	99.0	(0.6)	47.2	(2.0)
Dairy 2007	65.6	(4.1)	95.0	(2.0)	98.0	(1.9)	75.7	(2.8)

*Question variation: 2007 estimates specifically exclude owners and family members.

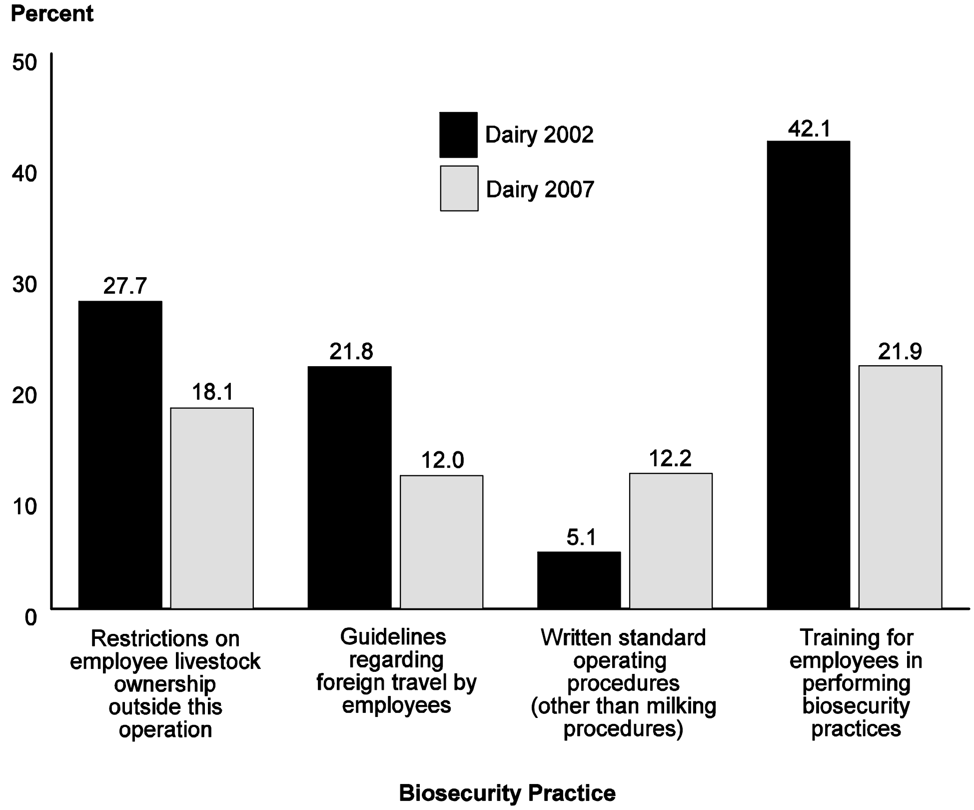
The percentage of operations that placed restrictions on employee livestock ownership outside the operation, had guidelines regarding foreign travel by employees, and trained employees in performing biosecurity practices declined from 2002 to 2007. Alternatively, the percentage of operations that had written standard operating procedures (other than milking procedures) increased from 5.1 percent in 2002 to 12.2 percent in 2007.

b. For operations with employees, percentage of operations by biosecurity practices used:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Biosecurity Practice	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Restrictions on employee livestock ownership outside this operation	27.7	(2.2)	18.1	(2.5)
Guidelines regarding foreign travel by employees	21.8	(2.3)	12.0	(2.0)
Written standard operating procedures (other than milking procedures)	5.1	(0.8)	12.2	(2.0)
Training for employees in performing biosecurity practices	42.1	(2.7)	21.9	(2.5)

Photo courtesy of Chuck Greiner, Agricultural Research Service

For Operations with Employees, Percentage of Operations by Biosecurity Practices Used



A higher percentage of small operations and all operations allowed visitors access to animal areas in 2007 compared with 2002. More than 8 of 10 operations, regardless of herd size, allowed visitors into animal areas during both study years.

c. Percentage of operations that allowed visitors in animal areas, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Dairy 2002	84.6	(2.0)	91.7	(1.5)	89.2	(2.8)	86.5	(1.5)
Dairy 2007	98.6	(0.8)	95.9	(1.8)	97.9	(1.6)	97.9	(0.7)

Of the following biosecurity practices implemented specifically for visitors, a higher percentage of operations in 2007 than in 2002 required disposable or clean boots for visitors entering animal areas and had restrictions on vehicles entering animal areas. The percentages of operations that had guidelines regarding which visitors were allowed in animal areas or had footbaths for visitors entering animal areas remained unchanged from 2002 to 2007.

d. For operations that allowed visitors in the animal areas, percentage of operations by biosecurity practices used:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Biosecurity Practice	Percent	Std. Error	Percent	Std. Error
Guidelines regarding which visitors are allowed in animal areas	38.6	(2.0)	30.4	(2.6)
Footbaths for visitors entering animal areas	6.3	(1.0)	6.9	(1.3)
Disposable or clean boots for visitors entering animal areas	18.9	(1.6)	28.3	(2.6)
Restrictions on vehicles entering animal areas	44.2	(2.1)	51.3	(2.9)

5. Specific biosecurity practices

Many diseases are initially introduced by an infected animal purchased as an addition to the herd. The majority of operations maintained a closed herd during 2002 and 2007. Over four-fifths of operations had insect and rodent control programs. Approximately one of three operations had a bird control program. Nearly one-half of all operations limited cattle contact with other livestock, elk, and deer, and controlled access to feed by other livestock and wildlife, or had a closed herd.

Percentage of operations that used the following biosecurity practices to prevent disease during the previous 12 months:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Biosecurity Practice	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Insect control	92.5	(1.1)	87.4	(2.0)
Rodent control	94.7	(0.9)	94.4	(1.1)
Bird control	29.1	(1.9)	33.8	(2.7)
Limit cattle contact with other livestock, elk, and deer	41.4	(2.1)	48.5	(2.8)
Control access to cattle feed by other livestock and wildlife	53.7	(2.1)	49.9	(2.9)
Closed herd*	59.5	(2.1)	56.2	(2.9)

*All replacements are from the operation; no contact with cattle from other operations.

6. Equipment handling for manure and feeding

Using the same equipment to remove manure and handle feed increases the risk of contaminating feed with disease-causing organisms, especially *Salmonella* and *M. paratuberculosis*. On some operations, it may not be feasible to have equipment dedicated solely to either feed handling or manure removal. In those cases, training employees to clean and disinfect equipment between uses will reduce the likelihood that feed will be contaminated with feces and pathogens.

There were no differences between 2002 and 2007 in the percentages of operations by frequency that the same equipment was used to handle manure and feed cattle.

a. Percentage of operations by frequency that the same equipment was ever used to handle manure and feed cattle:

<table>
<tr><th></th><th colspan="4">Percent Operations</th></tr>
<tr><th></th><th colspan="2">Dairy 2002*</th><th colspan="2">Dairy 2007</th></tr>
<tr><th>Frequency</th><th>Percent</th><th>Std. Error</th><th>Percent</th><th>Std. Error</th></tr>
<tr><td>Routinely</td><td rowspan="2">58.8</td><td rowspan="2">(2.1)</td><td>32.2</td><td>(2.7)</td></tr>
<tr><td>Rarely</td><td>35.6</td><td>(2.7)</td></tr>
<tr><td>Never</td><td>41.2</td><td>(2.1)</td><td>32.2</td><td>(2.7)</td></tr>
<tr><td>Total</td><td>100.0</td><td></td><td>100.0</td><td></td></tr>
</table>

*In 2002, question was “Does this operation ever use the same equipment to handle manure and feed cattle.”

The percentage of operations that used the same equipment to handle manure and feed cattle then washed the equipment with water or steam (54.2 and 61.0 percent of operations, respectively) remained unchanged from 2002 to 2007. The majority of operations that used “other” procedures in 2007 used separate loader buckets.

b. For operations that ever used the same equipment to handle manure and feed cattle, percentage of operations by procedure that best describes what is usually done with equipment after handling manure:

	Percent Operations			
	Dairy 2002		**Dairy 2007**	
Procedure	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Wash equipment with water or steam only	54.2	(2.9)	61.0	(3.4)
Chemically disinfect only	0.0	(--)	0.1	(0.1)
Wash equipment and chemically disinfect	5.7	(1.5)	4.6	(1.5)
Other	24.9	(2.5)	23.2	(3.1)
No procedures	15.2	(2.2)	11.1	(2.3)
Total	100.0		100.0	

7. Equipment sharing with other livestock operations

Sharing heavy equipment with other operations increases the risk of introducing new disease-causing agents to an operation. If equipment is shared, it should be sanitized and disinfected prior to use. In 2002 and 2007, about one of three operations shared equipment with other livestock operations.

Percentage of operations that shared any heavy equipment (tractors, feeding equipment, manure spreaders, trailers, etc.) with other livestock operations during the previous 12 months:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
	Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Dairy 2002	40.0	(2.7)	33.4	(2.8)	28.0	(3.7)	38.0	(2.1)
Dairy 2007	35.9	(3.7)	41.0	(4.1)	21.3	(4.3)	36.2	(2.8)

8. Johne's disease

A Johne's disease control program may include testing individual animals to identify those shedding *Mycobacterium avium* subspecies *paratuberculosis* and thereby presenting a risk to noninfected animals on the operation.

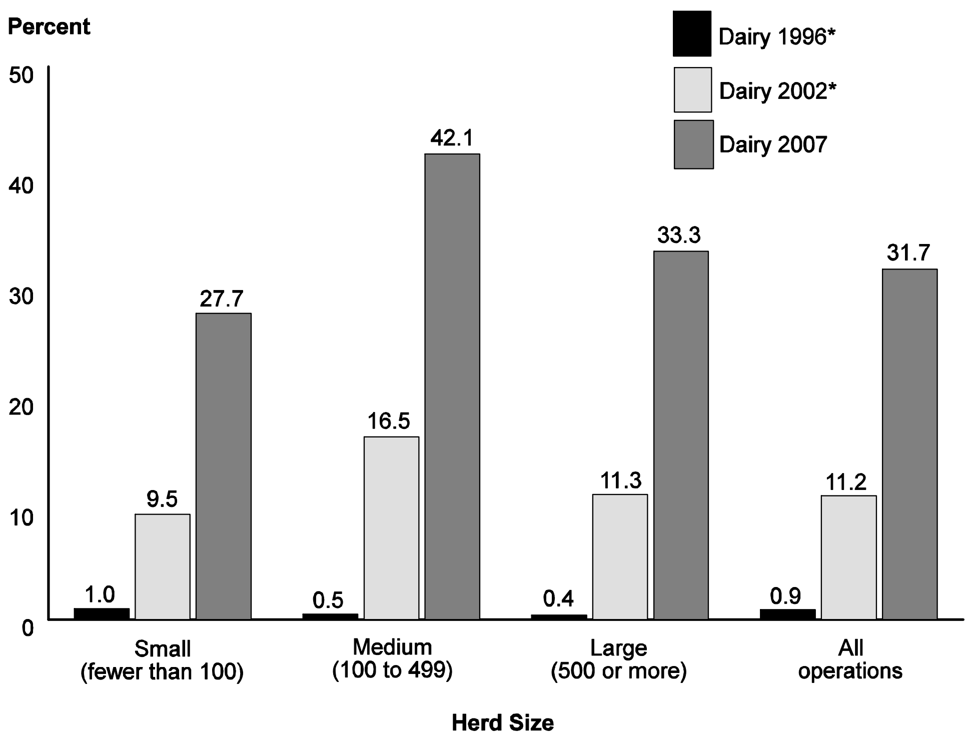
The percentage of operations participating in a Johne's disease control or certification program has increased for each herd size category and for all operations since 1996. Less than 1 percent of operations participated in a Johne's disease control or certification program in 1996 compared with 11.2 percent in 2002 and 31.7 percent in 2007.

a. Percentage of operations that participated in any Johne's disease control or certification program, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Dairy 1996*	1.0	(0.4)	0.5	(0.4)	0.4	(0.4)	0.9	(0.3)
Dairy 2002*	9.5	(1.7)	16.5	(2.3)	11.3	(2.3)	11.2	(1.4)
Dairy 2007	27.7	(3.3)	42.1	(4.1)	33.3	(4.5)	31.7	(2.5)

*Question variation: In 1996, "Is this operation currently on a Johne's certification program."; In 2002, "Does operation participate in a Johne's disease herd status, control, or certification program."

Percentage of Operations that Participated in any Johne's Disease Control or Certification Program, by Herd Size



*Question variation: In 1996, "Is this operation currently on a Johne's certification program."; in 2002, "Does operation participate in a Johne's disease herd status, control, or certification program."

The percentage of operations that tested for Johne's disease increased across herd sizes from 1996 to 2002 and for all operations from 1996 to 2007; 13.1 percent of operations tested for Johne's in 1996, 25.7 percent tested in 2002, and 35.3 percent tested in 2007. Based on the percentage of operations that participated in a Johne's disease control program (table 8a, p18), it appears that a substantial percentage of operations performed testing without being formally enrolled in a Johne's disease control or certification program.

b. Percentage of operations that performed any testing for Johne's disease, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
	Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Dairy 1996*	10.5	(1.3)	22.0	(2.4)	19.9	(4.3)	13.1	(1.1)
Dairy 2002	20.4	(2.5)	39.5	(3.3)	38.3	(4.0)	25.7	(1.9)
Dairy 2007	30.7	(3.4)	47.6	(4.1)	37.5	(5.7)	35.3	(2.6)

*Question variation: 1996 estimate was operations that tested in the last 24 months, while the 2002 and 2007 estimates are for testing performed during the previous 12 months.

Photo courtesy of Judy Rodriguez

9. Calving areas

Sick cows in the calving area are potential sources of disease for both dams and newborn calves. Although more than 50 percent of operations allowed sick cows in the calving area in 1996 and 2002, only 34.2 percent did so in 2007.

a. Percentage of operations that allowed sick cows in the calving area:

Percent Operations					
Dairy 1996		Dairy 2002		Dairy 2007*	
Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
54.9	(1.8)	54.1	(2.4)	34.2	(3.2)

*Question variation: Estimate only for operations with a dedicated calving area.

Cows that test positive for Johne's disease can contaminate the calving area, resulting in transmission of disease to newborn calves. To prevent calving-area contamination, test-positive animals should not be allowed in the calving area or other areas where calves could be exposed and potentially infected.

There were no differences between 2002 and 2007 in the percentage of operations that allowed Johne's disease test-positive cows into the calving area.

b. For operations that tested for Johne's disease, percentage of operations that allowed Johne's test-positive cows in the calving area:

Percent Operations			
Dairy 2002		Dairy 2007*	
Percent	Std. Error	Percent	Std. Error
15.2	(1.8)	15.5	(3.2)

*Question variation: Estimate only for operations with a dedicated calving area.

B. General Management

1. Flooring type

Flooring surfaces affect cow health and longevity. When given an option, cows select flooring that compresses and provides cushion, such as rubber mats, pasture, or dirt. Concrete flooring is associated with increased lameness, injuries, and decreased expression of estrus.

Overall, the percentage of operations that used concrete as the predominate flooring type for cattle decreased from 85.8 percent in 1996 to 51.1 percent in 2007. A higher percentage of operations used rubber mats over concrete in 2007 compared with 2002 (22.9 and 10.8 percent, respectively). In 2007, pasture was the predominant flooring for lactating cows on 10.1 percent of operations and for 5.1 percent of cows; dirt was the predominant flooring on 5.4 percent of operations and for 20.0 percent of cows, which probably reflects the use of drylots on large operations.

Percentage of operations (and percentage of cows on these operations) by predominant flooring type that lactating cows stood or walked on when not being milked:

	Percent Operations						**Percent Cows**					
	Dairy 1996		**Dairy 2002**		**Dairy 2007**		**Dairy 1996**		**Dairy 2002**		**Dairy 2007**	
Flooring Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Concrete–grooved	27.2	(1.4)	31.1	(1.7)	34.3	(2.4)	39.3	(1.7)	45.7	(1.9)	48.7	(3.5)
Concrete–textured	16.2	(1.4)	5.7	(1.0)			17.2	(1.7)	4.0	(0.7)		
Concrete–slat	0.8	(0.3)	1.0	(0.3)	1.3	(0.5)	1.6	(0.7)	1.7	(0.5)	1.1	(0.5)
Concrete–smooth	41.6	(1.8)	26.3	(2.0)	15.5	(2.3)	26.7	(1.4)	12.6	(1.0)	5.8	(0.8)
Rubber mats over concrete			10.8	(1.4)	22.9	(2.5)			6.9	(1.0)	13.9	(2.2)
Pasture	6.9	(1.0)	12.4	(1.3)	10.1	(1.7)	4.6	(0.6)	7.8	(0.8)	5.1	(0.9)
Dirt	5.8	(0.8)	7.1	(1.0)	5.4	(1.1)	9.6	(1.0)	18.0	(1.8)	20.0	(3.5)
Other	1.5	(0.4)	5.6	(1.0)	10.5	(1.8)	1.0	(0.3)	3.3	(0.7)	5.4	(1.1)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

2. Surface moisture

Wet flooring can be detrimental to hoof health. Cows on wet surfaces have increased hoof-horn moisture and are more prone to infectious hoof diseases.

The ground or flooring surface for lactating cows in 2007 was usually dry on 60.3 percent of operations in summer and 49.5 percent in winter, down from 71.0 and 58.9 percent, respectively, in 1996. The percentage of operations in which flooring was almost always wet but no standing water was present in summer increased from 7.8 percent in 1996 to 16.3 percent in 2007. The percentage of operations in which flooring was almost always wet, but no standing water was present in winter increased from 16.9 percent in 1996 to 28.1 percent in 2007.

Percentage of operations by category that best describes the surface moisture of the ground or flooring that lactating cows stood on most of the time, and by season:

	Percent Operations											
	Season											
	Summer						Winter					
	Dairy 1996		Dairy 2002		Dairy 2007		Dairy 1996		Dairy 2002		Dairy 2007	
Surface Moisture	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Usually dry	71.0	(1.6)	63.3	(2.0)	60.3	(2.7)	58.9	(1.5)	49.7	(2.1)	49.5	(2.6)
Wet about half the time	20.9	(1.5)	22.2	(1.8)	22.8	(2.4)	22.9	(1.4)	26.0	(1.8)	21.8	(2.2)
Almost always wet, but no standing water	7.8	(0.8)	13.3	(1.2)	16.3	(1.7)	16.9	(1.0)	23.1	(1.5)	28.1	(2.1)
Usually standing water or slurry	0.3	(0.1)	1.2	(0.5)	0.6	(0.3)	1.3	(0.3)	1.2	(0.4)	0.6	(0.3)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

3. Bedding types

The ideal bedding for lactating cows is dry and clean, provides cushion, and does not support bacterial growth. Of the bedding types listed in the table below, only the use of straw and/or hay decreased from 1996 to 2007, on operations and for cows. The percentage of cows bedded on corn cobs and stalks decreased by about one-half from 1996 to 2007. The percentage of operations that used sand or mattresses increased, with mattresses showing the largest increase from 4.7 percent in 1996 to 23.7 percent in 2007. Composted manure use increased, as 9.0 percent of cows were bedded on composted manure in 1996 compared with 24.2 percent in 2007.

Percentage of operations (and percentage of cows on these operations) by type of bedding used for lactating cows during the previous 90 days:

	Percent Operations						Percent Cows					
	Dairy 1996		Dairy 2002		Dairy 2007		Dairy 1996		Dairy 2002		Dairy 2007	
Bedding Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Straw and/or hay	66.9	(1.5)	54.0	(2.0)	54.1	(2.7)	47.7	(1.5)	35.6	(1.5)	33.4	(2.8)
Sand	11.2	(1.0)	18.1	(1.5)	21.9	(2.0)	15.3	(1.3)	21.3	(1.6)	30.3	(2.6)
Sawdust/ wood products	27.9	(1.5)	35.0	(1.9)	35.0	(2.6)	27.3	(1.3)	32.1	(1.5)	31.2	(2.8)
Composted/ dried manure	2.4	(0.4)	2.3	(0.4)	3.9	(0.5)	9.0	(1.4)	12.7	(1.5)	24.2	(2.6)
Rubber mats	27.0	(1.6)	25.8	(2.0)	30.2	(2.7)	18.8	(1.2)	15.0	(1.2)	18.5	(2.1)
Rubber tires	1.0	(0.3)	1.3	(0.4)	1.6	(0.6)	1.6	(0.5)	1.7	(0.4)	1.1	(0.4)
Shredded newspaper	6.7	(0.9)	7.9	(1.2)	5.2	(1.2)	5.7	(0.7)	5.4	(0.7)	3.1	(0.7)
Mattresses	4.7	(0.6)	17.4	(1.5)	23.7	(2.4)	7.0	(0.8)	18.1	(1.2)	20.1	(1.9)
Corn cobs and stalks	12.8	(1.3)	10.5	(1.4)	11.0	(1.9)	10.1	(1.1)	6.6	(0.8)	5.7	(1.0)
Shells/hulls			1.8	(0.4)					5.9	(1.1)		
Waterbeds					1.7	(0.8)					2.3	(1.0)
Other	3.7	(0.8)	5.0	(1.0)	11.7	(1.9)	4.8	(1.0)	6.8	(1.1)	13.3	(2.5)
Any bedding	95.2	(0.5)	93.2	(0.8)	97.0	(0.8)	87.5	(1.3)	85.8	(1.6)	94.9	(1.9)

4. Feedstuffs

The percentage of operations that fed alfalfa hay/haylage and/or corn silage to lactating cows increased from 1996 to 2007.

Percentage of operations by type of feedstuff fed to lactating cows during the previous 90 days:

<table>
<tr><th></th><th colspan="6">Percent Operations</th></tr>
<tr><th></th><th colspan="2">Dairy 1996</th><th colspan="2">Dairy 2002</th><th colspan="2">Dairy 2007</th></tr>
<tr><th>Feedstuff</th><th>Pct.</th><th>Std. Error</th><th>Pct.</th><th>Std. Error</th><th>Pct.</th><th>Std. Error</th></tr>
<tr><td>Alfalfa hay/haylage</td><td>72.3</td><td>(1.6)</td><td>93.8</td><td>(1.0)</td><td>92.3</td><td>(1.6)</td></tr>
<tr><td>Corn silage</td><td>77.4</td><td>(1.5)</td><td>81.6</td><td>(1.7)</td><td>87.6</td><td>(1.8)</td></tr>
<tr><td>Clover as forage or pasture</td><td>31.2</td><td>(1.7)</td><td>22.5</td><td>(1.9)</td><td>23.1</td><td>(2.4)</td></tr>
<tr><td>Whole cottonseed</td><td>28.7</td><td>(1.5)</td><td>37.8</td><td>(2.0)</td><td>33.0</td><td>(2.5)</td></tr>
<tr><td>Cottonseed meal or hulls</td><td>8.9</td><td>(0.9)</td><td>7.9</td><td>(1.0)</td><td>9.3</td><td>(1.5)</td></tr>
<tr><td>Whole soybeans or soybean meal</td><td>80.0</td><td>(1.3)</td><td>83.6</td><td>(1.5)</td><td>84.4</td><td>(2.1)</td></tr>
<tr><td>Bakery byproducts</td><td>6.4</td><td>(0.8)</td><td>5.5</td><td>(0.8)</td><td>6.6</td><td>(1.0)</td></tr>
<tr><td>Brewery byproducts</td><td>28.7</td><td>(1.6)</td><td>30.6</td><td>(1.9)</td><td>37.1</td><td>(2.7)</td></tr>
<tr><td>Corn</td><td></td><td></td><td>95.8</td><td>(0.7)</td><td>94.2</td><td>(1.4)</td></tr>
<tr><td>Barley</td><td></td><td></td><td>12.8</td><td>(1.2)</td><td>14.1</td><td>(1.9)</td></tr>
<tr><td>Wheat (not silage)</td><td></td><td></td><td>6.7</td><td>(1.0)</td><td>6.7</td><td>(1.1)</td></tr>
<tr><td>Oats (not silage)</td><td></td><td></td><td>22.3</td><td>(2.0)</td><td>17.5</td><td>(2.4)</td></tr>
<tr><td>Green chop</td><td></td><td></td><td>3.9</td><td>(1.0)</td><td>4.9</td><td>(1.4)</td></tr>
<tr><td>Feather/poultry meal</td><td></td><td></td><td>3.0</td><td>(0.7)</td><td>3.2</td><td>(0.7)</td></tr>
<tr><td>Fish meal</td><td></td><td></td><td>4.9</td><td>(0.7)</td><td>4.4</td><td>(0.9)</td></tr>
<tr><td>Fat/tallow</td><td>25.3</td><td>(1.5)</td><td>20.0</td><td>(1.6)</td><td>32.7</td><td>(2.5)</td></tr>
<tr><td>Porcine meat and bone meal</td><td rowspan="2">21.8*</td><td rowspan="2">(1.4)</td><td></td><td></td><td>8.3</td><td>(1.3)</td></tr>
<tr><td>Blood meal</td><td></td><td></td><td>13.2</td><td>(1.7)</td></tr>
</table>

*Question variation 1996: “Meat and bone meal or blood meal.”

5. Feeding practices

There were no differences in the percentages of operations by specific feeding practices for lactating cows. The majority of operations fed all lactating cows one ration in both study years.

a. Percentage of operations by feeding practices that best describe how lactating cows were fed:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Feeding Practice	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Feed all lactating cows the same ration	59.1	(2.2)	62.3	(2.7)
Feed individuals or groups based on production/stage of lactation	38.2	(2.2)	35.6	(2.7)
Feed individuals or groups based on lactation number			1.6	(0.6)
Feed individuals or groups based on criteria other than production/stage of lactation or lactation number	2.7	(0.4)	0.5	(0.3)
Total	100.0		100.0	

A similar percentage of operations fed anionic salts to close-up cows and/or springing heifers in 2002 and 2007.

b. Percentage of operations that fed anionic salts (e.g., BioChlor, SoyChlor, ammonium chloride, etc.) to prevent milk fever, by cattle class:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Cattle Class	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Close-up cows[1]	19.1	(1.4)	22.9	(2.2)
Springing heifers[2]	14.3	(1.2)	15.7	(1.9)

[1]Cows 2 to 4 weeks prior to calving.
[2]Heifers 2 to 4 weeks prior to calving.

The percentage of operations that separated close-up cows from other dry cows did not change from 2002 to 2007.

c. Percentage of operations that separated close-up cows from other dry cows, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
	Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Dairy 2002	56.1	(2.8)	81.7	(2.3)	98.2	(1.2)	63.9	(1.9)
Dairy 2007	47.1	(3.9)	74.9	(3.7	96.0	(2.1)	57.1	(2.9)

The use of any milk urea nitrogen (MUN) testing increased from 22.3 percent of operations in 2002 to 49.8 percent in 2007. The percentage of operations that routinely used MUN testing increased from 9.3 percent in 2002 to 30.9 percent in 2007.

d. Percentage of operations by use of milk urea nitrogen (MUN) testing to determine ration composition:

	Percent Operations			
	Dairy 2002		**Dairy 2007**	
Frequency	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Use routinely	9.3	(1.0)	30.9	(2.4)
Use only if have a problem	13.0	(1.3)	18.9	(2.2)
Never used	77.7	(1.6)	50.2	(2.7)
Total	100.0		100.0	

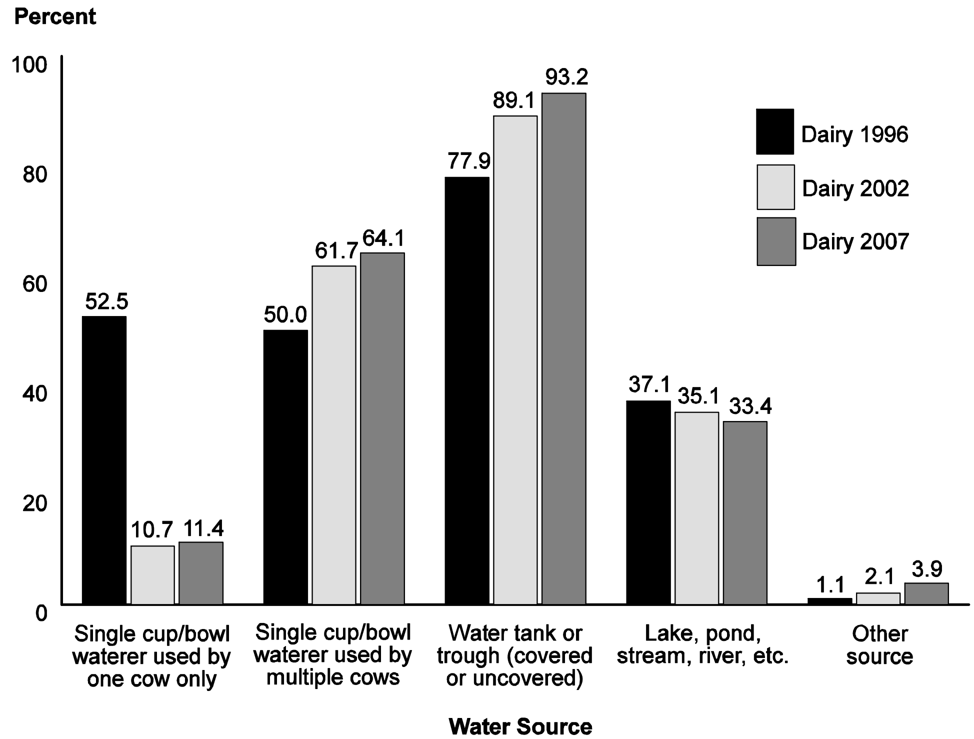
6. Water source

Water sources for cows have changed since 1996. The use of a single cup/bowl by only one cow decreased from 52.5 percent of operations in 1996 to 10.7 percent in 2002 and 11.4 percent in 2007. The percentage of operations that used a single cup/bowl for multiple cows increased from 50.0 percent of operations in 1996 to 64.1 percent in 2007. The percentage of operations that used a water tank or trough increased from 77.9 percent in 1996 to 93.2 percent in 2007. The changes in water sources reflect the changes in housing in which cows are in loose housing rather than restricted to a single stall and water source.

a. Percentage of operations by source of drinking water for any cows during the previous 12 months:

	Percent Operations					
	Dairy 1996		Dairy 2002		Dairy 2007	
Water Source	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Single cup/bowl waterer used by one cow only	52.5	(1.6)	10.7	(1.4)	11.4	(2.0)
Single cup/bowl waterer used by multiple cows	50.0	(1.8)	61.7	(1.8)	64.1	(2.4)
Water tank or trough (covered or uncovered)	77.9	(1.5)	89.1	(1.4)	93.2	(1.5)
Lake, pond, stream, river, etc.	37.1	(1.7)	35.1	(2.0)	33.4	(2.7)
Other source	1.1	(0.4)	2.1	(0.7)	3.9	(1.3)

Percentage of Operations by Source of Drinking Water for any Cows During the Previous 12 Months



The frequency that water tanks/troughs were cleaned 13 or more times a year increased from 13.6 percent of operations in 1996 to 34.2 percent in 2007.

b. For operations with a water tank or trough, percentage of operations by average number of times per year water tank or trough was drained ***and*** cleaned:

	Percent Operations					
	Dairy 1996		Dairy 2002		Dairy 2007	
Number Times/Year	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
0	8.4	(1.2)	6.2	(1.1)	4.6	(1.4)
1 to 4	51.8	(2.1)	46.5	(2.3)	37.1	(3.2)
5 to 12	26.2	(1.9)	22.3	(1.9)	24.1	(2.8)
13 or more	13.6	(1.4)	25.0	(1.9)	34.2	(2.8)
Total	100.0		100.0		100.0	

The percentage of operations that chlorinated drinking water for cows has not changed since 1996 and remains at approximately 9 percent. This percentage may not reflect water sources for cattle that are chlorinated prior to arriving at the operation, such as municipal water supplies.

c. Percentage of operations that usually chlorinated drinking water for cows:

Percent Operations					
Dairy 1996		Dairy 2002		Dairy 2007	
Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
10.7	(1.0)	9.8	(1.0)	8.7	(1.2)

7. Permanently removed cows

About one of four cows was permanently removed (excluding those that died) from operations in 2002 and 2007.

a. Percentage of cows permanently removed from the operation during the previous 12 months (excluding those that died):

Percent Cows*			
Dairy 2002		Dairy 2007	
Percent	Std. Error	Percent	Std. Error
24.9	(0.4)	25.8	(0.9)

*As a percentage of cow inventory at the time of interview.

The majority of permanently removed cows were removed at 200 or more days in milk in 2002 and 2007. The percentage of permanently removed cows by days in milk did not change between 2002 and 2007.

b. Percentage of cows permanently removed during the previous 12 months, by days in milk:

	Percent Cows			
	Dairy 2002		Dairy 2007	
Days in Milk	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Fewer than 50	15.6	(0.5)	16.2	(1.1)
50 to 199	24.1	(0.7)	22.6	(1.3)
200 or more	60.3	(0.9)	58.0	(1.8)
Dry cows			3.2	(0.4)
Total	100.0		100.0	

Photo courtesy of Judy Rodriguez

C. Milk Quality and Milking Procedures

1. Bulk tank somatic cell count

Bulk tank somatic cell count (BTSCC) refers to the number of white blood cells (leukocytes) and secretory cells per milliliter of raw milk and is used as a measure of milk quality and udder health. Increased BTSCCs are generally associated with increased intramammary infection and decreased milk production. The current regulatory limit for BTSCCs in the United States is 750,000 cells/ml. Although the U.S. regulatory limit is 750,000 cells/ml, producers may lose quality premiums or receive less money for their milk if it does not meet the quality guidelines determined by the processor who purchases the milk.

The majority of operations had an average BTSCC between 100,000 and 299,000 cell/ml during each of the three study years.

Percentage of operations by average BTSCC for milk shipped during the previous 12 months:

	Percent Operations					
	Dairy 1996[1]		Dairy 2002[2]		Dairy 2007[3]	
BTSCC (cells/ml)	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Less than 100,000	4.4	(0.7)	2.4	(0.6)	2.8	(1.0)
100,000 to 199,000	25.4	(1.6)	23.6	(1.9)	27.8	(2.6)
200,000 to 299,000	34.4	(1.7)	34.5	(2.1)	40.3	(2.8)
300,000 to 399,000	20.2	(1.5)	21.7	(1.7)	18.7	(2.0)
400,000 to 499,000	10.1	(1.2)	11.0	(1.4)	8.7	(1.9)
500,000 to 599,000	5.5	(0.9)	6.8	(1.1)	1.7	(1.0)
Total	100.0		100.0		100.0	

Question variation: [1]1996 question asked about previous 6 months. [2]2002 question asked about previous 90 days. [3]2007 question asked about previous 12 months.

2. Milking frequency

Milk production can be negatively affected by intramammary pressure. Frequent milking during peak production can shorten periods of increased intramammary pressure. Although increased milking frequency opens the teat canal more often, the risk for intramammary infection does not appear to be increased. Evidence suggests that increasing the times per day that fresh cows (cows less than 30 days in milk) are milked increases milk production during that period and persists throughout lactation.

More than 9 of 10 operations milked the majority of cows twice a day in 2002 and 2007.

Percentage of operations by number of times per day the majority of cows* were milked:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Times per Day	**Percent**	**Std. Error**	**Percent**	**Std. Error**
1	0.5	(0.4)	0.5	(0.4)
2	93.6	(0.8)	92.5	(0.9)
3	5.8	(0.7)	7.0	(0.8)
More than 3	0.1	(0.1)	0.0	(--)
Total	100.0		100.0	

*Question variation: other than fresh cows specified in 2007.

3. Udder and teat preparation

The percentage of operations that forestripped all cows increased from 44.5 percent in 2002 to 58.9 percent in 2007. The percentage of operations that did not forestrip any cows decreased from 13.1 percent in 2002 to 7.4 percent in 2007.

a. Percentage of operations by use of forestripping:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Forestripping	Percent	Std. Error	Percent	Std. Error
All cows	44.5	(2.1)	58.9	(2.9)
Some cows	42.4	(2.1)	33.7	(2.8)
No cows	13.1	(1.5)	7.4	(1.6)
Total	100.0		100.0	

Iodophor was the predominant predip compound used during summer and winter in 2002 and 2007. The use of primary predip compounds did not change from 2002 to 2007.

b. Percentage of operations by primary ***predip*** compounds used as disinfectants, by season:

	Percent Operations							
	Season							
	Summer				**Winter**			
	Dairy 2002		**Dairy 2007**		**Dairy 2002**		**Dairy 2007**	
Predip Compound	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Iodophor (iodine containing)	64.7	(2.4)	59.6	(2.9)	65.1	(2.4)	59.7	(2.9)
Chlorhexidine	9.4	(1.6)	11.7	(2.1)	10.6	(1.7)	11.8	(2.1)
Fatty acid based	4.7	(1.1)	2.5	(0.7)	4.7	(1.1)	2.5	(0.7)
Quaternary ammonium	0.3	(0.3)	0.3	(0.2)	0.5	(0.4)	0.3	(0.2)
Phenols	0.3	(0.2)	0.1	(0.1)	0.3	(0.2)	0.1	(0.1)
Chlorine product	3.7	(0.8)	7.2	(1.5)	3.7	(0.8)	7.1	(1.5)
Other	7.1	(1.2)	7.9	(1.6)	6.9	(1.2)	8.0	(1.6)
None	9.8	(1.6)	10.7	(1.8)	8.2	(1.5)	10.5	(1.8)
Total	100.0		100.0		100.0		100.0	

Single-use paper towel was the most common drying method used in 2002 and 2007. In summer and winter, the percentage of operations that air dried teats prior to milking decreased from about 27 percent in 2002 to about 12 percent in 2007. The use of single-use cloth towels increased from 2002 (10.2 and 7.9 percent in summer and winter, respectively) to 2007 (21.5 and 21.6 percent in summer and winter, respectively).

c. Percentage of operations by the method used to dry teats ***prior*** to milking, and by season:

	Percent Operations							
	Season							
	Summer				**Winter**			
	Dairy 2002		**Dairy 2007**		**Dairy 2002**		**Dairy 2007**	
Drying Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Air dry	27.0	(3.4)	12.4	(2.1)	27.4	(3.4)	12.3	(2.1)
Single-use cloth towel	10.2	(2.2)	21.5	(2.1)	7.9	(1.8)	21.6	(2.1)
Single-use paper towel	49.7	(3.9)	54.8	(2.8)	50.8	(3.8)	54.6	(2.8)
Multiple-use cloth towel	7.4	(1.6)	7.1	(1.3)	7.0	(1.5)	7.1	(1.3)
Multiple-use paper towel	4.2	(1.7)	0.6	(0.4)	5.4	(1.8)	0.6	(0.4)
Other	1.5	(1.0)	0.4	(0.3)	1.5	(1.0)	0.6	(0.3)
Not applicable–teats not wet prior to milking			3.2	(1.1)			3.2	(1.1)
Total	100.0		100.0		100.0		100.0	

4. Postmilking procedures

As with predip compounds, iodophor was the predominant postdip compound used during summer and winter in 2002 and 2007. The use of primary postdip compounds in summer and winter at the operation level did not change from 2002 to 2007.

Percentage of operations by primary ***postdip*** compounds used as disinfectants, and by season:

	Percent Operations							
	Season							
	Summer				Winter			
	Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Predip Compound	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Iodophor (iodine containing)	71.1	(1.9)	69.8	(2.9)	69.7	(2.0)	67.8	(2.9)
Chlorhexidine	11.4	(1.4)	12.1	(2.1)	12.1	(1.4)	13.4	(2.2)
Fatty acid based	5.4	(0.8)	6.4	(1.4)	6.2	(0.9)	7.2	(1.5)
Quaternary ammonium	0.4	(0.3)	0.3	(0.2)	0.5	(0.3)	0.8	(0.5)
Phenols	0.4	(0.2)	0.0	(--)	0.4	(0.2)	0.0	(0.0)
Chlorine product	1.2	(0.4)	2.3	(1.1)	1.2	(0.4)	1.7	(0.8)
Other	3.8	(0.8)	3.9	(1.1)	3.7	(0.8)	3.8	(1.1)
None	6.3	(1.1)	5.2	(1.6)	6.2	(1.2)	5.3	(1.6)
Total	100.0		100.0		100.0		100.0	

5. Milking practices

The percentage of operations in which milkers wore gloves to milk all cows increased from 32.9 percent in 2002 to 55.2 percent in 2007. The percentage of cows on operations in which milkers wore gloves increased from 48.7 in 2002 to 76.8 percent in 2007.

Percentage of operations (and percentage of cows on these operations) in which milkers wore gloves to milk all cows:

Percent Operations				Percent Cows			
Dairy 2002		Dairy 2007*		Dairy 2002		Dairy 2007*	
Percent	Std. Error	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
32.9	(1.9)	55.2	(2.8)	48.7	(1.9)	76.8	(2.5)

*Question variation: Specified latex or nitrile gloves in 2007.

6. Milking equipment

Less than 7.0 percent of operations used a backflush system in 2002 and 2007. There were no differences across herd sizes between 2002 and 2007 in the use of a backflush system.

a. Percentage of operations that used a backflush system in milking units, by herd size:

	Percent Operations							
	Herd Size (Number of Dairy Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Dairy 2002	4.9	(1.1)	9.8	(1.7)	20.7	(3.1)	6.7	(0.9)
Dairy 2007	5.9	(1.8)	8.6	(2.1)	9.3	(2.6)	6.8	(1.3)

Although there were no changes by herd size from 2002 to 2007 in the percentage of operations that used automatic takeoffs, the percentage of all operations increased from 36.0 percent in 2002 to 45.4 percent in 2007.

b. Percentage of operations that used automatic takeoffs, by herd size:

	Percent Operations							
	Herd Size (Number of Dairy Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
	Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Dairy 2002	21.3	(2.1)	71.0	(2.8)	93.3	(1.5)	36.0	(1.8)
Dairy 2007	30.2	(3.3)	76.9	(3.8)	89.5	(3.4)	45.4	(2.6)

7. Vaccination

There were no changes from 2002 to 2007 in the percentage of operations that administered coliform mastitis and *Salmonella* vaccines. As reported in both 2002 and 2007, about 4 of 10 operations vaccinated for coliform mastitis and about 1 of 10 vaccinated for *Salmonella*. *Salmonella* vaccine might also help prevent coliform mastitis.

a. Percentage of operations by type of vaccination used during the previous 12 months:

	Percent Operations			
	Dairy 2002[1]		**Dairy 2007**[2]	
Vaccination Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Coliform mastitis	36.0	(2.0)	37.6	(2.6)
Salmonella	10.7	(1.3)	13.4	(1.6)

[1]Question variation: Majority of cows.
[2]Question variation: All or some cows.

8. Dry-off procedures/antibiotic treatment

There were no differences between 2002 and 2007 in the percentage of operations by percentage of cows treated with dry-cow intramammary antibiotics at dry-off during the previous 12 months. More than 8 of 10 cows in 2002 and 2007 were on operations that dry treated 100.0 percent of cows.

a. Percentage of operations (and percentage of cows on these operations) by percentage of cows treated with dry-cow intramammary antibiotics at dry-off during the previous 12 months:

	Percent Operations				Percent Cows			
	Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Percent Dry Cows Treated	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
0.0	5.9	(1.0)	9.9	(1.7)	4.3	(0.8)	5.9	(1.5)
1.0 to 33.0	7.1	(1.2)	5.6	(1.4)	3.7	(0.6)	2.7	(0.9)
33.1 to 66.0	2.9	(0.7)	3.0	(0.8)	2.0	(0.6)	2.4	(0.8)
66.1 to 99.9	8.9	(1.2)	9.2	(1.8)	6.6	(0.9)	7.3	(1.3)
100.0	75.2	(1.9)	72.3	(2.7)	83.4	(1.4)	81.7	(2.3)
Total	100.0		100.0		100.0		100.0	

The percentage of cows treated with cephapirin decreased from 42.1 percent in 2002 to 31.0 percent in 2007, while the use of penicillin G (procaine)/novobiocin increased from 5.8 to 13.2 percent. Ceftiofur hydrochloride was used to treat 7.0 percent of cows in 2007 and was not approved for use in 2002.

b. For cows treated with dry cow intramammary antibiotics during the previous 12 months, percentage of cows treated, by type of antibiotic:

	Percent Dry Cows[1] Treated			
	Dairy 2002		**Dairy 2007**	
Antibiotic	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Ceftiofur hydrochloride[2]			7.0	(2.0)
Cephapirin (benzathine)	42.1	(1.8)	31.0	(2.3)
Cloxacillin (benzathine)	12.8	(1.4)	7.9	(1.8)
Erythromycin	0.8	(0.3)	0.3	(0.1)
Novobiocin	5.7	(1.1)	2.5	(1.9)
Penicillin G (procaine)	1.3	(0.4)	1.7	(0.5)
Penicillin G (procaine)/ dihydrostreptomycin	31.7	(2.0)	36.9	(3.2)
Penicillin G (procaine)/ novobiocin	5.8	(1.0)	13.2	(2.4)
Other	0.2	(0.1)	0.0	(--)

[1]As a percentage of cows dry treated during the previous 12 months. Some cows were treated with more than one antibiotic.
[2]Approved for use in dry cows in 2005.

D. Antibiotic Use

NOTE: In this section, the terms antibiotic and antimicrobial are used synonymously (See Terms Used in This Report, p 4).

1. Preweaned heifers

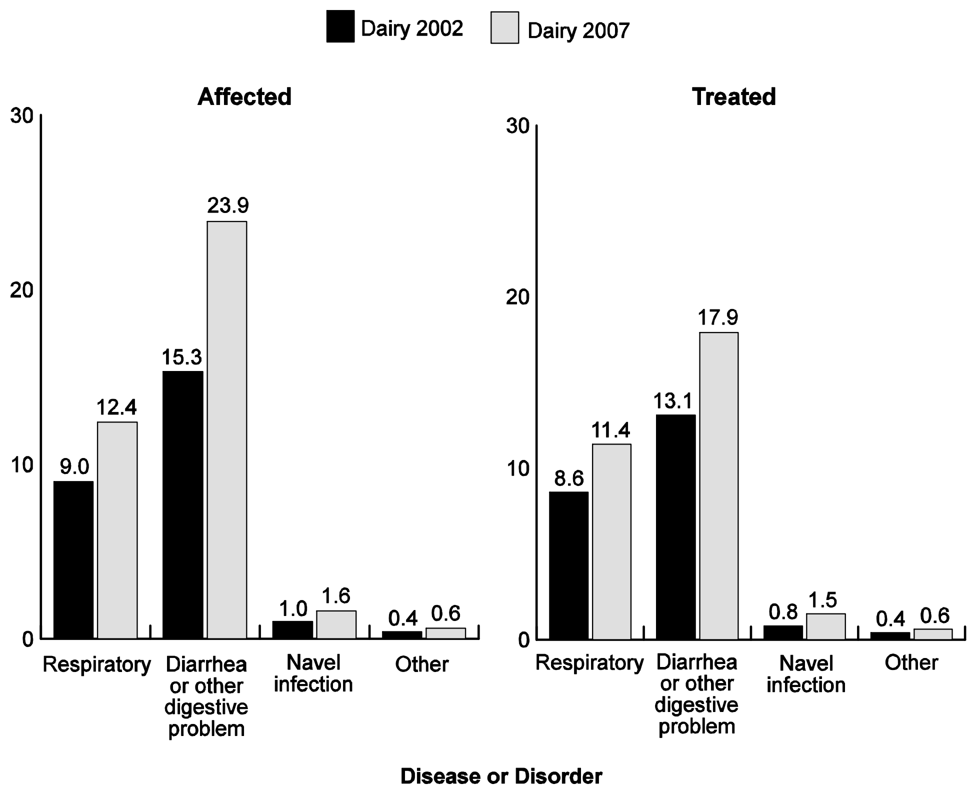
Diarrhea or other digestive problem was the single most common disease or disorder affecting preweaned heifer calves in 2002 and 2007, and a higher percentage of preweaned heifers were affected in 2007 (23.9 percent) compared with 2002 (15.3 percent). There were no differences between 2002 and 2007 in the percentages of preweaned heifers affected or treated for respiratory disease. Nor was there a difference in the percentage of heifers treated with antibiotics for diarrhea or other digestive problem between 2002 and 2007. The percentage of preweaned heifers treated for navel infection in 2007 was slightly higher than in 2002 (1.5 and 0.8 percent, respectively).

a. Percentage of preweaned heifers affected with the following diseases or disorders during the previous 12 months and percentage treated with antibiotics:

	Percent Preweaned Heifers*							
	Affected				Treated			
	Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Disease or Disorder	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Respiratory	9.0	(0.5)	12.4	(1.3)	8.6	(0.5)	11.4	(1.3)
Diarrhea or other digestive problem	15.3	(0.9)	23.9	(1.9)	13.1	(0.8)	17.9	(1.7)
Navel infection	1.0	(0.1)	1.6	(0.2)	0.8	(0.1)	1.5	(0.2)
Other	0.4	(0.1)	0.6	(0.2)	0.4	(0.1)	0.6	(0.2)

*As a percentage of dairy heifer calves born alive.

Percentage of Preweaned Heifers Affected with the Following Diseases or Disorders During the Previous 12 Months and Percentage Treated with Antibiotics



The percentage of preweaned heifers affected with a specific disease or disorder and treated with an antibiotic did not change between 2002 and 2007.

b. Of preweaned heifers affected with the following diseases or disorders during the previous 12 months, percentage treated with an antibiotic:

	Percent Affected Preweaned Heifers Treated			
	Dairy 2002		Dairy 2007	
Disease or Disorder	Percent	Std. Error	Percent	Std. Error
Respiratory	95.6	(1.1)	93.4	(2.3)
Diarrhea or other digestive problem	85.7	(2.0)	74.5	(4.8)
Navel infection	82.8	(4.9)	92.3	(2.4)
Other	96.9	(2.0)	97.2	(1.9)

In 2002 and 2007, florfenicol and noncephalosporin beta-lactam were the primary antibiotics used for preweaned heifers with respiratory disease on more than 10 percent of operations. Although the primary antibiotic used on operations for diarrhea or other digestive problem did not change, a higher percentage of operations had heifers affected with diarrhea in 2007 than in 2002 (79.5 and 66.2 percent, respectively). A lower percentage of operations that had heifers with diarrhea or other digestive problem did not treat affected heifers in 2007 compared with 2002 (17.4 and 7.0 percent, respectively). The use of noncephalosporin beta-lactam as the primary antibiotic used for navel infection increased from 11.4 percent of operations in 2002 to 21.2 percent in 2007. Additionally, in 2007 a higher percentage of operations had preweaned heifers with navel infections than in 2002 (31.2 and 17.0 percent, respectively), and a higher percentage of operations used any antibiotic to treat navel infections in 2007 than in 2002 (28.7 and 15.2 percent, respectively).

c. Percentage of operations (including those not reporting diseases or disorders) by primary antibiotic used to treat preweaned heifers during the previous 12 months, and by disease or disorder treated:

	Percent Operations							
	Disease/Disorder							
	Respiratory		Diarrhea/ Other Digestive Problem		Navel Infection		Other	
	Dairy 2002	Dairy 2007	Dairy 2002	Dairy 2007	Dairy 2002	Dairy 2007	Dairy 2002	Dairy 2007
Primary Antibiotic Used	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**
Aminocyclitol*		0.0 (0.0)		1.7 (0.7)		0.0 (--)		0.0 (--)
Aminoglycoside	1.1 (0.4)	0.6 (0.4)	6.0 (1.0)	4.0 (1.1)	0.3 (0.2)	0.0 (0.0)	0.3 (0.3)	0.4 (0.4)
Noncephalosporin beta-lactam	13.9 (1.7)	11.6 (2.0)	12.4 (1.6)	9.4 (1.8)	11.4 (1.3)	21.2 (2.5)	1.1 (0.4)	1.4 (0.7)
Cephalosporin	6.9 (1.0)	8.2 (1.5)	4.7 (0.8)	5.6 (1.1)	1.1 (0.4)	2.2 (0.6)	0.1 (0.0)	0.5 (0.4)
Florfenicol	11.8 (1.4)	18.3 (2.2)	2.3 (0.6)	4.0 (1.1)	0.6 (0.4)	1.1 (0.5)	0.2 (0.1)	0.0 (0.0)
Macrolide	9.6 (1.3)	15.2 (2.1)	3.4 (0.9)	1.5 (0.5)	0.3 (0.3)	0.8 (0.4)	0.1 (0.1)	0.3 (0.2)
Sulfonamide	2.8 (0.8)	1.9 (0.7)	13.8 (1.6)	9.2 (1.5)	0.1 (0.1)	0.9 (0.9)	0.0 (--)	0.2 (0.1)
Tetracycline	9.7 (1.2)	8.9 (1.7)	12.8 (1.4)	16.2 (2.3)	1.4 (0.4)	1.4 (0.4)	0.6 (0.3)	1.0 (0.6)
Other/unknown	1.9 (0.5)	2.0 (0.7)	3.8 (0.8)	10.5 (1.8)	0.0 (0.0)	1.1 (0.6)	0.0 (--)	0.7 (0.5)
Any antibiotic	57.7 (2.3)	66.7 (2.8)	59.2 (2.2)	62.1 (2.8)	15.2 (1.5)	28.7 (2.6)	2.4 (0.6)	4.5 (1.1)
No treatment but disease	0.5 (0.3)	1.4 (0.6)	7.0 (1.2)	17.4 (2.2)	1.8 (0.6)	2.5 (0.7)	0.3 (0.2)	0.2 (0.2)
No disease or disorder	41.8 (2.3)	31.9 (2.8)	33.8 (2.1)	20.5 (2.4)	83.0 (1.6)	68.8 (2.7)	97.3 (0.6)	95.3 (1.2)
Total	100.0		100.0		100.0		100.0	

*Included in “other” in 2002.

In 2007, 11.4 percent of preweaned heifers were treated for respiratory disease; 17.9 percent were treated for diarrhea or other digestive problem; and 1.5 percent were treated for navel infection (see table 1a). Table d. on the following page presents the primary antibiotic used to treat these preweaned heifers.

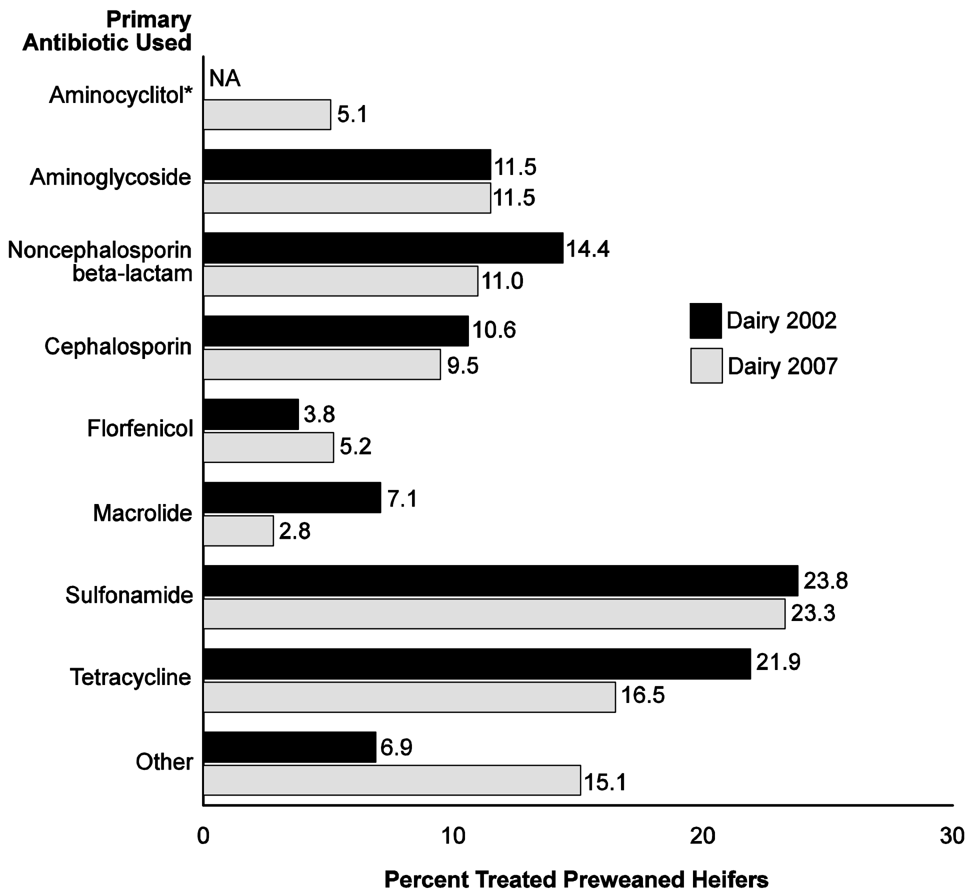
The percentage of preweaned heifers by primary antibiotic used to treat a disease or disorder did not change between 2002 to 2007. For both study periods, more than 14 percent of heifers treated for respiratory disease were on operations that primarily used cephalosporin, florfenicol, or macrolide to treat respiratory disease. In 2002 and 2007, sulfonamide and tetracycline were the primary antibiotics used to treat more than 15.0 percent of heifers with diarrhea or other digestive problem. The majority of preweaned heifers treated for navel infection were on operations that primarily used noncephalosporin beta-lactam antibiotics to treat navel infections.

d. Of preweaned heifers treated with antibiotics for the following diseases or disorders during the previous 12 months (see table 1a, p 41), percentage of preweaned heifers by primary antibiotic used to treat disease or disorder:

	Percent Treated Preweaned Heifers							
	Disease/Disorder							
	Respiratory		Diarrhea/ digestive		Navel Infection		Other	
	Dairy 2002	Dairy 2007	Dairy 2002	Dairy 2007	Dairy 2002	Dairy 2007	Dairy 2002	Dairy 2007
Primary Antibiotic Used	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**
Aminocyclitol*		0.1 (0.1)		5.1 (2.0)		0.0 (--)		0.0 (--)
Aminoglycoside	1.8 (0.7)	2.4 (1.7)	11.5 (2.5)	11.5 (3.9)	0.5 (0.5)	0.3 (0.2)	12.7 (8.5)	0.9 (0.9)
Noncephalosporin beta-lactam	14.5 (2.0)	7.9 (2.1)	14.4 (2.3)	11.0 (2.8)	80.5 (4.2)	69.6 (7.9)	28.5 (9.9)	12.9 (6.4)
Cephalosporin	14.6 (2.0)	24.6 (8.5)	10.6 (2.0)	9.5 (2.3)	4.8 (2.1)	5.0 (1.7)	0.8 (0.8)	4.0 (3.4)
Florfenicol	29.3 (3.3)	25.4 (5.5)	3.8 (1.1)	5.2 (1.8)	3.9 (2.6)	3.7 (2.0)	19.1 (13.1)	0.2 (0.2)
Macrolide	16.1 (2.2)	19.8 (3.7)	7.1 (1.8)	2.8 (1.6)	1.2 (1.1)	11.6 (8.9)	0.9 (0.8)	15.2 (10.3)
Sulfonamide	3.9 (1.4)	3.3 (1.8)	23.8 (2.7)	23.3 (6.2)	0.4 (0.3)	1.8 (1.8)	0.0 (--)	10.2 (9.1)
Tetracycline	17.9 (2.7)	13.2 (3.3)	21.9 (3.2)	16.5 (2.9)	8.7 (2.8)	6.7 (3.2)	38.0 (13.5)	24.8 (16.5)
Other	1.9 (0.6)	3.3 (1.5)	6.9 (1.5)	15.1 (3.0)	0.0 (--)	1.3 (0.6)	0.0 (--)	31.8 (18.6)
Total	100.0		100.0		100.0		100.0	

*Included in “other” in 2002.

Of Preweaned Heifers Treated with Antibiotics for Diarrhea or Other Digestive Problem During the Previous 12 Months, Percentage of Preweaned Heifers by Primary Antibiotic Used to Treat Diarrhea or Other Digestive Problem



*Included in "other" in 2002.

2. Weaned heifers

Ionophores have not consistently been considered antibiotics, but according to Food and Drug Administration (FDA) guidelines ionophores are a type of antibiotic. Excluding ionophores, antibiotic use in weaned heifer rations remained the same between 2002 and 2007. However, when including ionophores as antibiotics, 50.9 percent of operations used antibiotics in weaned heifer rations to prevent disease or promote growth in 2007 compared with 17.5 percent in 2002.

a. Percentage of operations by use of antibiotics in weaned heifer rations to prevent disease or promote growth during the previous 12 months:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Antibiotic Usage	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Antibiotics in heifer ration	17.5	(1.5)	18.2	(2.0)
Ionophores only in heifer ration*			32.7	(2.6)
Did not know if antibiotics were in heifer ration	2.0	(0.6)	2.3	(0.9)
No antibiotics in heifer ration	76.6	(1.7)	44.2	(2.8)
No weaned heifers on operation	3.9	(0.7)	2.6	(0.8)
Total	100.0		100.0	

*Ionophores have not consistently been considered antibiotics, but according to FDA guidelines ionophores are a type of antibiotic.

Of operations that used antibiotics in weaned heifer rations, a lower percentage used chlortetracycline or sulfamethazine in 2007 than in 2002. In 2007, no operations used bacitracin methylene disalicylate or tylosin phosphate in weaned heifer rations.

b. For operations that used antibiotics in weaned heifer rations during the previous 12 months, percentage of operations by antibiotic used:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Antibiotic Used	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Bacitracin methylene disalicylate	3.7	(1.8)	0.0	(--)
Bambermycin	0.9	(0.5)	0.5	(0.5)
Chlortetracycline compounds	62.4	(4.5)	14.4	(2.3)
Neomycin sulfate	4.6	(1.7)	4.1	(1.8)
Ionophores			84.9	(2.8)
Neomycin-oxytetracycline	14.5	(3.2)	5.4	(1.9)
Oxytetracycline compounds	21.5	(3.6)	10.9	(2.2)
Sulfamethazine	27.2	(4.1)	5.7	(1.5)
Tylosin phosphate	0.0	(0.0)	0.0	(--)
Virginiamycin	0.0	(--)	0.2	(0.2)
Other antibiotics	2.3	(2.1)	2.0	(1.4)

Respiratory disease was the most common disease or disorder affecting weaned heifers; however, the percentage of weaned heifers affected was less than 6 percent during 2002 and 2007. There were no differences between 2002 and 2007 in the percentages of weaned heifers affected or treated with antibiotics for a specific disease or disorder.

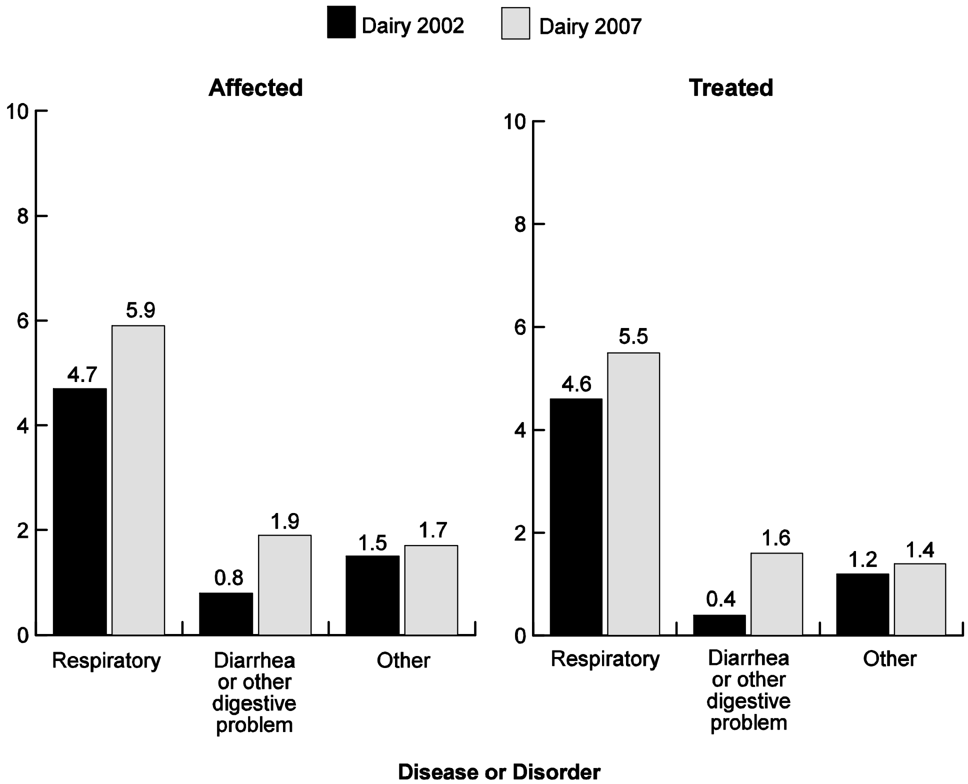
c. Percentage of weaned heifers affected with the following diseases or disorders during the previous 12 months and percentage treated with antibiotics:

	Percent Weaned Heifers*							
	Affected				Treated			
	Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Disease or Disorder	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Respiratory	4.7	(0.3)	5.9	(0.5)	4.6	(0.3)	5.5	(0.5)
Diarrhea or other digestive problem	0.8	(0.2)	1.9	(0.7)	0.4	(0.2)	1.6	(0.7)
Other	1.5	(0.2)	1.7	(0.6)	1.2	(0.2)	1.4	(0.6)

*As a percentage of weaned heifer inventory on January 1.

Photo courtesy Dr. Jason Lombard

Percentage of Weaned Heifers Affected with the Following Diseases or Disorders During the Previous 12 Months and Percentage Treated with Antibiotics



The percentage of weaned heifers affected with a specific disease or disorder and treated with antibiotics did not differ between 2002 and 2007. Although the percentage of heifers affected and treated for diarrhea or other digestive problem appeared much lower in 2002 compared with 2007 (50.7 and 85.4 percent, respectively), the large standard errors associated with the estimates preclude identifying a change.

d. Of weaned heifers affected with the following diseases or disorders during the previous 12 months, percentage treated with an antibiotic:

	Percent Affected Weaned Heifers Treated			
	Dairy 2002		Dairy 2007	
Disease or Disorder	Percent	Std. Error	Percent	Std. Error
Respiratory	97.5	(0.9)	93.3	(1.8)
Diarrhea or other digestive problem	50.7	(12.6)	85.4	(7.8)
Other	86.3	(4.3)	81.3	(8.9)

The percentage of operations that had weaned heifers with respiratory disease increased from 41.9 percent in 2002 to 54.3 percent in 2007. However, the percentage of operations that used any antibiotic to treat respiratory disease in weaned heifers was similar in 2002 and 2007. A lower percentage of operations in 2002 than in 2007 reported respiratory disease but did not treat it (0.5 and 5.1 percent, respectively). A lower percentage of operations in 2002 than in 2007 used any antibiotic to treat diarrhea or other digestive problem in weaned heifers (3.5 and 7.4, respectively). “Other” diseases or disorders were treated with an antibiotic on 14.8 percent of operations in 2002 and 6.2 percent in 2007. There was also an increase in the percentage of operations reporting “other” diseases that did not treat with an antibiotic (0.7 percent in 2002 and 4.7 percent in 2007).

e. Percentage of operations (including those not reporting diseases or disorders) by primary antibiotic used to treat weaned heifers during the previous 12 months, and by disease/disorder:

	Percent Operations											
	Disease/Disorder											
	Respiratory				**Diarrhea/Other Digestive Problem**				**Other**			
	Dairy 2002		**Dairy 2007**		**Dairy 2002**		**Dairy 2007**		**Dairy 2002**		**Dairy 2007**	
Primary Antibiotic Used	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Aminocyclitol*			0.4	(0.2)			0.0	(--)			0.0	(--)
Aminoglycoside	0.0	(0.0)	0.0	(--)	0.3	(0.1)	0.2	(0.1)	0.3	(0.2)	0.0	(--)
Noncephalosporin beta-lactam	7.2	(1.1)	7.8	(1.6)	1.0	(0.4)	1.6	(0.8)	7.1	(1.0)	3.3	(1.1)
Cephalosporin	4.6	(0.8)	4.5	(1.3)	0.5	(0.1)	0.7	(0.2)	0.6	(0.3)	0.2	(0.2)
Florfenicol	8.0	(1.1)	12.4	(1.7)	0.0	(--)	0.4	(0.2)	0.0	(--)	0.0	(--)
Macrolide	6.5	(1.0)	8.0	(1.2)	0.0	(--)	0.2	(0.2)	0.8	(0.4)	0.2	(0.2)
Sulfonamide	2.2	(0.7)	1.5	(0.5)	0.8	(0.2)	0.4	(0.1)	0.4	(0.2)	0.2	(0.1)
Tetracycline	11.6	(1.3)	11.0	(1.7)	0.8	(0.3)	1.4	(0.5)	5.1	(0.8)	1.9	(0.6)
Other	1.3	(0.5)	3.6	(1.1)	0.1	(0.1)	2.5	(0.7)	0.5	(0.3)	0.4	(0.2)
Any antibiotic	41.4	(2.1)	49.2	(2.9)	3.5	(0.6)	7.4	(1.3)	14.8	(1.4)	6.2	(1.3)
No treatment but disease	0.5	(0.3)	5.1	(1.4)	3.1	(0.8)	4.2	(1.1)	0.7	(0.4)	4.7	(1.5)
No disease or disorder	58.1	(2.1)	45.7	(2.9)	93.4	(1.0)	88.4	(1.6)	84.5	(1.5)	89.1	(1.9)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

*Included in “other” category in 2002.

In 2007, 5.5 percent of weaned heifers were treated for respiratory disease; 1.6 percent were treated for diarrhea or other digestive problem; and 1.4 percent were treated for “other” diseases or disorders (see table 2c, p 49). The following table presents the primary antibiotic used to treat these weaned heifers.

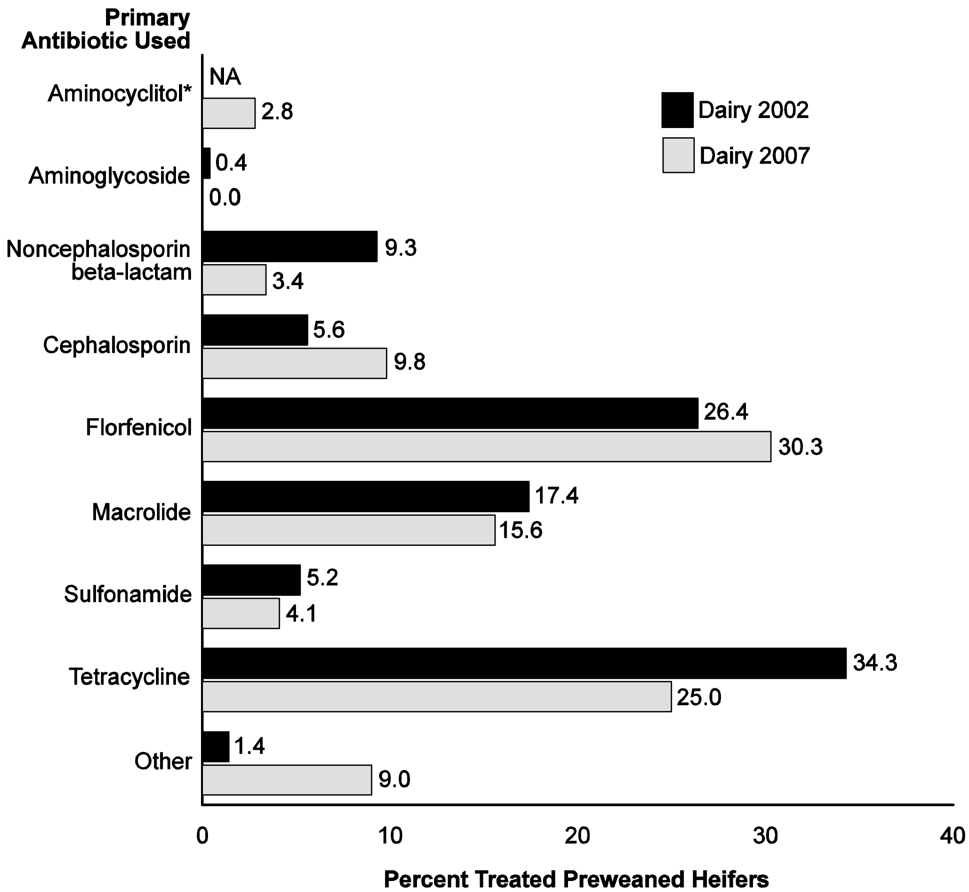
In 2002 and 2007, florfenicol, macrolide, and tetracycline were the primary antibiotics used to treat respiratory disease in more than 15 percent of weaned heifers. The percentage of treated weaned heifers on operations that primarily used noncephalosporin beta-lactam antibiotics decreased from 9.3 percent in 2002 to 3.4 percent in 2007.

f. Of weaned heifers treated with antibiotics during the previous 12 months (see table 2c, p 49), percentage of weaned heifers by primary antibiotic used for the following diseases/disorders:

	Percent Treated Weaned Heifers											
	Disease/Disorder											
	Respiratory				Diarrhea/Digestive				Other			
	Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Primary Antibiotic Used	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Aminocyclitol*			2.8	(2.5)			0.0	(--)			0.0	(--)
Aminoglycoside	0.4	(0.4)	0.0	(--)	9.2	(7.8)	0.0	(--)	1.3	(1.3)	0.0	(--)
Noncephalosporin beta-lactam	9.3	(1.5)	3.4	(0.8)	12.6	(7.2)	3.9	(2.8)	41.3	(7.2)	24.1	(14.2)
Cephalosporin	5.6	(1.2)	9.8	(2.8)	54.3	(20.0)	3.2	(2.3)	3.7	(2.3)	0.9	(0.9)
Florfenicol	26.4	(3.8)	30.3	(4.9)	0.0	(--)	10.0	(8.3)	0.0	(--)	0.0	(--)
Macrolide	17.4	(3.4)	15.6	(3.2)	0.0	(--)	0.2	(0.2)	2.3	(1.2)	0.5	(0.4)
Sulfonamide	5.2	(1.8)	4.1	(1.7)	11.0	(5.7)	2.0	(1.2)	3.0	(1.6)	1.7	(1.4)
Tetracycline	34.3	(3.9)	25.0	(4.7)	11.8	(6.7)	55.1	(22.2)	46.2	(6.8)	67.0	(16.2)
Other	1.4	(0.7)	9.0	(3.5)	1.1	(1.2)	25.6	(15.1)	2.2	(1.3)	5.8	(4.1)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

*Included in “other” category in 2002.

Of Weaned Heifers Treated with Antibiotics for Respiratory Disease During the Previous 12 Months, Percentage of Weaned Heifers by Primary Antibiotic Used to Treat Respiratory Disease



*Included in "other" in 2002.

3. Cows

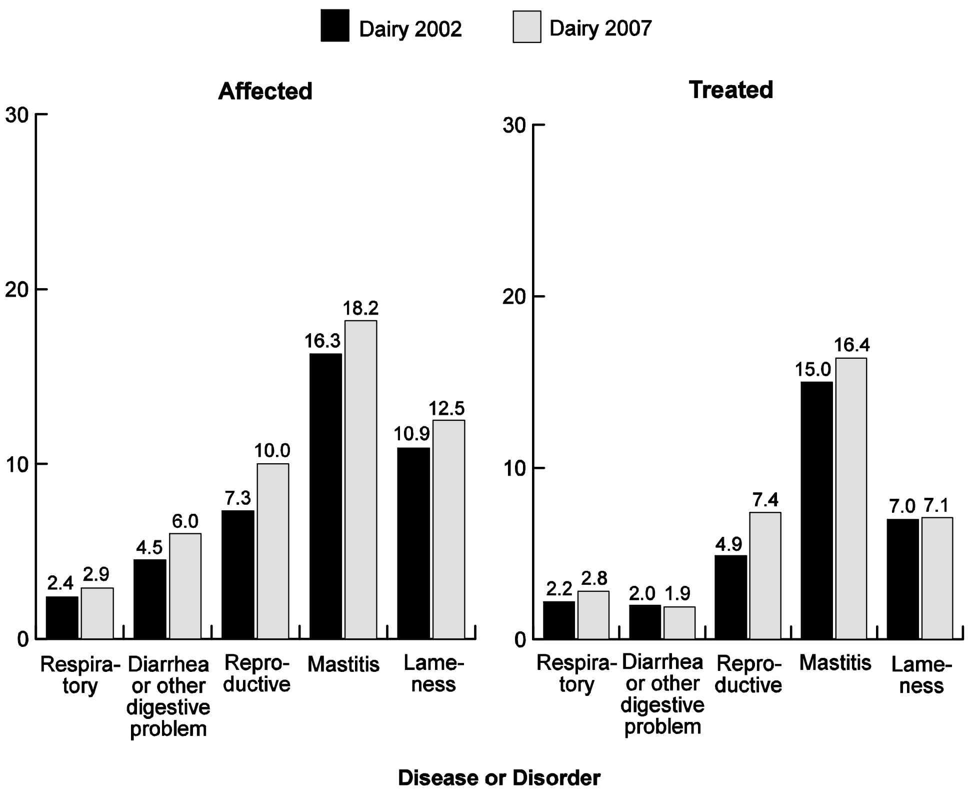
The percentage of cows with reproductive disease increased from 7.3 percent in 2002 to 10.0 percent in 2007, and the percentage treated for reproductive disease increased from 4.9 percent in 2002 to 7.4 percent in 2007.

a. Percentage of cows affected with the following diseases or disorders during the previous 12 months and percentage treated with antibiotics:

	Percent Cows*							
	Affected				Treated			
	Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Disease or Disorder	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Respiratory	2.4	(0.2)	2.9	(0.2)	2.2	(0.1)	2.8	(0.2)
Diarrhea or other digestive problem	4.5	(0.3)	6.0	(0.6)	2.0	(0.2)	1.9	(0.2)
Reproductive	7.3	(0.4)	10.0	(0.7)	4.9	(0.3)	7.4	(0.7)
Mastitis	16.3	(0.7)	18.2	(0.9)	15.0	(0.7)	16.4	(0.8)
Lameness	10.9	(0.7)	12.5	(0.9)	7.0	(0.6)	7.1	(0.7)
Other	0.6	(0.1)	0.7	(0.2)	0.2	(0.1)	0.5	(0.1)

*As a percentage of cow inventory on January 1.

Percentage of Cows Affected with the Following Diseases or Disorders During the Previous 12 Months and Percentage Treated with Antibiotics



The percentage of cows affected with a specific disease and treated with antibiotics did not change between 2002 and 2007.

b. Of cows affected with the following diseases or disorders during the previous 12 months, percentage treated with an antibiotic:

	Percent Affected Cows Treated			
	Dairy 2002		Dairy 2007	
Disease or Disorder	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Respiratory	92.6	(4.0)	96.4	(1.2)
Diarrhea or other digestive problem	44.7	(3.7)	32.3	(4.0)
Reproductive	66.9	(3.1)	74.7	(3.1)
Mastitis	91.9	(1.2)	89.9	(1.3)
Lameness	64.9	(3.3)	56.5	(4.1)
Other	41.4	(11.0)	66.2	(12.7)

In 2002, 52.5 percent of operations had cows with reproductive disease compared with 74.7 percent of operations in 2007. The percentage of operations that used cephalosporin as the primary antibiotic to treat reproductive disease in cows increased from 7.3 percent in 2002 to 17.2 percent in 2007. The percentage of operations that treated reproductive disease with antibiotics increased from 42.1 percent in 2002 to 52.9 percent in 2007. In addition, the percentage of operations that had cows with reproductive disease and did not treat them with an antibiotic increased from 2002 to 2007 (10.4 and 21.8 percent, respectively).

For mastitis treatment, the percentage of operations that used cephalosporin increased from 2002 to 2007 (33.3 and 44.5 percent, respectively), while the use of noncephalosporin beta-lactam and macrolide antibiotics to treat mastitis decreased from 2002 to 2007. The percentage of operations with lame cows increased from 60.2 percent in 2002 to 75.8 percent in 2007. The overall percentage of operations that used antibiotics for lameness remained the same between 2002 and 2007; however, the percentage of operations that had cows with lameness but did not treat them with antibiotics increased between 2002 and 2007 (8.6 and 17.2 percent, respectively).

c. Percentage of operations (including those not reporting diseases or disorders) by primary antibiotic used to treat cows during the previous 12 months, and by disease/disorder:

	Percent Operations											
	Disease/Disorder											
	Reproductive				Mastitis				Lameness			
	Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Primary Antibiotic Used	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Aminocyclitol*			0.6	(0.6)			1.1	(0.6)			0.0	(--)
Aminoglycoside	0.1	(0.1)	0.0	(--)	0.9	(0.4)	0.5	(0.4)	0.1	(0.1)	0.0	(--)
Noncephalosporin beta-lactam	15.9	(1.7)	13.5	(2.0)	29.0	(2.1)	16.9	(2.0)	14.7	(1.6)	13.6	(2.1)
Cephalosporin	7.3	(1.0)	17.2	(2.0)	33.3	(2.2)	44.5	(2.9)	18.3	(1.6)	23.0	(2.2)
Florfenicol	0.0	(--)	0.2	(0.2)	0.1	(0.1)	0.0	(--)	0.0	(--)	0.3	(0.2)
Lincosamide					11.9	(1.5)	15.8	(2.1)				
Macrolide	0.3	(0.3)	0.0	(--)	2.7	(0.8)	0.3	(0.2)	0.5	(0.3)	0.2	(0.1)
Sulfonamide	1.8	(0.8)	0.1	(0.1)	1.0	(0.4)	1.8	(0.9)	1.8	(0.5)	1.4	(0.4)
Tetracycline	16.7	(1.7)	17.7	(2.1)	4.4	(0.9)	2.5	(0.7)	13.9	(1.6)	18.6	(2.2)
Other	0.0	(0.0)	3.6	(1.3)	1.0	(0.5)	2.0	(1.0)	2.3	(0.7)	1.5	(0.6)
Any antibiotic	42.1	(2.3)	52.9	(2.8)	84.3	(1.7)	85.4	(2.2)	51.6	(2.3)	58.6	(2.9)
No treatment but disease	10.4	(1.4)	21.8	(2.5)	1.0	(0.5)	7.7	(1.5)	8.6	(1.5)	17.2	(2.4)
No disease	47.5	(2.3)	25.3	(2.5)	14.7	(1.7)	6.9	(1.7)	39.8	(2.3)	24.2	(2.6)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

*Included in “other” category in 2002.

In 2007, respiratory disease was reported on about 6 of 10 operations (59.3 percent). The highest percentage of operations (33.0 percent) that had cows with respiratory disease used cephalosporin as the primary antibiotic to treat the disease. The percentage of operations that had cows with diarrhea or other digestive problem increased from 43.1 percent in 2002 to 56.6 percent in 2007. A two-fold increase was observed between 2002 and 2007 in the percentage of operations that had cows with digestive disease but did not treat with antibiotics (15.2 and 31.6 of operations, respectively). No change occurred between 2002 and 2007 in the percentage of operations that treated cows with antibiotics for digestive disease. Less than 7.0 percent of operations treated “other” diseases with antibiotics in 2002 and 2007.

d. Percentage of operations (including those not reporting diseases or disorders) by primary antibiotic used to treat cows during the previous 12 months, and by disease/disorder:

	Percent Operations											
	Disease/Disorder											
	Respiratory				Diarrhea/Other Digestive Problem				Other			
	Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Primary Antibiotic Used	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Aminocyclitol*			1.0	(0.5)			0.0	(--)			0.0	(--)
Aminoglycoside	0.5	(0.4)	0.3	(0.3)	1.0	(0.5)	0.6	(0.3)	0.0	(--)	0.0	(--)
Noncephalosporin beta-lactam	9.0	(1.4)	10.5	(1.8)	11.4	(1.4)	8.8	(1.6)	3.1	(0.9)	3.0	(1.1)
Cephalosporin	27.6	(2.0)	33.0	(2.7)	10.1	(1.3)	11.3	(1.8)	0.9	(0.5)	1.8	(0.7)
Florfenicol	1.3	(0.4)	2.4	(0.9)	0.2	(0.1)	0.3	(0.2)	0.0	(0.0)	0.0	(--)
Macrolide	1.9	(0.8)	1.2	(0.6)	0.3	(0.3)	0.6	(0.4)	0.0	(--)	0.0	(--)
Sulfonamide	1.9	(0.7)	1.7	(0.8)	2.8	(0.6)	1.3	(0.4)	0.0	(0.0)	0.0	(--)
Tetracycline	6.2	(1.0)	4.7	(1.0)	2.1	(0.6)	1.1	(0.4)	0.8	(0.5)	0.6	(0.4)
Other	0.6	(0.3)	1.0	(0.5)	0.0	(0.0)	1.1	(0.6)	0.0	(--)	1.5	(0.8)
Any antibiotic	49.0	(2.3)	55.8	(2.9)	27.9	(2.0)	25.0	(2.4)	4.8	(1.1)	6.9	(1.5)
No treatment but disease	1.5	(0.5)	3.5	(1.2)	15.2	(1.7)	31.6	(2.7)	3.3	(0.9)	3.5	(1.2)
No disease	49.5	(2.3)	40.7	(2.9)	56.9	(2.2)	43.4	(2.9)	91.9	(1.4)	89.6	(1.8)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

*Included in “other” category in 2002.

In 2007, 7.4 percent of cows were treated for reproductive disease; 16.4 percent were treated for mastitis; and 7.1 percent were treated for lameness (see table 3a, p 54). Table e. on the following page presents the primary antibiotic used to treat these cows.

No changes occurred between 2002 and 2007 in the percentage of treated cows by primary antibiotic used for reproductive disease. Tetracycline, cephalosporin, and noncephalosporin beta-lactam remained the primary antibiotics used to treat cows with reproductive disease.

The percentage of cows treated for mastitis with noncephalosporin beta-lactam and macrolide antibiotics decreased from 2002 to 2007, while the use of cephalosporin increased.

The majority of cows were on operations that primarily used tetracycline, cephalosporin, or noncephalosporin beta-lactam antibiotics to treat lameness.

e. Of cows treated with antibiotics for the following diseases or disorders during the previous 12 months (see table 3a, p 54), percentage of cows by primary antibiotic used to treat disease or disorder:

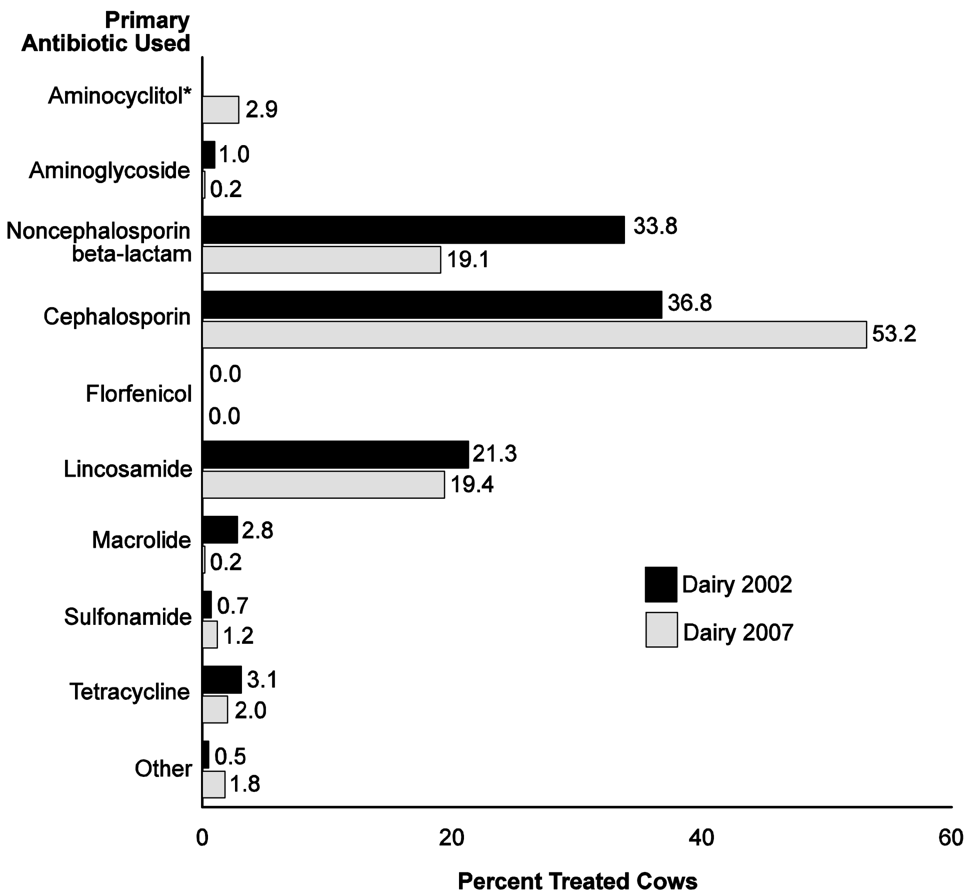
Percent Treated Cows

Disease/Disorder

	Reproductive				Mastitis				Lameness			
	Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Primary Antibiotic Used	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Aminocyclitol*			0.2	(0.2)			2.9	(2.0)			0.0	(--)
Aminoglycoside	0.1	(0.1)	0.0	(--)	1.0	(0.5)	0.2	(0.2)	0.1	(0.1)	0.0	(--)
Noncephalosporin beta-lactam	31.1	(3.4)	19.7	(3.8)	33.8	(2.9)	19.1	(3.0)	17.3	(3.3)	19.5	(5.4)
Cephalosporin	23.2	(3.0)	27.9	(4.7)	36.8	(3.1)	53.2	(4.1)	29.8	(4.4)	27.2	(3.8)
Florfenicol	0.0	(--)	0.2	(0.2)	0.0	(0.0)	0.0	(--)	0.0	(--)	0.5	(0.3)
Lincosamide					21.3	(3.2)	19.4	(3.1)				
Macrolide	0.1	(0.1)	0.0	(--)	2.8	(1.0)	0.2	(0.2)	0.2	(0.1)	0.5	(0.3)
Sulfonamide	4.2	(2.2)	0.2	(0.2)	0.7	(0.3)	1.2	(0.5)	4.4	(1.1)	4.2	(1.4)
Tetracycline	41.2	(4.1)	44.4	(6.0)	3.1	(0.8)	2.0	(0.7)	42.4	(5.1)	42.1	(5.4)
Other	0.1	(0.1)	7.4	(4.5)	0.5	(0.2)	1.8	(0.9)	5.8	(1.8)	6.0	(3.0)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

*Included in “other” category in 2002.

Of Cows Treated with Antibiotics for Mastitis During the Previous 12 months, Percentage of Cows by Primary Antibiotic Used to Treat Mastitis



*Included in "other" catergory in 2002.

In 2007, 2.8 percent of cows were treated for respiratory disease; 1.9 percent were treated for diarrhea or other digestive problem; and 0.5 percent were treated for “other” disease or disorder (see table 3a). Table f. on the following page presents the primary antibiotic used to treat these cows.

For respiratory disease and diarrhea or other digestive problem, the percentages of treated cows by primary antibiotic used did not change from 2002 to 2007. As opposed to the treatment of reproductive disease and lameness in the previous table, tetracycline was not used on a high percentage of cows treated for respiratory or digestive disease between 2002 and 2007. Cephalosporin was the primary antibiotic used to treat the majority of cows with respiratory disease in 2002 and 2007 (67.3 and 70.5 percent of treated cows, respectively). About 7 of 10 cows treated for digestive disease were on operations that used noncephalosporin beta-lactam or cephalosporin as primary antibiotics for diarrhea or other digestive problem.

f. Of cows treated with antibiotics for the following diseases or disorders during the previous 12 months, percentage of cows by primary antibiotic used on the operation to treat a disease or disorder:

	Percent Treated Cows											
	Disease/Disorder											
	Respiratory				Diarrhea/Other Digestive Problem				Other			
	Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Primary Antibiotic Used	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Aminocyclitol*			3.3	(1.6)			0.0	(--)			0.0	(--)
Aminoglycoside	0.4	(0.4)	0.6	(0.5)	3.2	(1.7)	6.4	(4.4)	0.0	(--)	0.0	(--)
Noncephalosporin beta-lactam	13.0	(1.9)	11.0	(2.5)	41.2	(4.3)	30.3	(5.7)	61.4	(15.1)	29.9	(11.6)
Cephalosporin	67.3	(3.1)	70.5	(3.9)	37.9	(4.3)	36.0	(5.9)	16.1	(8.0)	23.6	(11.5)
Florfenicol	2.1	(0.8)	1.9	(0.7)	0.4	(0.3)	0.4	(0.4)	0.1	(0.1)	0.0	(--)
Macrolide	1.3	(0.5)	1.1	(0.5)	0.7	(0.7)	1.1	(0.8)	0.0	(--)	0.0	(--)
Sulfonamide	3.1	(1.0)	2.8	(1.4)	11.9	(2.4)	15.6	(6.6)	7.1	(6.9)	0.0	(--)
Tetracycline	11.6	(2.0)	6.4	(1.6)	4.6	(1.7)	7.0	(2.9)	15.3	(9.8)	2.6	(1.9)
Other	1.2	(0.5)	2.4	(1.3)	0.1	(0.1)	3.2	(2.2)	0.0	(--)	43.9	(16.6)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

*Included in “other” category in 2002.

E. Surgical Procedures

1. Dehorning

Between 1996 and 2007, the percentage of operations that dehorned heifer calves while on the operation decreased on large operations and on all operations. In 2007, 94.0 percent of operations still dehorned calves. The percentage of large operations that dehorned calves decreased from 88.9 percent in 1996 to 64.3 percent in 2007, which might be due to the increase in operations that have calves raised off-site.

a. Percentage of operations that routinely dehorned heifer calves while on the operation, by herd size:

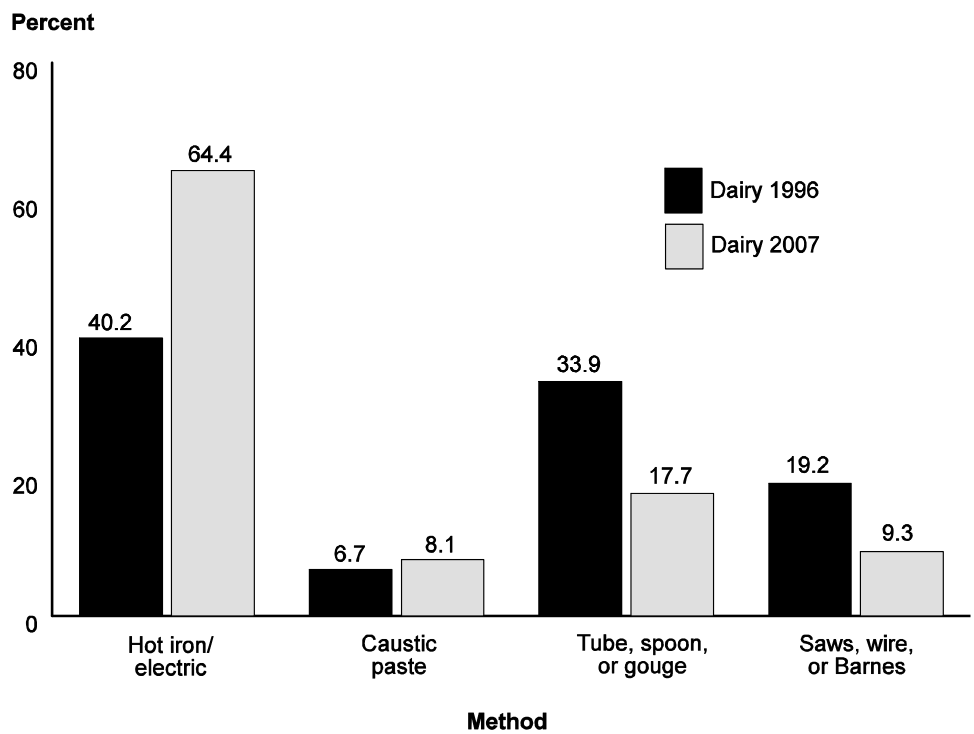
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Study	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Dairy 1996	98.6	(0.5)	98.9	(0.4)	88.9	(4.1)	98.4	(0.4)
Dairy 2007	97.3	(1.6)	92.6	(2.8)	64.3	(6.3)	94.0	(1.4)

The use of hot iron/electric dehorners increased from 40.2 percent of operations in 1996 to 64.4 percent in 2007. In contrast, the use of tube, spoon, or gouge, and saws, wire, or Barnes dehorners decreased by about one-half in the same period.

b. For operations that routinely dehorned heifer calves, percentage of operations by primary method used to dehorn heifer calves:

	Percent Operations			
	Dairy 1996		Dairy 2007	
Primary Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Hot iron/electric	40.2	(1.7)	64.4	(3.0)
Caustic paste	6.7	(1.0)	8.1	(1.8)
Tube, spoon, or gouge	33.9	(1.8)	17.7	(2.4)
Saws, wire, or Barnes	19.2	(1.5)	9.3	(1.6)
Other			0.5	(0.3)
Total	100.0		100.0	

For Operations that Routinely Dehorned Heifer Calves, Percentage of Operations by Primary Method used to Dehorn Heifer Calves



Approximately 4 of 10 operations that used a method to dehorn calves that caused bleeding disinfected the equipment between each animal.

c. For operations that routinely dehorned heifer calves with surgical dehorning equipment that causes bleeding, percentage of operations that chemically disinfected equipment between each animal:

Percent Operations			
Dairy 1996		Dairy 2007	
Percent	Std. Error	Percent	Std. Error
38.3	(2.6)	46.4	(4.9)

2. Tail docking

About one-half of operations tail-docked cows in each study period.

a. Percentage of operations by percentage of tail-docked cows:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Percent Cows	**Percent**	**Std. Error**	**Percent**	**Std. Error**
0	49.5	(2.1)	51.4	(2.9)
1.0 to 24.9	17.5	(1.6)	10.8	(1.9)
25.0 to 75.9	9.1	(1.3)	8.9	(1.6)
76.0 to 99.9	8.0	(1.1)	14.3	(2.2)
100.0	15.9	(1.5)	14.6	(2.0)
Total	100.0		100.0	

Overall, 38.8 percent of cows had their tail docked in 2007 compared with 32.9 percent in 2002. A higher percentage of cows had their tail docked on medium operations than on small or large operations in 2002 and 2007.

b. Percentage of cows with docked tail, by herd size:

	Percent Cows*							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Study	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Dairy 2002	27.3	(2.3)	44.3	(2.6)	27.0	(2.7)	32.9	(1.5)
Dairy 2007	27.1	(3.2)	55.5	(3.6)	34.5	(4.3)	38.8	(2.4)

F. Hoof Health

1. Lameness

The percentage of operations with cases of lameness in bred heifers increased from 36.5 percent in 2002 to 58.7 percent in 2007. The highest percentage of operations that had lameness in bred heifers reported that between 1.0 and 24.9 percent of bred heifers were affected.

From 1996 to 2007, almost all operations had at least 1.0 percent of cows affected by lameness during the previous 12 months. The percentage of operations that had 1.0 to 24.9 percent of cows affected by lameness decreased from 75.4 percent in 1996 to 63.9 percent in 2007. However, the percentage of operations that had 50.0 percent or more cows affected with lameness increased from 5.0 percent in 1996 to 12.0 percent in 2007.

a. Percentage of operations by percentage of lameness cases in bred heifers and cows during the previous 12 months:

	Percent Operations											
	Cattle Class											
	Bred Heifers						Cows					
	Dairy 1996[1 2]		Dairy 2002[3]		Dairy 2007[4]		Dairy 1996[1 5]		Dairy 2002[6]		Dairy 2007[7]	
Percent Lameness Cases	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
0	63.5	(1.7)	61.1	(2.1)	41.3	(3.1)	4.9	(0.8)	4.7	(1.0)	3.6	(1.1)
1.0 to 24.9	29.8	(1.6)	32.0	(1.9)	49.6	(3.0)	75.4	(1.6)	68.5	(2.0)	63.9	(2.7)
25.0 to 49.9	5.0	(0.8)	4.8	(0.9)	6.3	(1.7)	14.7	(1.3)	16.6	(1.5)	20.5	(2.3)
50.0 or more	1.7	(0.6)	2.1	(0.6)	2.8	(1.0)	5.0	(0.8)	10.2	(1.3)	12.0	(1.8)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

Question variation:
[1]1996 question variation: asked number of animals that showed clinical signs of lameness.
[2]Cows in first lactation were used as a proxy for total bred heifers during the previous 12 months.
[3]As a percentage of home-raised replacements entering milking string in 2001.
[4]As a percentage of dairy-cow replacements entering milking string in 2006.
[5]As a percentage of milk cows on the operation January 1, 1996.
[6]As a percentage of milk cows on the operation at time of interview (February through April, 2002).
[7]As a percentage of milk cows on the operation at time of interview (February through August, 2007).

Digital dermatitis remained the primary cause of lameness in bred heifers, accounting for more than 50 percent of all lameness cases. In cows, digital dermatitis as a percentage of all lameness cases decreased from 63.4 percent in 1996 to 49.1 percent in 2007.

b. Percentage of lameness cases in bred heifers and cows due to digital dermatitis (hairy-heel warts), by cattle class:

Percent Lameness Cases											
Cattle Class											
Bred Heifers						Cows					
Dairy 1996		Dairy 2002		Dairy 2007		Dairy 1996		Dairy 2002		Dairy 2007	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
54.9	(3.3)	61.8	(2.8)	61.8	(5.5)	63.4	(2.5)	53.9	(2.0)	49.1	(2.8)

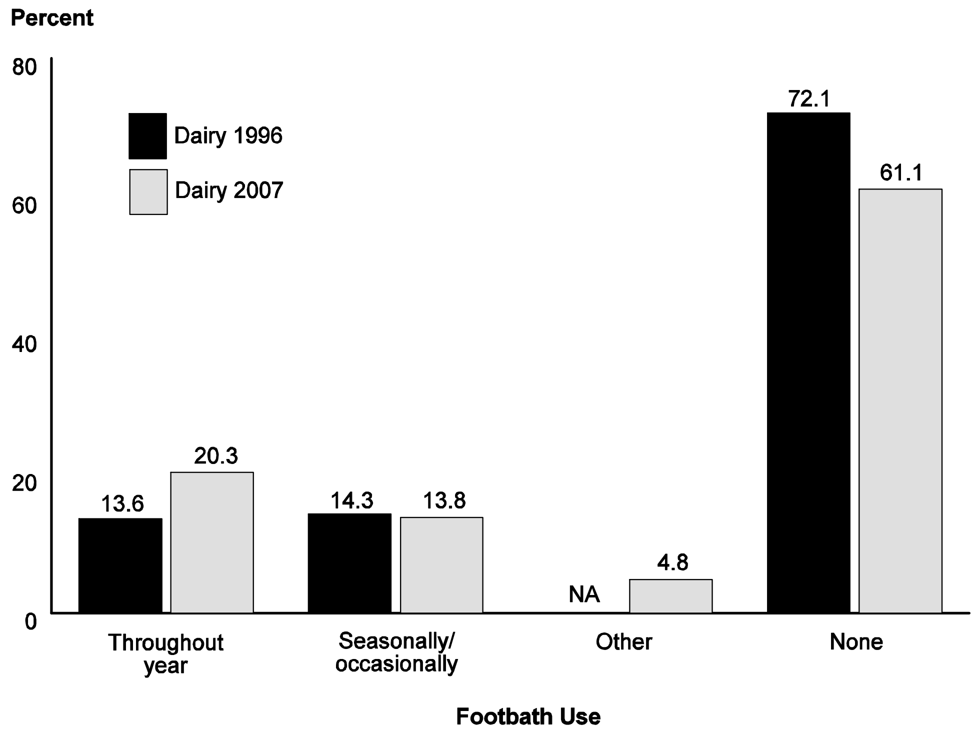
2. Footbath

Between 1996 and 2007, the percentage of operations that used footbaths for cows throughout the year increased from 13.6 percent in 1996 to 20.3 percent in 2007. Footbath use throughout the year increased as herd size increased.

Percentage of operations by use of a footbath for cows during the previous 12 months, and by herd size:

	Percent Operations							
	Herd Size (Number Dairy Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
	Dairy 1996	Dairy 2007	Dairy 1996	Dairy 2007	Dairy 1996	Dairy 2007	Dairy 1996	Dairy 2007
Footbath Use	Pct. (SE)	Pct. (SE)	Pct. (SE)	Pct. (SE)	Pct. (SE)	Pct. (SE)	Pct. (SE)	Pct. (SE)
Throughout year	6.4 (1.0)	5.2 (1.5)	34.9 (2.7)	46.3 (4.2)	66.3 (6.2)	80.8 (5.1)	13.6 (1.0)	20.3 (1.7)
Seasonally/ occasionally	12.2 (1.4)	12.9 (2.5)	22.8 (2.4)	18.6 (3.7)	9.2 (3.7)	5.5 (2.4)	14.3 (1.2)	13.8 (1.9)
Other		4.9 (2.1)		4.8 (2.1)		2.6 (2.2)		4.8 (1.5)
None	81.4 (1.7)	77.0 (3.3)	42.3 (2.7)	30.3 (3.9)	24.5 (5.5)	11.1 (4.2)	72.1 (1.5)	61.1 (2.6)
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Percentage of Operations by Use of a Footbath for Cows During the Previous 12 Months



3. Hoof trimming

Hoof trimming increased from 75.9 percent of operations in 1996 to 84.8 percent in 2007. A substantial increase occurred between 1996 and 2007 in the percentage of operations that trimmed 90 to 100 percent of cows during the previous 12 months (13.0 and 46.4 percent, respectively).

a. Percentage of operations by percentage of cows that had their hooves trimmed at least once during the previous 12 months:

	Percent Operations			
	Dairy 1996		Dairy 2007	
Percent Cows	Percent	Std. Error	Percent	Std. Error
0	24.1	(1.6)	15.2	(2.4)
1 to 9	24.0	(1.6)	5.4	(1.5)
10 to 39	20.0	(1.5)	13.1	(2.1)
40 to 59	8.8	(1.0)	9.0	(1.6)
60 to 89	10.1	(0.9)	10.9	(1.9)
90 to 100	13.0	(1.0)	46.4	(3.0)
Total	100.0		100.0	

Professional hoof trimmers trimmed the majority of hooves on 50.8 percent of operations in 1996 and on 76.7 percent of operations in 2007. The percentages of operations in which a veterinarian or owner or operation personnel trimmed the majority of hooves decreased from 1996 to 2007. Between 1996 and 2007, the percentage of cows that had hooves trimmed by a professional hoof trimmer increased from 68.0 percent in 1996 to 80.1 percent in 2007.

b. For operations that had cows' hooves trimmed during the previous 12 months, percentage of operations (and percentage of cows on these operations) by the person who trimmed the ***majority*** of hooves:

	Percent Operations				**Percent Cows**			
	Dairy 1996		**Dairy 2007**		**Dairy 1996**		**Dairy 2007**	
Hoof Trimmer	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Professional hoof trimmer (not the operation's personnel)	50.8	(2.0)	76.7	(2.8)	68.0	(1.8)	80.1	(3.2)
Veterinarian (not the operation's personnel)	20.2	(1.8)	5.5	(1.8)	11.5	(1.0)	1.4	(0.4)
Owner or the operation's personnel	28.9	(1.9)	17.2	(2.4)	20.2	(1.7)	17.6	(3.1)
Other	0.1	(0.1)	0.6	(0.4)	0.3	(0.2)	0.9	(0.5)
Total	100.0		100.0		100.0		100.0	

The operation average number of visits made by a professional hoof trimmer or either a professional hoof trimmer or veterinarian during the previous 12 months increased in each herd size from 1996 to 2007. On medium operations, the average number of visits by a veterinarian to trim hooves decreased during the same period. For all operations, the operation average number of visits for professional hoof trimmers increased from 2.6 in 1996 to 7.1 in 2007.

c. For operations in which a professional hoof trimmer or veterinarian visited to trim hooves or to evaluate lame cows (as part of a routine trimming program), operation average number of visits made by professional hoof trimmer, veterinarian, or either during the previous 12 months, by herd size:

	Operation Average Number Visits							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
	Dairy 1996	**Dairy 2007**	**Dairy 1996**	**Dairy 2007**	**Dairy 1996**	**Dairy 2007**	**Dairy 1996**	**Dairy 2007**
Professional	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**	**Pct. (SE)**
Hoof trimmer	1.1 (0.1)	2.0 (0.2)	4.4 (0.3)	9.0 (0.5)	17.8 (1.7)	44.5 (4.0)	2.6 (0.1)	7.1 (0.5)
Veterinarian	2.3 (0.3)	1.3 (0.3)	2.0 (0.3)	0.7 (0.2)	0.4 (0.3)	0.2 (0.2)	2.2 (0.2)	1.1 (0.2)
Either	3.4 (0.3)	3.3 (0.3)	6.4 (0.4)	9.7 (0.6)	18.2 (1.7)	44.7 (4.0)	4.8 (0.2)	8.2 (0.5)

G. Hemorrhagic Bowel Syndrome (HBS)

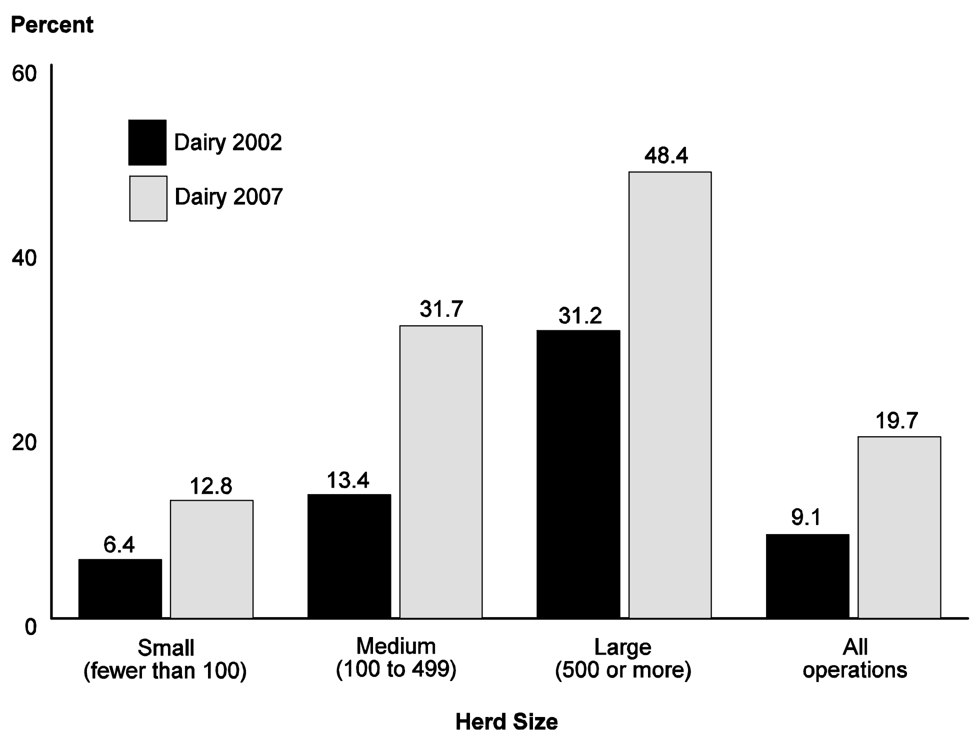
1. Clinical signs

Clinical signs consistent with HBS were observed in at least one cow on a lower percentage of medium operations in 2002 than in 2007 (13.4 and 31.7 percent, respectively). The percentage of operations in which at least one cow showed clinical signs consistent with HBS increased from 9.1 percent in 2002 to 19.7 percent in 2007.

Percentage of operations in which at least one cow showed clinical signs consistent with HBS during the previous 5 years, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Study	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Dairy 2002	6.4	(1.3)	13.4	(1.9)	31.2	(3.8)	9.1	(1.1)
Dairy 2007	12.8	(2.6)	31.7	(4.1)	48.4	(6.2)	19.7	(2.1)

Percentage of Operations in which at Least One Cow Showed Clinical Signs Consistent with HBS During the Previous 5 Years, by Herd Size



H. Nutrient Management

1. Manure-handling methods

The percentage of operations that left manure on pasture as a manure-handling method increased for weaned-heifer and cow housing areas between 2002 and 2007. Similarly, the use of scrapers on drylots as a manure-handling method increased for both housing areas from 2002 to 2007. When comparing manure handling methods in weaned heifer and cow housing areas, a higher percentage of operations used gutter cleaners in cow housing areas, while bedded packs were used by a higher percentage of operations in weaned-heifer housing.

a. Percentage of operations by manure handling methods used in weaned-heifer and cow housing areas:

<table>
<tr><th colspan="11">Percent Operations</th></tr>
<tr><th colspan="11">Housing Area</th></tr>
<tr><th></th><th colspan="4">Weaned-heifer*</th><th colspan="6">Cow</th></tr>
<tr><th></th><th colspan="2">Dairy 2002</th><th colspan="2">Dairy 2007</th><th colspan="2">Dairy 1996</th><th colspan="2">Dairy 2002</th><th colspan="2">Dairy 2007</th></tr>
<tr><th>Manure-handling Method</th><th>Pct.</th><th>Std. Error</th><th>Pct.</th><th>Std. Error</th><th>Pct.</th><th>Std. Error</th><th>Pct.</th><th>Std. Error</th><th>Pct.</th><th>Std. Error</th></tr>
<tr><td>Manure left on pasture</td><td>73.8</td><td>(1.8)</td><td>88.5</td><td>(1.9)</td><td></td><td></td><td>72.4</td><td>(1.8)</td><td>85.3</td><td>(2.3)</td></tr>
<tr><td>Drylot scraped</td><td>50.3</td><td>(2.2)</td><td>75.3</td><td>(3.1)</td><td></td><td></td><td>57.0</td><td>(2.1)</td><td>82.5</td><td>(2.5)</td></tr>
<tr><td>Gutter cleaner</td><td>18.1</td><td>(1.8)</td><td>23.6</td><td>(2.8)</td><td>63.2</td><td>(1.3)</td><td>52.6</td><td>(1.9)</td><td>58.0</td><td>(2.5)</td></tr>
<tr><td>Alley scraper (mechanical or tractor)</td><td>42.7</td><td>(2.1)</td><td>47.3</td><td>(3.1)</td><td>57.7</td><td>(1.7)</td><td>51.4</td><td>(2.0)</td><td>54.9</td><td>(2.9)</td></tr>
<tr><td>Alley flush with fresh water</td><td>0.9</td><td>(0.3)</td><td>1.0</td><td>(0.4)</td><td rowspan="2">2.8</td><td rowspan="2">(0.3)</td><td>2.5</td><td>(0.5)</td><td>1.5</td><td>(0.4)</td></tr>
<tr><td>Alley flush with recycled water</td><td>2.3</td><td>(0.5)</td><td>3.5</td><td>(0.7)</td><td>4.4</td><td>(0.6)</td><td>5.0</td><td>(0.8)</td></tr>
<tr><td>Slotted floor</td><td>2.9</td><td>(0.7)</td><td>4.9</td><td>(1.2)</td><td></td><td></td><td>3.9</td><td>(0.6)</td><td>6.2</td><td>(1.2)</td></tr>
<tr><td>Bedded pack (manure pack)</td><td>62.1</td><td>(2.1)</td><td>60.6</td><td>(3.0)</td><td></td><td></td><td>31.6</td><td>(2.0)</td><td>40.0</td><td>(2.9)</td></tr>
<tr><td>Manure vacuum</td><td></td><td></td><td>0.6</td><td>(0.2)</td><td></td><td></td><td></td><td></td><td>1.5</td><td>(0.8)</td></tr>
<tr><td>Other method</td><td>4.8</td><td>(1.0)</td><td>6.5</td><td>(1.7)</td><td>1.1</td><td>(0.4)</td><td>3.9</td><td>(0.8)</td><td>5.3</td><td>(1.5)</td></tr>
</table>

*For operations that housed weaned heifers.

There were no changes between 2002 and 2007 in methods used to handle the majority of manure in weaned-heifer housing or cow housing areas. In weaned-heifer housing, more than 9 percent of operations left manure on pasture, scraped the drylot, used a gutter cleaner, alley scraper, or bedded pack to handle the majority of manure. In cow-housing areas, gutter cleaners or alley scrapers were used by more than 30 percent of operations as the method or handling the majority of manure.

b. Percentage of operations by method used to handle the ***majority*** of manure in weaned-heifer and cow housing areas:

	Percent Operations							
	Housing Area							
	Weaned-heifer*				Cow			
	Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Manure-handling Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Manure left on pasture	18.1	(1.7)	15.4	(2.1)	8.6	(1.2)	5.7	(1.3)
Drylot scraped	14.0	(1.5)	17.5	(2.3)	7.5	(1.0)	10.1	(1.5)
Gutter cleaner	9.1	(1.4)	14.6	(2.5)	43.4	(2.0)	42.8	(3.0)
Alley scraper (mechanical or tractor)	26.7	(1.9)	23.5	(2.5)	34.2	(1.9)	30.1	(2.4)
Alley flush with fresh water	0.3	(0.2)	0.0	(--)	0.6	(0.3)	0.2	(0.1)
Alley flush with recycled water	0.9	(0.2)	0.9	(0.3)	2.1	(0.3)	2.5	(0.5)
Slotted floor	1.3	(0.5)	1.5	(0.6)	1.1	(0.4)	1.4	(0.6)
Bedded pack (manure pack)	27.1	(2.0)	22.6	(2.6)	1.1	(0.5)	3.2	(1.2)
Manure vacuum			0.0	(0.0)			1.9	(1.1)
Other	2.5	(0.7)	4.0	(1.4)	1.4	(0.6)	2.1	(0.8)
Total	100.0		100.0		100.0		100.0	

*For operations that housed weaned heifers.

2. Waste-storage and treatment systems

The only change in the use of waste-storage or treatment systems between 2002 and 2007 was the increase in the percentage of operations that used compost (4.3 and 11.1 percent, respectively). However, from 1996 to 2002 increases were seen in the percentages of operations that stored slurry in a tank, stored untreated slurry or liquid manure in an earthen basin, or used a manure pack.

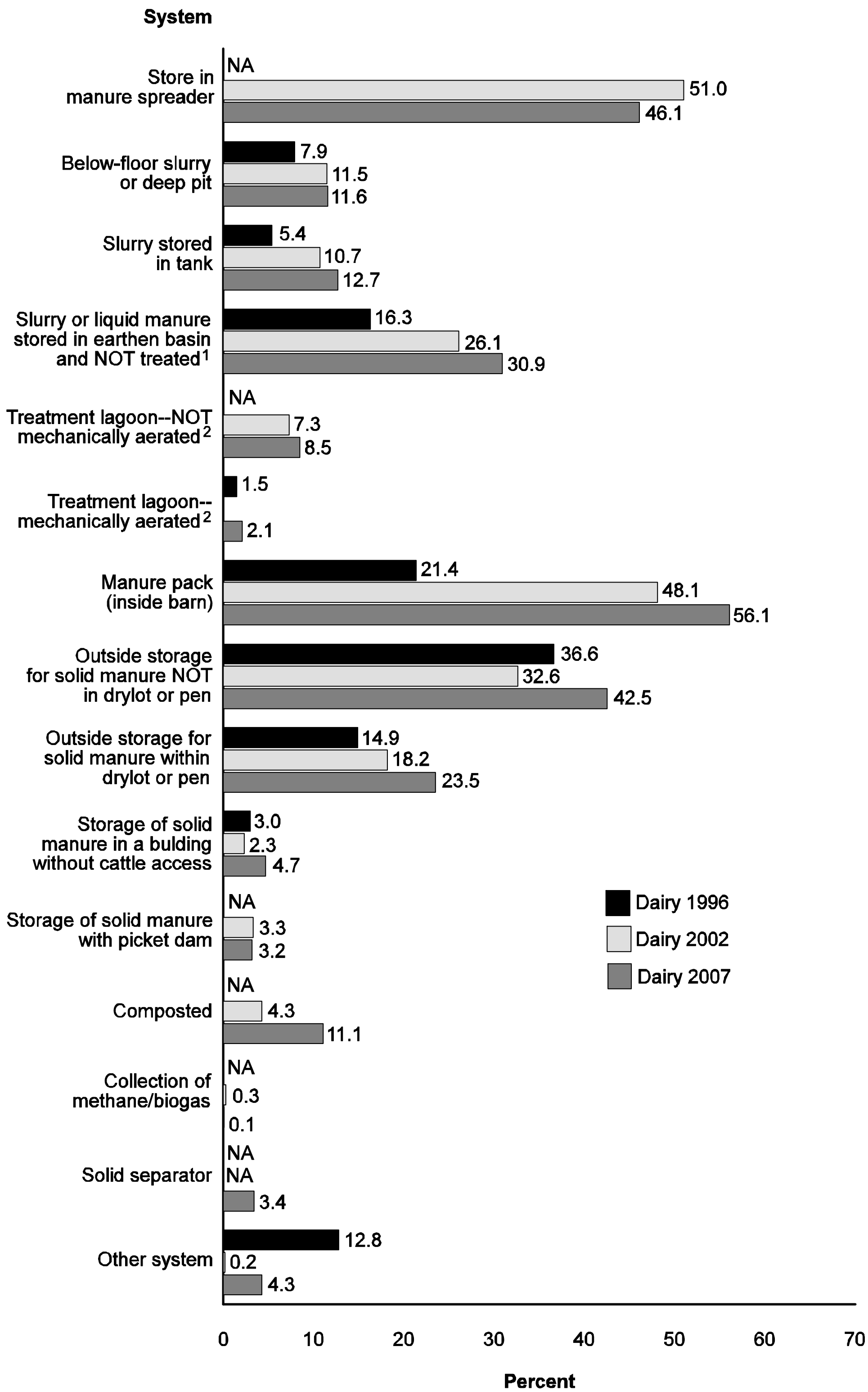
a. Percentage of operations by waste-storage and/or treatment system used:

<table>
<tr><th></th><th colspan="6">Percent Operations</th></tr>
<tr><th></th><th colspan="2">Dairy 1996</th><th colspan="2">Dairy 2002</th><th colspan="2">Dairy 2007</th></tr>
<tr><th>Treatment System</th><th>Pct.</th><th>Std. Error</th><th>Pct.</th><th>Std. Error</th><th>Pct.</th><th>Std. Error</th></tr>
<tr><td>Store in manure spreader</td><td></td><td></td><td>51.0</td><td>(2.0)</td><td>46.1</td><td>(2.9)</td></tr>
<tr><td>Below-floor slurry or deep pit</td><td>7.9</td><td>(0.8)</td><td>11.5</td><td>(1.2)</td><td>11.6</td><td>(1.6)</td></tr>
<tr><td>Slurry stored in tank</td><td>5.4</td><td>(0.7)</td><td>10.7</td><td>(1.2)</td><td>12.7</td><td>(1.8)</td></tr>
<tr><td>Slurry or liquid manure stored in earthen basin and NOT treated[1]</td><td>16.3</td><td>(1.2)</td><td>26.1</td><td>(1.8)</td><td>30.9</td><td>(2.6)</td></tr>
<tr><td>Treatment lagoon–NOT mechanically aerated[2]</td><td></td><td></td><td rowspan="2">7.3</td><td rowspan="2">(0.8)</td><td>8.5</td><td>(1.1)</td></tr>
<tr><td>Treatment lagoon–mechanically aerated[2]</td><td>1.5</td><td>(0.3)</td><td>2.1</td><td>(0.5)</td></tr>
<tr><td>Manure pack (inside barn)</td><td>21.4</td><td>(1.5)</td><td>48.1</td><td>(2.1)</td><td>56.1</td><td>(2.9)</td></tr>
<tr><td>Outside storage for solid manure NOT in drylot or pen</td><td>36.6</td><td>(1.8)</td><td>32.6</td><td>(2.0)</td><td>42.5</td><td>(3.0)</td></tr>
<tr><td>Outside storage for solid manure within drylot or pen</td><td>14.9</td><td>(1.4)</td><td>18.2</td><td>(1.6)</td><td>23.5</td><td>(2.5)</td></tr>
<tr><td>Storage of solid manure in a building without cattle access</td><td>3.0</td><td>(0.6)</td><td>2.3</td><td>(0.6)</td><td>4.7</td><td>(1.0)</td></tr>
<tr><td>Storage of solid manure with picket dam</td><td></td><td></td><td>3.3</td><td>(0.7)</td><td>3.2</td><td>(0.9)</td></tr>
<tr><td>Composted</td><td></td><td></td><td>4.3</td><td>(0.9)</td><td>11.1</td><td>(2.0)</td></tr>
<tr><td>Collection of methane/biogas</td><td></td><td></td><td>0.3</td><td>(0.2)</td><td>0.1</td><td>(0.0)</td></tr>
<tr><td>Solid separator</td><td></td><td></td><td></td><td></td><td>3.4</td><td>(0.5)</td></tr>
<tr><td>Other system</td><td>12.8</td><td>(0.9)</td><td>0.2</td><td>(0.1)</td><td>4.3</td><td>(1.2)</td></tr>
</table>

[1]Question variation: In 1996 only asked about slurry storage in earthen basin.

[2]These two categories were combined in Dairy 2002.

Percentage of Operations by Waste-storage and/or Treatment System Used



[1]Question variation: In 1996 only asked about slurry storage in earthen basin.

[2]These two categories were combined in Dairy 2002.

3. Maximum manure storage capacity

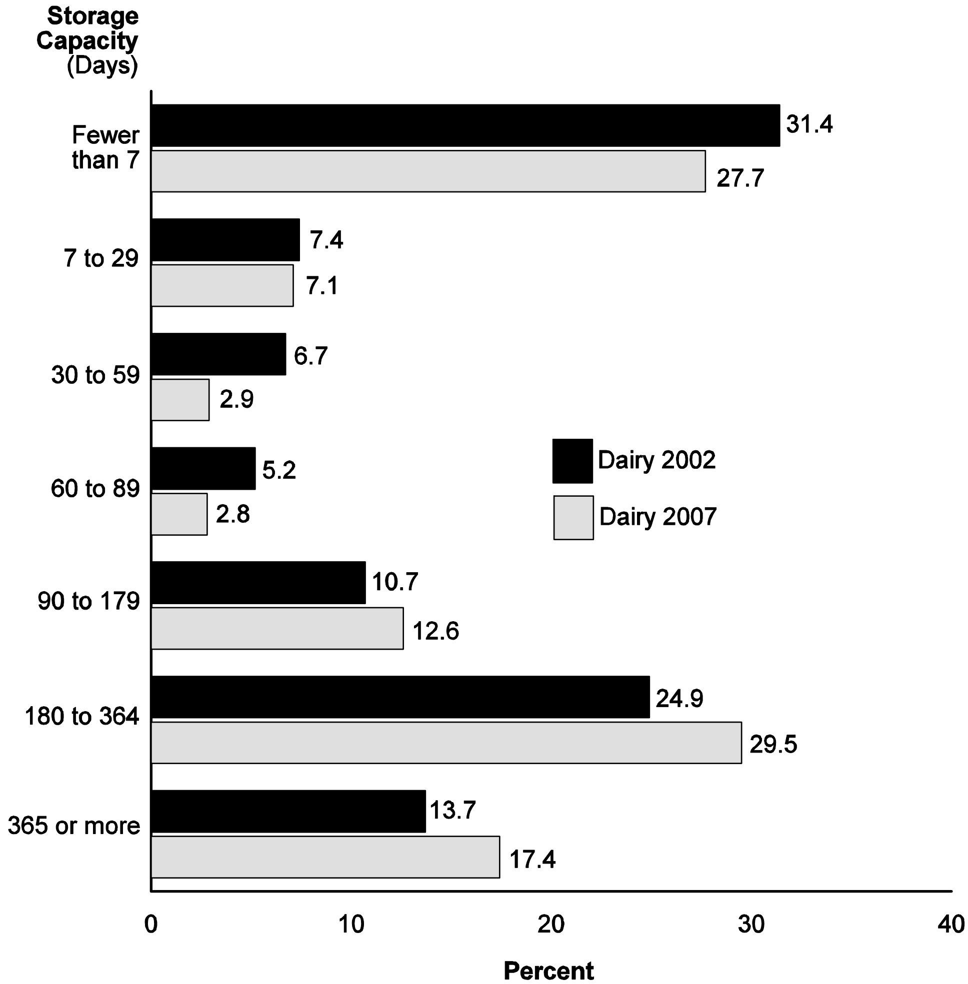
Producers were asked the following: "Assuming your facility was completely emptied of manure, and it was operating at full animal capacity, how many days could you operate and store manure before manure had to be removed from the storage facility?"

Overall, the days of storage capacity remained unchanged between 2002 to 2007.

Percentage of operations by maximum manure storage capacity:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Storage Capacity (Days)	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Fewer than 7	31.4	(2.1)	27.7	(2.7)
7 to 29	7.4	(1.1)	7.1	(1.7)
30 to 59	6.7	(1.2)	2.9	(0.7)
60 to 89	5.2	(1.0)	2.8	(0.9)
90 to 179	10.7	(1.2)	12.6	(1.7)
180 to 364	24.9	(1.7)	29.5	(2.6)
365 or more	13.7	(1.4)	17.4	(2.2)
Total	100.0		100.0	

Percentage of Operations by Maximum Manure Storage Capacity



4. Manure use

Almost all operations applied manure to owned or rented land in all three study years. Between 1996 and 2007, the percentages of operations that sold manure or received other compensation or gave manure away increased.

Percentage of operations by method of manure use:

	Percent Operations					
	Dairy 1996		Dairy 2002		Dairy 2007	
Method	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Applied manure to land either owned or rented	98.9	(0.3)	98.3	(0.4)	99.1	(0.4)
Sold manure or received other compensation	2.3	(0.3)	4.8	(0.7)	7.1	(1.3)
Gave manure away	6.8	(0.8)	16.2	(1.5)	16.8	(2.0)
Used composted manure as bedding	4.7*	(0.7)	1.8	(0.3)	5.1	(1.4)
Other			0.1	(0.1)	0.9	(0.4)

*Question variation: In 1996 inquired about composting manure, not using it as bedding.

5. Manure application

Between 1996 and 2007, approximately 9 of 10 operations used a broadcast/ solid spreader to apply manure to land. The percentage of operations that used surface application of liquid manure increased each study year. The percentage of operations that used subsurface application of liquid manure increased from 4.3 percent in 1996 to 8.8 percent in 2007.

a. For operations that applied manure to land, percentage of operations by manure application method used:

	Percent Operations					
	Dairy 1996		Dairy 2002		Dairy 2007	
Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Broadcast/ solid spreader	88.7	(1.1)	90.0	(1.2)	91.5	(1.7)
Surface application	22.7	(1.4)	30.1	(1.8)	40.7	(2.8)
Subsurface application	4.3	(0.7)	6.1	(0.8)	8.8	(1.5)
Irrigation/ sprinkler	7.0	(0.6)	7.6	(0.7)	7.3	(0.8)
Other	0.1	(0.1)	0.3	(0.2)	1.3	(0.7)

The percentage of operations that never incorporated manure into the soil within 24 hours of application decreased from 82.1 percent in 1996 to 36.0 percent in 2007. The percentage of operations that always or almost always incorporated manure in the soil within 24 hours after application increased from 13.9 percent of operations in 2002 to 22.0 percent in 2007.

b. For operations that applied manure to land, percentage of operations by frequency that manure was incorporated into soil within 24 hours after application, including subsurface injection:

	Percent Operations					
	Dairy 1996*		Dairy 2002		Dairy 2007	
Frequency	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Always or almost always	17.9	(1.3)	13.9	(1.4)	22.0	(2.2)
Sometimes			42.6	(2.2)	42.0	(3.0)
Never	82.1	(1.3)	43.5	(2.2)	36.0	(2.9)
Total	100.0		100.0		100.0	

*1996 question variation: yes/no question.

The percentage of operations that analyzed the nutrient content of manure increased from 14.0 percent in 1996 to about 26 percent in 2007.

c. For operations that applied manure to land, percentage of operations that analyzed manure during the previous 12 months, by nutrient:

	Percent Operations					
	Dairy 1996*		Dairy 2002		Dairy 2007	
Nutrient	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Nitrogen	14.0	(1.2)	20.9	(1.6)	26.9	(2.4)
Phosphorus			20.4	(1.6)	26.4	(2.3)
Potassium			20.3	(1.6)	26.4	(2.3)

*1996 question variation: asked if analyzed content of manure such as nitrogen.

Crop nitrogen and phosphorus requirements used as criteria to determine frequency of applying manure to land increased from 44.8 and 38.5 percent, respectively, in 2002 to 56.3 and 49.2 percent, respectively, in 2007.

d. For operations that applied manure to land, percentage of operations by criteria used to determine how much or how frequently manure is applied to the land:

	Percent Operations					
	Dairy 1996*		Dairy 2002		Dairy 2007	
Criteria	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Crop nitrogen requirement	43.2	(1.8)	44.8	(2.1)	56.3	(3.0)
Crop phosphorus requirement			38.5	(2.1)	49.2	(3.1)
Manure volume/acreage available			68.3	(2.1)	70.3	(2.8)
Soil quality improvement					70.7	(2.8)
Other criteria			6.5	(1.0)	6.2	(1.5)

*1996 question variation: asked if manure application rate was established based on manure nutrients and/or crop needs.

There were no differences from 2002 to 2007 in the percentage of operations by distance between where manure was applied and surface water. Almost one of four operations applied manure 100 feet or less from surface water. About one of three operations applied manure 1,000 feet or more away from surface water.

e. For operations that applied manure to land, percentage of operations by minimum distance (in feet) between location of manure application and surface water, such as a lake, pond, stream, or river:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Minimum Distance (Feet)	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 100	24.3	(1.8)	24.4	(2.5)
100 to 199	14.9	(1.6)	16.7	(2.2)
200 to 499	16.3	(1.6)	20.3	(2.5)
500 to 999	7.2	(1.1)	7.8	(1.7)
1,000 or more	37.3	(2.1)	30.8	(2.9)
Total	100.0		100.0	

There were no changes between 2002 and 2007 in the percentage of operations that applied manure to crops. More than one-half of operations applied manure to actively growing pasture or hay. Almost one of three operations applied manure to forage to be ensiled during 2002 and 2007.

f. Percentage of operations that applied manure to actively growing plants, by crop type:

	Percent Operations			
	Dairy 2002		**Dairy 2007**	
Crop Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Pasture or hay	55.6	(2.2)	52.2	(2.9)
Forage to be ensiled	30.6	(2.0)	28.0	(2.5)
Other forage	9.0	(1.1)	13.4	(1.9)
Grain or oilseed	9.2	(1.2)	10.7	(1.7)
Other	0.4	(0.2)	3.9	(1.4)
Any	63.9	(2.1)	64.4	(2.9)

6. Written nutrient management plan

A higher percentage of operations in 2007 than in 2002 had a written nutrient management plan (43.6 and 30.6 percent, respectively).

a. Percentage of operations that had a written nutrient management plan addressing topics such as land treatment practices or manure storage structures, by herd size:

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Study	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Dairy 2002	23.3	(2.3)	48.4	(3.0)	55.8	(4.1)	30.6	(1.8)
Dairy 2007	35.1	(3.8)	62.1	(4.4)	62.7	(5.9)	43.6	(2.9)

For operations that had a written nutrient management plan, the percentage of operations that participated in a USDA voluntary cost share program increased from 45.9 percent in 2002 to 64.5 percent in 2007.

b. For operations that had a written nutrient management plan, percentage of operations that developed or implemented the plan in cooperation with Federal, State, or local agencies or requirements:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Plan was…	Percent	Std. Error	Percent	Std. Error
Developed in cooperation with the USDA Natural Resource Conservation Service or a local conservation district	81.0	(2.6)	89.2	(2.2)
Implemented to help satisfy a State or local regulatory requirement	54.9	(3.8)	62.9	(4.2)
Part of USDA voluntary cost share program	45.9	(3.5)	64.5	(3.6)

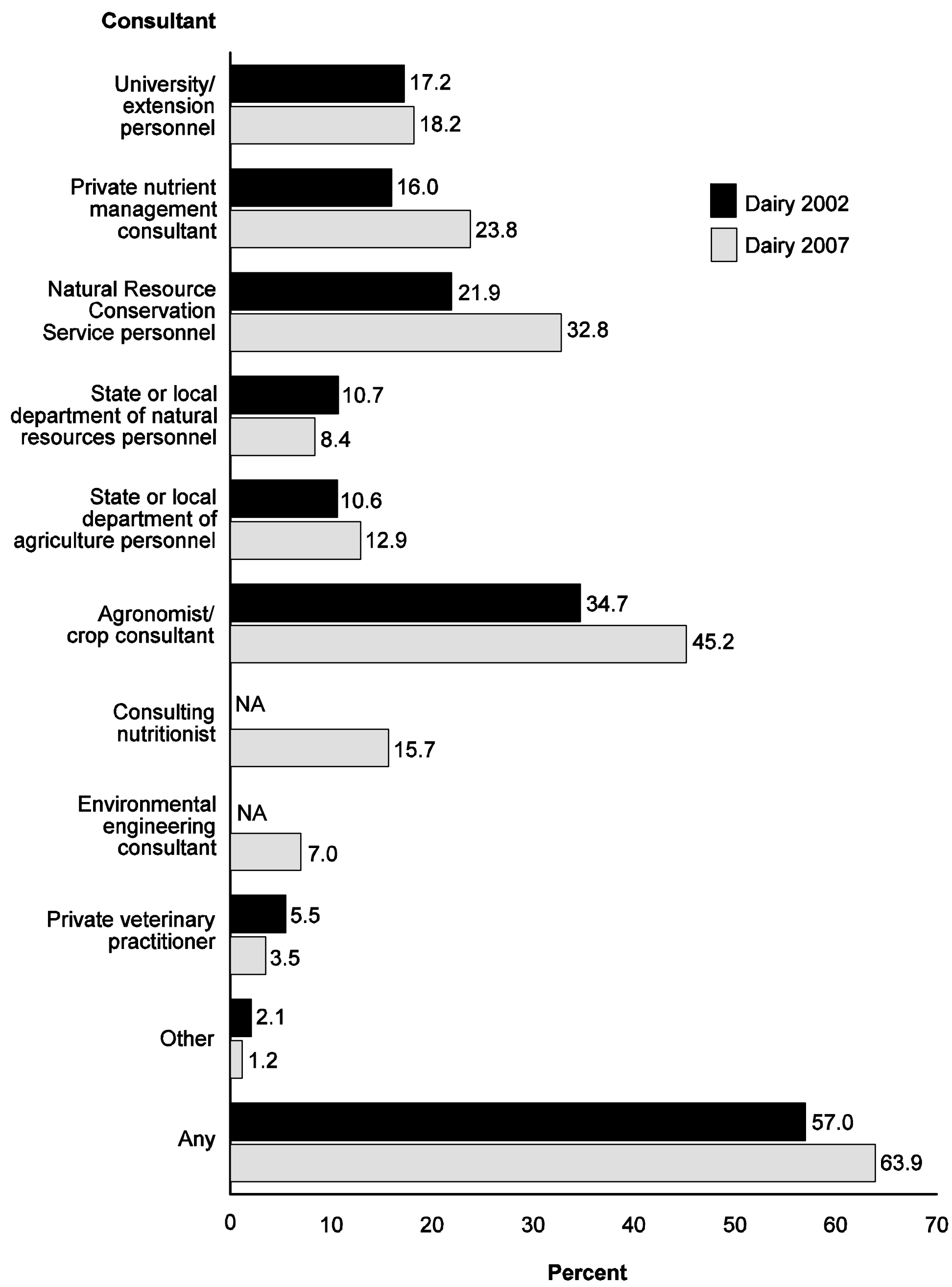
7. Waste-management consultant

The percentage of operations that used a private nutrient management consultant, Natural Resource Conservation Service personnel, or agronomist/crop consultant for waste management consultation increased between 2002 and 2007. However, the use of any consultant was similar in both studies.

Percentage of operations that consulted with the following people about waste management for their operation during the previous 12 months:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Consultant	Percent	Std. Error	Percent	Std. Error
University/extension personnel	17.2	(1.6)	18.2	(2.2)
Private nutrient management consultant	16.0	(1.4)	23.8	(2.4)
Natural Resource Conservation Service personnel	21.9	(1.6)	32.8	(2.6)
State or local department of natural resources personnel	10.7	(1.3)	8.4	(1.2)
State or local department of agriculture personnel	10.6	(1.3)	12.9	(1.7)
Agronomist/crop consultant	34.7	(2.0)	45.2	(2.9)
Consulting nutritionist			15.7	(2.0)
Environmental engineering consultant			7.0	(1.3)
Private veterinary practitioner	5.5	(1.0)	3.5	(0.8)
Other	2.1	(0.5)	1.2	(0.7)
Any	57.0	(2.2)	63.9	(2.8)

Percentage of Operations that Consulted with the Following People About Waste Management for Their Operation During the Previous 12 Months



8. Knowledge of concentrated animal feeding operation (CAFO) classification

There were no differences between 2002 and 2007 in the percentage of operations by actual or perceived CAFO classification of the operation.

Percentage of operations by actual or perceived classification* under current Federal EPA guidelines regarding CAFOs:

	Percent Operations			
	Dairy 2002		Dairy 2007	
Classification Category	Percent	Std. Error	Percent	Std. Error
Never heard of CAFO	38.1	(2.1)	31.2	(2.8)
Have heard of CAFO, but unsure how my operations is or will be classified	20.5	(1.8)	20.8	(2.7)
My operation is not or will likely not be classified as a CAFO	33.3	(2.0)	37.2	(2.8)
My operation is or will likely be classified as a CAFO	8.1	(0.9)	10.8	(1.3)
Total	100.0		100.0	

*Regulations of the CAFO rule became effective December 22, 2008.

Appendix I: Methodology*

	NAHMS Dairy Studies		
	1996	2002	2007
Data collection dates	2/20-5/24	2/25-4/30	2/26-8/31
Minimum number of dairy cattle	30	30	30
Number of States	20	21	17
Data collectors	State and Federal VMOs and AHTs		
Participating States as a percentage of U.S. population coverage			
Operations	85.6	86.6	84.7
Cows	82.7	85.5	82.5
Respondent Sample profile (herd size)			
Small (fewer than 100 cows)	630	400	233
Medium (100-499 cows)	502	392	215
Large (500 or more cows)	87	221	134
Response category			
Survey complete	1,219	1,013	582
Percent of total	76.0	70.4	54.0
Refused	340	335	380
Did not contact	16	76	111
Ineligible	29	14	4
Total	1,604	1,438	1,077

*For more detailed information about the methodology for each study, see methodology section of each descriptive report at: http://nahms.aphis.usda.gov

Appendix II: Study Objectives and Related Outputs

1. Describe trends in dairy cattle health and management practices
   - Part II: Changes in the U.S. Dairy Cattle Industry, 1991-2007, March 2008
   - **Part V: Changes in Dairy Cattle Health and Management in the United States, 1996-2007, June 2009**

2. Evaluate management factors related to cow comfort and removal rates
   - Part VI: Dairy Facilities and Cow Comfort on U.S. Dairy Operations, 2007, Interpretive Report, expected fall 2009

3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices
   - Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
   - Off-Site Heifer Raising on U.S. Dairy Operations, 2007, info sheet, November 2007
   - Colostrum Feeding and Management on U.S. dairy Operations, 1991-2007, info sheet, March 2008
   - Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, February 2009
   - Calving Management on U.S. Dairy Operations, 2007, info sheet, February 2009
   - Calf Health and Management Practices on U.S. Dairy Operations, 2007, Interpretive Report, expected summer 2009
   - Failure of Passive Transfer in Dairy Heifer Calves, 200, info sheet, expected fall 2009

4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVDV)
   - Bovine Viral Diarrhea (BVD) Detection in Bulk Tank Milk and BVD Management Practices in the United States, 1996-2007, info sheet, October 2008

5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens
   - Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
   - Milking Procedures on U.S. Dairy Operations, 2007, info sheet, September 2008

6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies*paratuberculosis*
- Johne's Disease on U.S. Dairies, 1991-2007 info sheet, April 2008

7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices
- Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
- Biosecurity Practices on U.S. Dairy operations, 2002-07, Interpretive Report, expected summer 2009

8. Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns
- Antibiotic Use on U.S. Dairy Operations, 2002-07, info sheet, September 2008
- *Listeria* and *Salmonella* in Bulk Tank Milk on U.S. Dairy Operations, 2002-07, info sheet, June 2009
- *Salmonella* and *Campylobacter* on U.S. Dairy Operations, 2002-07, info sheet, June 2009
- Food Safety Pathogens Isolated from U.S. Dairy Operations, 2007, Interpretive Report, expected winter 2009

Additional information sheets
- Dairy Cattle Identification Practices in the United States, 2007, info sheet, November 2007
- Bovine Leukosis Virus (BLV) on U.S. Dairy Operations, 2007, info sheet, September 2008
- Reproduction Practices on U.S. Dairy Operations, 2007, info sheet, February 2009
- Dairy Cattle Injection Practices in the United States, 2007, info sheet, February 2009
- Methicillin-Resistant *Staphylococcus aureus* (MRSA) Isolation from Bulk Tank Milk in the United States, 2007, info sheet, expected spring 2009

United States
Department of
Agriculture

Animal and
Plant Health
Inspection Service

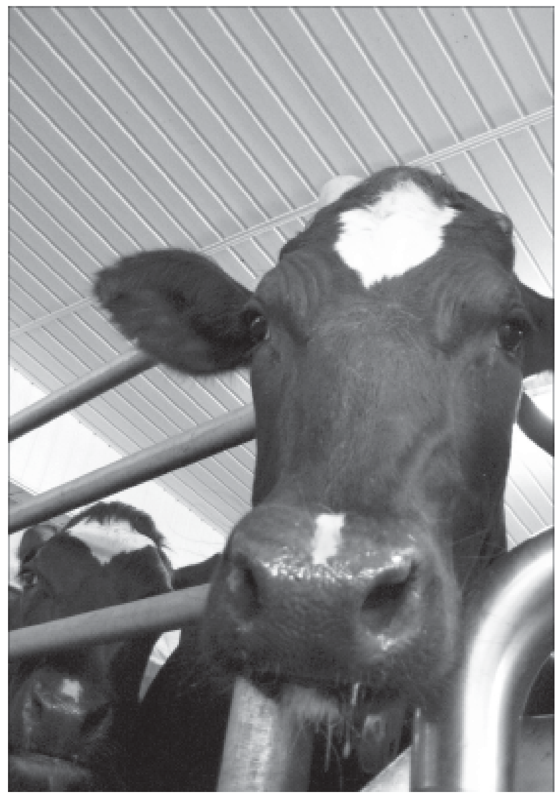
Veterinary
Services

National
Animal Health
Monitoring
System

May 2010

Dairy 2007

Biosecurity Practices on U.S. Dairy Operations, 1991-2007



Items of Note

Dairy 2007 marks the fourth time that the National Animal Health Monitoring System has conducted a national study of the U.S. dairy industry. This report contains the latest information on the biosecurity practices used on U.S. dairies and, when possible, provides comparisons of these practices over time.

Preventing and reducing the presence of disease on dairy operations is important and often difficult. Biosecurity and biocontainment practices can significantly reduce the risk of introducing or spreading diseases. Biosecurity is a system of management practices used to prevent the entry of disease-causing agents. Biocontainment is a system of management practices used to prevent the spread of disease between groups of animals on an operation. Sources of potential disease include the introduction of cattle from outside sources and contact with other animals, employees, visitors, vehicles, or equipment.

Disease familiarity

The implementation of biosecurity and biocontainment practices aimed at a specific disease requires that producers have a basic knowledge of the disease or consult with a veterinarian to design an appropriate disease-prevention system. In 2002 and 2007, most producers were fairly knowledgeable or knew some basics about foot-and-mouth disease, BSE, Johne's disease, and *Mycoplasma* mastitis; however, the majority of producers were unfamiliar with heartwater, screwworm, bluetongue, vesicular stomatitis, and hemorrhagic bowel syndrome.

Information sources

In 2002 and 2007, most producers indicated that they would use their private veterinarian for disease information if a foreign animal disease occurred in the United States. Similarly, most producers would contact their veterinarian if they suspected that a foreign animal disease was on their operation. The fact that producers would first turn to their veterinarian in the case of a foreign animal disease occurrence highlights the continuing need to educate veterinary practitioners on foreign animal diseases and provide training on how to handle animals suspected of having a foreign animal disease.

New additions

From 1996 to 2007, approximately one of four operations brought any cattle onto the operation from outside sources. Biosecurity practices that can reduce the risk of new cattle introducing disease to an operation include having knowledge of the disease status of the source operation, testing new cattle for specific diseases before or immediately after arrival, implementing a quarantine period, and vaccinating for specific diseases. Of operations that introduced new cattle to their operation in 2007, 47.2 percent required vaccination for new additions, 23.3 percent required testing, and 20.3 percent quarantined newly introduced cattle.

Contact with wildlife

Cattle on many dairy operations frequently have contact with cats, dogs, and deer, all of which are capable of spreading disease to cattle. Deer can transmit tuberculosis to cattle and vice versa and are difficult to exclude from cattle pastures. Wildlife access to hay stacks and other stored feed can be limited through the use of buildings and fences. Almost one-half of dairy operations in 2007 limited cattle contact with wildlife or other livestock (48.5 percent) or controlled access to cattle feed (49.9 percent).

Employees and visitors

Employees or visitors—especially those who have contact with animals from other operations—can introduce disease agents via their boots, clothing, vehicles, or other equipment. As people travel more frequently throughout the world, the risk of inadvertent or intentional introduction of disease agents foreign to the United States increases. Establishing written policies or guidelines pertaining to travel and animal contact by visitors and employees will help reduce the risk of disease introduction. The percentage of operations that had employees increased from 47.2 percent in 2002 to 75.7 percent in 2007. As expected, the number of full-time employees increased as herd size increased. More than one-half of all operations in 2007 had visitors 1 to 14 times per week. In 2007, 30.4 percent of operations had guidelines for determining which visitors were allowed in animal areas, and 51.3 percent had restrictions on vehicles entering animal areas.

Vaccination

Vaccination can reduce the prevalence and/or severity of specific diseases. The percentage of operations that vaccinated heifers against any disease decreased from 91.3 percent in 1991 to 83.0 percent in 2007. The percentage of operations that vaccinated heifers against brucellosis decreased from 1991 to 2007 (66.8 and 41.6 percent, respectively). This decrease may be due to the fact that from 1991 to 2007 many States switched from a mandatory to a voluntary brucellosis vaccination program. In addition, the number of States certified brucellosis-free increased from 34 in 1996 to 49 in 2007, which may have impacted the number of operations that vaccinated against brucellosis. Overall, vaccine use in cows remained at approximately 80 percent from 1996 to 2007. The highest percentage of vaccines administered to heifers and cows were primarily for viral respiratory diseases.

Disease conditions

The three most common diseases/conditions in dairy cattle identified by producers in 2007 were clinical mastitis, lameness, and infertility problems (16.5, 14.0, and 12.9 percent of cows, respectively). In addition, these diseases/conditions accounted for the majority of cows permanently removed from the herd and for about one-third of cow deaths.

Mortality

Animal deaths represent the least desirable health outcome. Once a death has occurred, determining cause is important in preventing future deaths and improving the health of the herd. The percentage of preweaned heifer deaths decreased from 10.8 percent in 1996 to 7.8 percent in 2007. Weaned heifer-calf deaths increased from 2.2 percent in 1991 to 2.8 percent in 2002 then decreased to 1.8 percent in 2007. In contrast to heifer deaths, cow deaths increased from 3.8 percent in 1996 to 5.7 percent in 2007. A relatively low percentage of operations performed necropsies on dead preweaned heifers, weaned heifers, or cows (8.0, 7.1, and 13.0 percent, respectively).

Selected Highlights of Biosecurity Practices on U.S. Dairy Operations, 1991–2007

Most producers were fairly knowledgeable or knew some basics about foot-and-mouth disease, BSE, Johne's disease, and *Mycoplasma* mastitis; however, the majority of producers were unfamiliar with heartwater, screwworm, bluetongue, vesicular stomatitis, and hemorrhagic bowel syndrome in 2002 and 2007.

Most producers in 2002 and 2007 indicated that they would use their private veterinarian for disease information if a foreign animal disease occurred in the United States or contact their veterinarian if they suspected that a foreign animal disease was on their operation.

In Dairy 2007, the most common classes of cattle brought on the operation from outside sources were: lactating dairy cows, added by 13.8 percent of operations; weaned dairy bulls, added by 12.5 percent of operations; and bred dairy heifers, added by 12.2 percent of operations.

Almost one-half of cow replacements for large operations (47.8 percent) were born on the operation but raised off-site. In 2007, nearly two-thirds of operations that sent heifers off-site to be raised (63.8 percent) used a rearing facility in which the heifers had contact with cattle from other operations.

Of operations bringing dairy cattle from outside sources onto the operation, less than one-half (47.2 percent) required vaccination of new additions prior to arrival; approximately one of five operations (20.3 percent) quarantined new additions, and nearly one of four operations (23.3 percent) required testing for new additions.

The percentage of operations that had employees increased from 47.2 percent in 2002 to 75.7 percent in 2007. In addition to employees, dairy operations had regular and frequent visits from a variety of people doing business with the operation, including delivery people, milk haulers, cattle haulers, artificial insemination technicians, nutritionists, and veterinarians. These people, who may or may not have had contact with cattle on the operation and multiple other operations, can carry diseases from one operation to another. In an average week, over one-half of all operations (51.6 percent) had between 1 and 14 visits by people coming onto the operation.

In 2007, 3 of 10 operations (30.4 percent) had guidelines for determining which visitors were allowed in animal areas. Of operations that had visitors in the 12 months prior to the 2007 interview, 6.9 percent had footbaths for visitors entering animal areas. A higher percentage of operations in 2007 than in 2002 required disposable or clean boots for visitors entering animal areas and had restrictions on vehicles entering animal areas. The percentage of operations that had guidelines about which visitors were allowed in animal areas or that had footbaths for visitors entering animal areas remained unchanged from 2002 to 2007.

Dogs, cats, and members of the deer family were the three animal types most often reported as having contacts with dairy cattle. On operations in which deer or other members of the deer family had contact with cattle and/or their feed or water in 2007, 90.8 percent of operations reported that cattle could possibly or sometimes have face-to-face contact with deer. There were no differences by region in the percentages of operations that reported face-to-face contact between cattle and deer.

The percentage of operations that separated newborn calves from their dams immediately after they were born doubled from 1991 to 2007 (28.0 to 55.9 percent of operations, respectively).

Overall, only 2.1 percent of operations routinely measured passive transfer status via serum total proteins.

In 2007, about one-third of operations (32.2 percent) routinely used the same equipment to handle manure and to feed cattle; another one-third (35.6 percent) rarely used the same equipment; and another one-third (32.2 percent) never used the same equipment to handle both manure and feed. In 2002 and 2007, about one of three operations shared equipment with other livestock operations.

The percentage of operations that administered any vaccine to heifers decreased from 91.3 percent in 1991 to 83.0 percent in 2007. The percentage of operations that vaccinated heifers against brucellosis decreased from 66.8 percent in 1991 to 41.6 percent in 2007. In cows, the use of the most common vaccines (BVD, IBR, PI3, BRSV, and leptospirosis) has remained steady since 1996.

The three most common disease conditions in cows identified by producers in 2007 were clinical mastitis, lameness, and infertility problems (16.5, 14.0, and 12.9 percent of cows, respectively).

The percentages of preweaned and weaned heifer calves that died decreased from 1996 to 2007, while the percentage of cows that died increased. The percentage of cow deaths due to lameness or injury increased from 12.7 percent in 1996 to 20.0 percent in 2007.

In 2007, a relatively low percentage of operations performed necropsies on dead preweaned heifers, weaned heifers, or cows (8.0, 7.1, and 13.0 percent, respectively) to determine cause of death.

Although rendering remained the primary method of dead-cow disposal, the percentage of operations that used this method decreased from 62.4 percent in 2002 to 56.9 percent in 2007.

Acknowledgements

This report has been prepared from material received and analyzed by the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS) via four national studies of health management and animal health on U.S. dairy operations conducted in 1991, 1996, 2002, and 2007.

The NAHMS dairy studies were cooperative efforts between State and Federal agricultural statisticians, animal health officials, university researchers, and extension personnel. We want to thank the National Agricultural Statistics Service (NASS) enumerators, State and Federal veterinary medical officers (VMOs), and animal health technicians (AHTs) who visited the farms and collected the data. Their hard work and dedication to the National Animal Health Monitoring System (NAHMS) are invaluable. The roles of the producer, Area Veterinarian in Charge (AVIC), NAHMS Coordinator, VMO, AHT, and NASS enumerator were critical in providing quality data for all the dairy reports. Thanks also to the personnel at the Centers for Epidemiology and Animal Health (CEAH) for their efforts in generating and distributing valuable reports from the data. Additional support was afforded by the generous contributions of collaborators for the Dairy studies, including

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- TREK Diagnostic Systems;
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- University of Wisconsin, Madison; and
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Larry M. Granger
Director
Centers for Epidemiology and Animal Health

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Contacts for further information:
Questions or comments on data analysis: Dr. Jason Lombard (970) 494–7000
Information on reprints or other reports: Ms. Abby Fienhold (970) 494–7000
Email: NAHMS@aphis.usda.gov

Feedback:
Feedback, comments, and suggestions regarding the Dairy 2007 study reports are welcomed. Please forward correspondence via email at: NAHMS@aphis.usda.gov, or you may submit feedback via online survey at:
http://nahms.aphis.usda.gov
(Click on “FEEDBACK on NAHMS reports.”)

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Introduction

Biosecurity and Biocontainment

Biosecurity and biocontainment methods can significantly reduce the risk of introducing new diseases to an operation or of spreading disease among animals on the operation. Biosecurity is a system of management practices used to prevent the entry of disease-causing agents. Biocontainment is a system of management practices used to prevent the spread of disease between groups of animals on an operation (Villarroel et al., 2007). A good biocontainment plan can limit the spread of disease already present on the operation and also serve to back up the biosecurity plan in the event that a new disease is introduced to an operation. Biosecurity and biocontainment measures are both necessary to reduce the potential impacts of a disease outbreak.

Recognizing and understanding all aspects of potential biosecurity breaches are essential to managing a successful biosecurity program. Generally, the biosecurity issues that receive the most attention are: the process of introducing new animals to the operation, which includes knowing the source and health history of new animals; isolating new animals from the main herd and testing them for appropriate diseases; designing strategic vaccination programs; and sanitation practices, including milking procedures, disinfection of equipment, and manure management. Many other key components of disease control are often overlooked. For example, minimizing stress helps animals resist and overcome disease challenges. Animal stress can be reduced by providing a comfortable and clean environment, sufficient housing space, adequate bunk space, and by segregating cattle into appropriate age and/or size groups. Providing quality feed and water, maintaining a balanced ration with proper nutrient levels, and providing transition diets to cows around the time of calving also help decrease nutritional stress and ensure optimal immune function for disease resistance. Managing and regulating visitors, service personnel, employees, and animal traffic are also essential aspects of biosecurity. Finally, controlling animals' exposure to wildlife, insects, and wind-borne pathogens are other areas for consideration.

Importance of Biosecurity

Infectious diseases can have a devastating impact on the productivity of any dairy operation. Virtually every disease results in productivity losses, and in some cases these losses can be substantial, particularly on larger operations in which more animals are at risk. Milk production and quality can decrease, resulting in immediate financial consequences. Reproductive efficiency can decline, compounding the financial strain by increasing days open and culling rates. As a result, calf numbers are negatively affected and replacement costs rise. Furthermore, treatment expenses, debilitated animals, and increased death losses certainly have financial implications, but also may limit animal marketing options. Finally, depending on the nature of the pathogen, public health issues may arise, such as the spread of zoonoses, antimicrobial resistance, drug residues, and impaired or reduced food safety.

On a national level, biosecurity programs are crucial in keeping the country free from numerous animal diseases exotic to the United States. Due to the threat of bioterrorism and the recent international outbreaks of infectious diseases such as foot-and-mouth and bovine spongiform encephalopathy, strict import and trade restrictions have been implemented as components of a national biosecurity plan. In addition, there are current and past eradication programs for many diseases familiar to most livestock producers, such as tuberculosis, brucellosis, classical swine fever (hog cholera), and pseudorabies. These programs include national-level biosecurity protections.

Whether motivation stems from risk of decreased productivity on individual operations or producer responsibility to exclude or eradicate disease on a national level, the net benefit of biosecurity is improved animal and public health.

Biosecurity Development

Developing a formal biosecurity plan is an exercise in risk assessment. As such, there are four steps to include in the assessment process:

1. Hazard identification,
2. Exposure assessment,
3. Risk characterization, and
4. Mitigation plan.

1. Hazard identification—The preliminary step in designing a biosecurity plan is to assess the specific risks for the operation. Wells (2000) suggests that the operation first identify its chief source of income. For example, on most dairies milk is the primary product. Diseases that cause decreased milk production and quality and result in early culling should have the highest priority. In contrast, dairies that market primarily animal semen or embryos should concentrate biosecurity efforts against reproductive diseases, as well as diseases with international trade implications such as bovine leukosis virus and bluetongue virus (Dargatz et al., 2002; McCluskey, 2002).

2. Exposure assessment—Operations must identify which specific diseases are most likely to be hazards for their particular farms and identify the most probable means by which cattle would be exposed. Many factors should be considered, including: the addition of new animals; disease history; proximity to other livestock operations; potential contact with wildlife; prospective visitors; off-farm animal travel; geographic location; rodent, insect, and bird populations; and wind and weather patterns (Wells, 2000; BAMN, 2001a; Kirk, 2009).

3. Risk characterization—Once potential hazards have been assessed, the degree of risk must be characterized for the operation. This qualitative assessment can be done simultaneously with the exposure assessment.

Operations that purchase replacement heifers have a higher risk of introducing infectious diseases to the premises than those that do not make off-site animal purchases. In addition, dairies that allow the same employees to work with calves, sick cows, and milk cows have a higher potential risk of transferring disease agents between groups of animals than dairies that assign employees to one specific group of animals. The risk of transmitting *Mycobacterium avium*, subspecies *paratuberculosis* (the causative agent of Johne's disease) is increased on operations that feed pooled colostrum and/or unpasteurized pooled milk to calves (Nielsen et al., 2008). This risk is compounded if the colostrum comes from cows with unknown Johne's disease status.

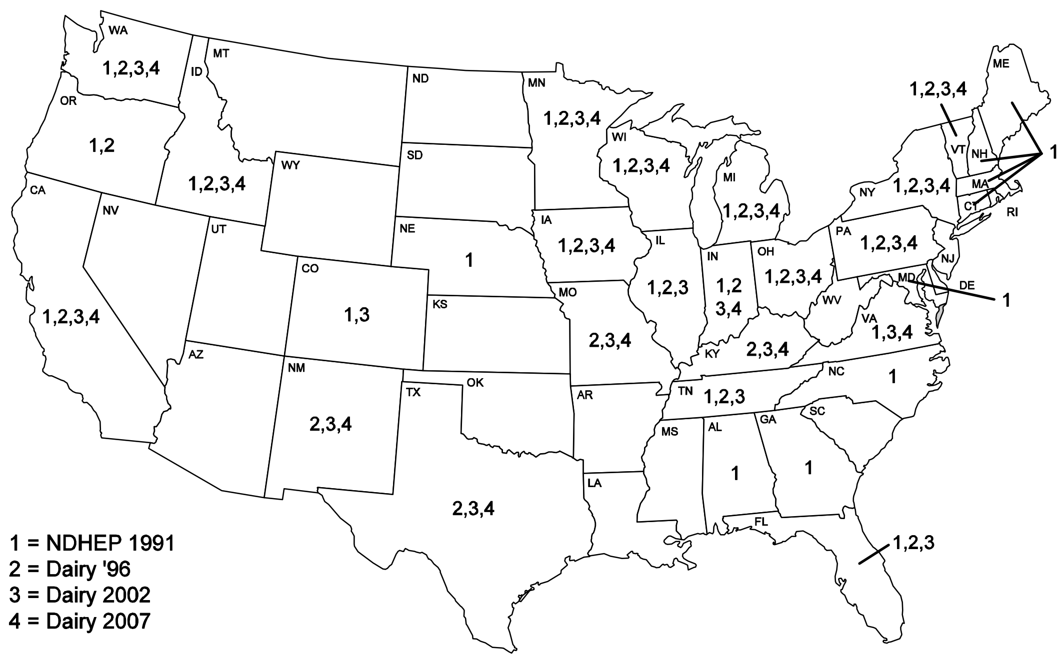
Another component of characterizing an operation's greatest risks is evaluating the potential means of disease control and how the mitigation plan will be implemented on the operation. Vaccine availability and efficacy for certain diseases also must be considered. Vaccination is relatively efficacious for diseases such as infectious bovine rhinotracheitis, but vaccines are not generally available for other diseases, such as anaplasmosis and Johne's disease.

4. Mitigation plan—All information obtained from steps 1 through 3 should be assimilated into a final plan for mitigation. The mitigation plan should include: the diseases of utmost importance; where control efforts are to be directed; a detailed plan to assess the current levels of disease on the operation (serologic or fecal testing, for example); and written strategies detailing what will be done to prevent the introduction or spread of these diseases (McCluskey, 2002).

Numerous checklists and scorecards have been developed to aid in the analysis process. These assessments can serve as guidelines to help identify potential hazards and the degree of risk for disease acquisition or transmission on an operation. Risk assessments are available for specific diseases or situations. For example, The Center for Food Security and Public Health at Iowa State University has a series of risk assessment tools available for veterinarians and dairy producers: http://www.cfsph.iastate.edu/Infection_Control/index.php (Center for Food Safety and Public Health). The New York State Cattle Health Assurance Program provides a risk assessment tailored to herd expansion biosecurity concerns (New York State Cattle Health Assurance Program), and a Johne's disease risk assessment is available at: http://johnesdisease.orgHandbook%20for%20Vets%20&%20Beef%20Producers.pdf.

This report, "Biosecurity Practices on U.S. Dairy Operations, 1991–2007", provides national estimates of dairy cattle health and management practices for comparable populations from the National Dairy Heifer Evaluation Project (NDHEP) 1991, NAHMS Dairy 1996, Dairy 2002, and Dairy 2007 studies (see map, next page). The latest study, Dairy 2007, was conducted in 17 of the Nation's major dairy States and provides participants, stakeholders, and the industry as a whole with valuable information representing 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. State and Federal veterinary medical officers (VMOs) and animal health technicians (AHTs) conducted the questionnaire interviews. Due to educational efforts, producer awareness and recognition of some diseases have increased and may be partially responsible for changes observed in disease prevalence.

States Participating in NAHMS Dairy Studies, 1991, 1996, 2002, 2007



Terms Used in This Report

Biocontainment: Management practices used to prevent the spread of disease between groups of animals on an operation.

Biosecurity: Management practices used to prevent the entry of disease-causing agents onto an operation.

Bovine viral diarrhea (BVD): An infectious disease of cattle caused by a pestivirus. Infection can result in early embryonic death, abortion, stillbirths, and congenital defects such as cerebellar agenesis, which results in ataxia or lack of coordination. Cattle infected with BVD virus in utero are referred to as persistently infected. Persistently infected animals continuously shed large quantities of the virus via nasal discharge, saliva, semen, urine, feces, tears, and milk, thereby serving as a source of persistently infected cattle.

Cow: Female dairy bovine that has calved at least once.

Heifer: Female dairy bovine that has not yet calved.

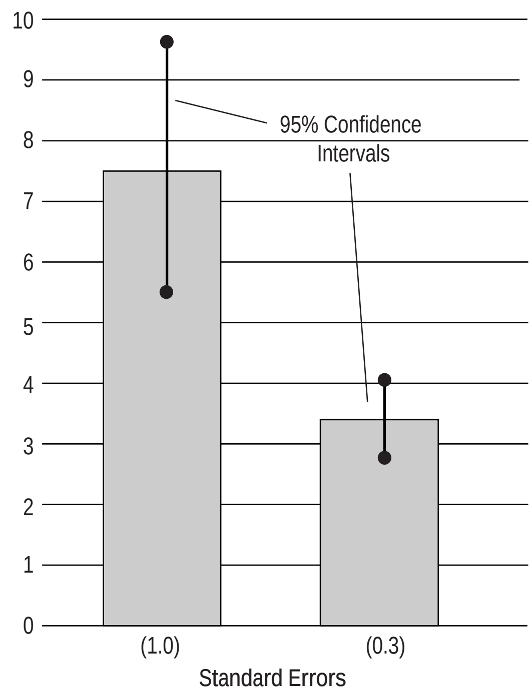
Herd size: Herd size is based on the respective January 1 cow inventory. Small herds are those with fewer than 100 cows; medium herds are those with 100 to 499 cows; and large herds are those with 500 or more cows.

Operation average: The average value for all operations. A single value for each operation is summed over all operations reporting divided by the number of operations reporting. For example, operation average number of shipments (see table a., p 21) is calculated by summing reported average number of shipments over all operations divided by the number of operations.

Population estimates: The estimates in this report make inference to all of the operations with dairy cows in the target population (see Section II: Methodology, p 130). Data from the operations responding to the survey are weighted to reflect their probability of selection during sampling and to account for any survey nonresponse.

Precision of population estimates: Estimates in this report are provided with a measure of precision called the standard error. A 95-percent confidence interval can be created with bounds equal to the estimate plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean 95 out of 100 times. In the example to the right, an estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). The second estimate of 3.4 shows a standard error of 0.3 and results in limits of 2.8 and 4.0. Alternatively, the 90-percent confidence interval would be created by multiplying the standard error by 1.65 instead of 2. Most estimates in this report are rounded to the nearest tenth. If rounded to 0, the standard error was reported (0.0). If there were no reports of the event, no standard error was reported (--). References to estimates being higher or lower than other estimates are based on the 95-percent confidence intervals not overlapping.

Examples of a 95% Confidence Interval



Regions (2007):
- **West:** California, Idaho, New Mexico, Texas, Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, Wisconsin

Sample profile: Information that describes characteristics of the operations from which data were collected.

Section I: Population Estimates

NOTE: Unless otherwise specified, estimates in the following tables represent only operations with 30 or more dairy cows.

A. Producer Familiarity with Disease

1. Knowledge of specific diseases

Familiarity with the signs of various diseases is an important part in developing an effective biosecurity plan. Familiarity with diseases may also help limit the spread of a disease, should it be introduced into the herd.

Producer familiarity with diseases varied greatly. In 2002 and 2007, most producers were fairly knowledgeable or knew some basics about foot-and-mouth disease, bovine spongiform encephalopathy, Johne's disease, and *Mycoplasma* mastitis; however, the majority of producers were unfamiliar with heartwater, screwworm, bluetongue, vesicular stomatitis, and hemorrhagic bowel syndrome. In 2002, the percentage of producers that were fairly knowledgeable about foot-and-mouth disease was about twice that of producers in 2007 (16.5 and 8.9 of operations, respectively). The percentage of operations that were fairly knowledgeable about Johne's disease, *Mycoplasma* mastitis, and hemorrhagic bowel syndrome increased from 2002 to 2007.

Percentage of operations by level of familiarity with specific cattle diseases in 2007

	Percent Operations							
	Level of Familiarity							
	Fairly Knowledge-able		Know Some Basics		Recognized the Name, Not Much Else		Had Not Heard of it Before	
	Dairy 2002	Dairy 2007	Dairy 2002	Dairy 2007	Dairy 2002	Dairy 2007	Dairy 2002	Dairy 2007
Disease	Pct. (SE)	Pct. (SE)	Pct. (SE)	Pct. (SE)	Pct. (SE)	Pct. (SE)	Pct. (SE)	Pct. (SE)
Foot-and-mouth disease	16.5 (1.5)	8.9 (1.2)	54.6 (2.1)	49.3 (2.9)	28.1 (1.9)	40.7 (2.9)	0.8 (0.3)	1.1 (0.7)
Heartwater	0.3 (0.2)	0.6 (0.3)	0.9 (0.3)	1.0 (0.4)	3.7 (0.7)	4.5 (1.0)	95.1 (0.8)	93.9 (1.1)
Bovine spongiform encephalopathy (BSE)	13.9 (1.5)	19.6 (2.0)	46.5 (2.2)	60.8 (2.7)	38.0 (2.1)	18.8 (2.2)	1.6 (0.5)	0.8 (0.6)
Screwworm	5.9 (1.0)	4.0 (0.8)	11.5 (1.2)	15.1 (1.9)	45.1 (2.2)	37.4 (2.6)	37.5 (2.2)	43.5 (2.7)
Johne's disease (*Mycobacterium* paratuberculosis)	45.3 (2.1)	57.9 (2.9)	42.3 (2.1)	36.2 (2.8)	11.4 (1.4)	4.4 (1.2)	1.0 (0.3)	1.5 (0.6)
Bluetongue	2.6 (0.6)	2.2 (0.9)	5.2 (0.8)	8.5 (1.2)	40.7 (2.0)	41.0 (2.8)	51.5 (2.1)	48.3 (2.8)
Vesicular stomatitis	1.1 (0.3)	0.7 (0.3)	2.8 (0.5)	3.4 (0.8)	12.9 (1.3)	14.1 (1.7)	83.2 (1.4)	81.8 (1.9)
Anthrax	9.6 (1.2)	5.1 (1.2)	32.6 (2.0)	28.4 (2.6)	54.0 (2.2)	56.3 (2.8)	3.8 (0.8)	10.2 (1.8)
Mycoplasma mastitis	8.7 (1.0)	20.3 (1.8)	21.8 (1.7)	39.9 (2.8)	46.6 (2.2)	30.4 (2.8)	22.9 (2.0)	9.4 (1.8)
Hemorrhagic bowel syndrome (HBS)	1.0 (0.2)	8.2 (1.1)	2.5 (0.4)	17.6 (1.9)	8.7 (1.3)	22.6 (2.3)	87.8 (1.3)	51.6 (2.7)

() = standard error.

2. Information sources in case of a foreign animal disease outbreak

The introduction of a foreign animal disease into the United States could be catastrophic. Knowing where producers would turn for information in the event of a foreign animal disease outbreak is critical to planning for the control of an outbreak.

Most producers in 2002 and 2007 indicated they would use their private veterinarian as an information source if a foreign animal disease outbreak occurred in the United States (92.8 and 93.6 percent, respectively). Other resources would be used, but not to the extent of the private veterinarian.

Percentage of operations by likelihood of using the following information sources if an outbreak of foreign animal disease occurred in the United States

	Percent Operations											
	Likelihood											
	Very Likely				Somewhat Likely				Not Likely			
	Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Information Source	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Other dairy producers	40.5	(2.1)	41.4	(2.8)	34.5	(2.0)	37.8	(2.7)	25.0	(1.9)	20.8	(2.3)
Private veterinarian	92.8	(1.1)	93.6	(1.3)	6.6	(1.1)	5.4	(1.3)	0.6	(0.3)	1.0	(0.5)
Extension agent	34.2	(2.0)	32.5	(2.7)	36.9	(2.1)	38.9	(2.9)	28.9	(2.0)	28.6	(2.5)
Dairy organization or cooperative	30.3	(1.9)	30.7	(2.6)	41.8	(2.1)	42.3	(2.8)	27.9	(1.9)	27.0	(2.6)
Magazines	41.8	(2.1)	39.0	(2.8)	44.7	(2.1)	49.4	(2.8)	13.5	(1.5)	11.6	(1.5)
Internet	19.0	(1.6)	23.1	(2.2)	27.4	(1.9)	28.8	(2.6)	53.6	(2.1)	48.1	(2.8)
State Veterinarian's office	34.7	(2.1)	26.7	(2.4)	31.3	(2.0)	37.4	(2.8)	34.0	(2.1)	35.9	(2.9)
U.S. Department of Agriculture	25.1	(1.8)	22.6	(2.4)	38.1	(2.2)	42.5	(2.8)	36.8	(2.1)	34.9	(2.7)
Television/ newspapers	30.7	(2.1)	25.8	(2.5)	35.2	(2.0)	38.8	(2.8)	34.1	(2.0)	35.4	(2.6)
Other	3.7	(0.9)	4.7	(1.2)	0.8	(0.3)	2.4	(1.0)	95.5	(1.0)	92.9	(1.6)

3. Resource contacts

Most producers indicated they would contact their private veterinarian if they suspected a foreign animal disease on their operation. About 4 of 10 operations would contact the State Veterinarian's office. These responses highlight the continuing need to educate veterinary practitioners on the identification and handling of suspected foreign animal diseases on livestock operations.

Percentage of operations that would contact the following resources if an animal on the operation was suspected of having foot-and-mouth disease or another foreign animal disease

	Percent Operations			
	Dairy 2002		Dairy 2007	
Resource	Percent	Std. Error	Percent	Std. Error
Extension agent/university	25.4	(1.8)	20.8	(2.3)
State Veterinarian's office	43.9	(2.2)	35.7	(2.6)
U.S. Department of Agriculture	25.5	(1.8)	21.8	(2.3)
Private veterinarian	97.9	(0.7)	98.6	(0.5)
Feed company or milk cooperative representative	28.0	(1.9)	25.7	(2.3)
Other	3.3	(0.7)	4.1	(1.3)

B. Herd Addition Risks

1. Classes of cattle brought onto dairy operations from outside sources

For most dairies, the introduction of new animals poses one of the greatest threats to biosecurity. All other factors being equal, the number of new animals introduced onto the operation and the number of times new animals are introduced (number of shipments) can help quantify the level of risk. Each age group or class of animals brought onto an operation poses its own biosecurity risks. Lactating cows can harbor contagious mastitis pathogens, which can easily be spread to other cows in the string. Bred cattle can harbor reproductive pathogens, and calves can introduce new strains of respiratory and enteric pathogens to other calves (Villarroel et al., 2007). A comprehensive biosecurity program examines the risks particular to each operation through the introduction of each group of cattle and institutes a series of controls to help reduce the risks.

In Dairy 2007, the most common classes of cattle brought onto the operation from outside sources were lactating dairy cows (13.8 percent of operations), weaned dairy bulls (12.5 percent of operations), and bred dairy heifers (12.2 percent of operations). The percentages of operations that introduced bred heifers or lactating cows decreased from 1996 to 2007.

From 1996 to 2007, about 4 of 10 operations brought any cattle from outside sources onto the operation. A lower percentage of operations in 2007 brought on any cattle compared with 2002.

a. Percentage of operations* that brought the following classes of cattle onto the operation

	Percent Operations			Percent Operations			
Cattle Class	**Dairy 1996**	**Std. Error**	**Cattle Class**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Preweaned calves (dairy or beef)	5.0	(0.7)	Preweaned calves (dairy or beef)	5.1	(0.7)	3.4	(0.6)
Dairy heifers weaned, but not bred	7.3	(0.7)	Dairy heifers weaned, but not bred	6.7	(0.7)	6.4	(0.7)
Bred dairy heifers	18.5	(0.9)	Bred dairy heifers	15.8	(0.9)	12.2	(0.9)
Lactating dairy cows	19.9	(1.0)	Lactating dairy cows	16.4	(1.0)	13.8	(1.0)
Dry dairy cows	7.1	(0.8)	Dry dairy cows	5.9	(0.6)	4.3	(0.6)
Bulls (weaned)	8.7	(0.7)	Dairy bulls (weaned)	13.7	(0.9)	12.5	(0.9)
			Beef bulls (weaned)	2.3	(0.4)	1.7	(0.3)
Other heifers and cows (including beef)	1.9	(0.4)	Beef heifers and cows`	1.5	(0.3)	1.3	(0.3)
Steers (weaned)	2.0	(0.3)	Steers (weaned)	1.1	(0.3)	1.8	(0.4)
Any	43.9	(1.3)	Any	45.7	(1.4)	38.9	(1.4)

*Operations with any dairy cows.

Only 1.0 percent of large operations and 3.8 percent of small operations added preweaned calves from outside sources in 2007. A higher percentage of large operations brought on dairy heifers, bred dairy heifers, dairy bulls, and any beef or dairy cattle compared with medium or small operations.

b. Percentage of operations* that brought the following classes of cattle onto the operation, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Preweaned calves (dairy or beef)	3.8	(0.8)	2.5	(0.6)	1.0	(0.3)	3.4	(0.6)
Dairy heifers weaned, but not bred	5.3	(0.8)	7.6	(1.2)	16.3	(2.6)	6.4	(0.7)
Bred dairy heifers	8.9	(1.0)	18.1	(1.8)	34.7	(2.6)	12.2	(0.9)
Lactating dairy cows	13.2	(1.3)	16.0	(1.7)	13.0	(1.9)	13.8	(1.0)
Dry dairy cows	4.1	(0.8)	4.3	(0.9)	5.5	(1.5)	4.3	(0.6)
Beef heifers and cows	0.9	(0.3)	2.5	(0.7)	1.1	(0.6)	1.3	(0.3)
Dairy bulls (weaned)	11.4	(1.1)	14.1	(1.6)	22.5	(2.4)	12.5	(0.9)
Beef bulls (weaned)	1.5	(0.4)	2.2	(0.6)	1.5	(0.5)	1.7	(0.3)
Steers (weaned)	2.0	(0.5)	1.3	(0.5)	0.7	(0.6)	1.8	(0.4)
Any	35.6	(1.7)	44.3	(2.3)	61.6	(2.8)	38.9	(1.4)

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

A higher percentage of operations in the West region added any cattle from outside sources compared with operations in the East region (49.3 and 38.0 percent of operations, respectively).

c. Percentage of operations* that brought the following classes of cattle onto the operation, by region

	Percent Operations			
	Region			
	West		East	
Cattle Class	Percent	Std. Error	Percent	Std. Error
Preweaned calves (dairy or beef)	0.6	(0.3)	3.6	(0.6)
Dairy heifers weaned, but not bred	12.6	(2.2)	5.9	(0.7)
Bred dairy heifers	21.1	(2.3)	11.5	(0.9)
Lactating dairy cows	8.5	(1.5)	14.3	(1.1)
Dry dairy cows	2.3	(0.7)	4.4	(0.7)
Beef heifers and cows	1.5	(0.7)	1.3	(0.3)
Dairy bulls (weaned)	21.8	(2.6)	11.8	(0.9)
Beef bulls (weaned)	2.8	(0.9)	1.6	(0.3)
Steers (weaned)	0.3	(0.3)	1.9	(0.4)
Any	49.3	(3.0)	38.0	(1.5)

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

2. Source of replacements

Many diseases are initially introduced into a herd by the purchase of an infected animal. Knowing the source of purchased cattle may provide the buyer the opportunity to directly inquire about diseases on the source operation. Almost two-thirds of operations (64.2 percent) did not introduce cattle into their herds during the previous 12 months, which is slightly higher than the 61.1 percent reported in table b., p 13. The difference between the two estimates is likely the result of the different populations used to make the estimates: the 64.2 percent represents operations with 30 or more cows, while 61.1 percent represents operations with any dairy cows.

Only 2.6 percent of operations did not know the source of any cattle introduced in 2007, while 24.2 percent knew the source of all cattle introduced. A higher percentage of small operations than large operations had no incoming cattle. Of small operations, 67.4 percent had no incoming cattle, and 22.0 percent knew the source of all incoming cattle. About one-third of large operations (32.0 percent) knew the source of all incoming cattle, while 43.5 percent had no incoming cattle.

a. Percentage of operations in which the producer was aware of the source and geographic origin of all, some, or none of the incoming cattle during the previous 12 months, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Knew the Source and Geographic Origin of …	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
All incoming cattle	22.0	(3.3)	28.0	(3.8)	32.0	(5.2)	24.2	(2.4)
Some incoming cattle	8.6	(2.3)	7.8	(2.3)	19.1	(3.7)	9.0	(1.7)
None of the incoming cattle	2.0	(1.2)	3.6	(1.6)	5.4	(2.9)	2.6	(0.9)
No incoming cattle*	67.4	(3.7)	60.6	(4.2)	43.5	(5.7)	64.2	(2.8)
Total	100.0		100.0		100.0		100.0	

*If the operation sent heifers off-site but cattle were not commingled with cattle from other operations, these operations were considered to have no incoming cattle.
Source: NAHMS Dairy 2007.

Almost all operations (97.0 percent) had some replacement cows enter the milking herd. Replacement cows entering the milking herd accounted for over one-third (38.4 percent) of the January 1, 2007, cow inventory. Calves born and raised on the operation entered the milking herd as replacements on the majority of operations (89.8 percent). Cow replacements were born off the operation on 14.1 percent of operations, while 6.8 percent of operations had replacements born on the operation but raised elsewhere. Estimates for the percentage of cows entering the milking herd in table b. below and in table c. on the next page differ slightly because table b. represents operations with any dairy cows and table c. represents operations with 30 or more dairy cows; however, when considering the standard errors, the difference in the estimates are not statistically significant.

b. Percentage of operations[1] (and percentage of cow inventory), by source of cow replacements that entered the milking herd

Replacement Source	Percent Operations	Standard Error	Percent Cows[2]	Standard Error
Born and raised on operation	89.8	(0.8)	27.8	(0.8)
Born on operation, raised off operation	6.8	(0.6)	8.0	(0.7)
Born off operation	14.1	(1.0)	2.6	(0.2)
Any replacements	97.0	(0.5)	38.4	(0.8)

[1]Operations with any dairy cows.
[2]Number of replacements that entered the milking herd during 2006, as a percentage of the January 1, 2007, cow inventory.
Source: NAHMS Dairy 2007.

On operations with 30 or more dairy cows, over one-third of the milking herd inventory (36.2 percent) consisted of cow replacements that had entered the milking herd during the previous 12 months. There were no substantial differences by herd size.

c. Cow replacements that entered the milking herd during the previous 12 months, as a percentage of cow inventory on the day of interview, by herd size

Percent Cow Inventory							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
33.0	(1.1)	34.5	(1.1)	39.0	(2.6)	36.2	(1.2)

Source: NAHMS Dairy 2007.

Heifers born and raised on the operation constituted the highest percentage of cow replacements (58.8 percent) on all operations, over four-fifths of replacements on small operations (81.5 percent), three-fourths of replacements on medium operations (73.8 percent), and two-fifths of replacements on large operations (40.5 percent).

Some operations sent their heifer calves to off-site raising facilities—operations dedicated to raising dairy replacement calves. There are several advantages to off-site calf raising. The potential for contact between calves and older cattle is greatly reduced, decreasing the risk that young calves will contract diseases from older animals. The work force is dedicated solely to raising calves and, as a result, closer attention may be paid to the calves' care and feeding. In addition, off-site calf raising frees up space on the milking operation, creating more space for lactating cows. One disadvantage of off-site calf raising is the risk that calves will be exposed to infectious agents while off-site and return to their home operations carrying diseases which are new to the home herd. This is especially true if calves from more than one operation are commingled at a calf raising site (Villarroel et al., 2007).

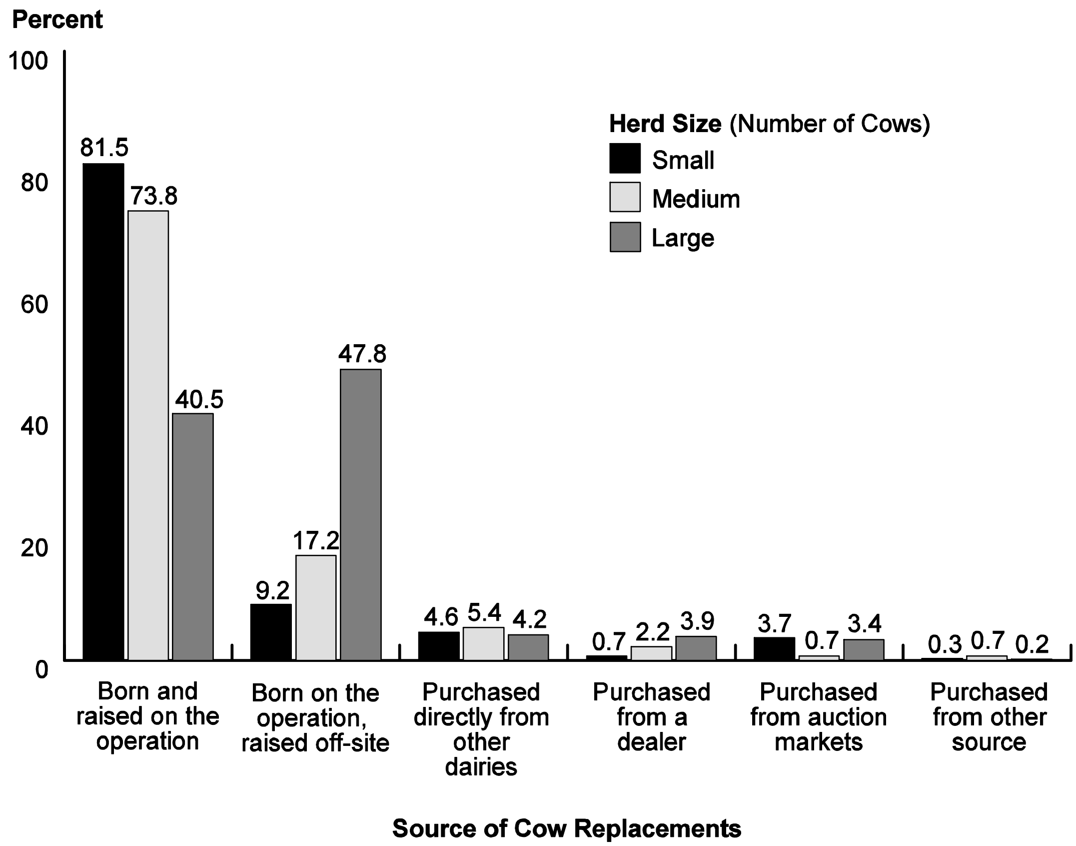
Heifers born on the operation and raised off-site accounted for the second highest percentage of cow replacements for all operations. Almost one-half of cow replacements for large operations (47.8 percent) were born on the operation but raised off-site. Heifers born on-site and raised off-site constituted much lower percentages of cow replacements for medium and small operations (17.2 and 9.2 percent, respectively).

d. Percentage of cow replacements that entered the milking herd during the previous 12 months, by source and by herd size

	Percent Cow Replacements							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Source of Cow Replacements	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Born and raised on the operation	81.5	(3.3)	73.8	(3.5)	40.5	(6.3)	58.8	(3.5)
Born on operation, raised off-site	9.2	(2.2)	17.2	(3.4)	47.8	(6.0)	30.8	(3.3)
Purchased directly from other dairies	4.6	(1.6)	5.4	(1.1)	4.2	(1.2)	4.6	(0.8)
Purchased from a dealer	0.7	(0.4)	2.2	(0.6)	3.9	(1.0)	2.7	(0.5)
Purchased from auction markets	3.7	(1.4)	0.7	(0.3)	3.4	(1.9)	2.7	(1.0)
Purchased from other source	0.3	(0.2)	0.7	(0.5)	0.2	(0.1)	0.4	(0.1)
Total	100.0		100.0		100.0		100.0	

Source: NAHMS Dairy 2007.

Percentage of Cow Replacements that Entered the Milking Herd During the Previous 12 Months, by Source and by Herd Size



Source: NAHMS Dairy 2007.

There were no substantial regional differences in the source of dairy cow replacements.

e. Percentage of cow replacements that entered the milking herd during the previous 12 months, by source and by region

	Percent Cow Replacements			
	Region			
	West		East	
Source of Cow Replacements	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Born and raised on the operation	50.6	(7.4)	64.3	(3.1)
Born on operation, raised off-site	40.4	(7.1)	24.3	(2.8)
Purchased directly from other dairies	2.3	(1.2)	6.2	(1.0)
Purchased from a dealer	2.2	(0.7)	3.1	(0.7)
Purchased from auction markets	4.2	(2.4)	1.7	(0.6)
Purchased from other source	0.3	(0.2)	0.4	(0.2)
Total	100.0		100.0	

Source: NAHMS Dairy 2007.

3. Number of cow-replacement shipments

Each shipment of cattle arriving at an operation presents the risk of introducing new pathogens to the operation, and more shipments mean more opportunities for disease introduction. Large operations received an average of 48.1 cow-replacement shipments during the previous 12 months compared with medium and small operations (6.0 and 2.6 shipments, respectively). Heifers born on-site and raised off-site constituted the most shipments of incoming cattle to operations of any size. Animals purchased from auction markets comprised the second largest average number of shipments received by large operations, which had an average of 28.3 shipments from auction markets during the previous 12 months. The operation average number of shipments for all cow-replacement sources was 9.7.

a. Operation average number of shipments by source of cow replacements during the previous 12 months, and by herd size

	Operation Average Number of Shipments							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Source of Cow Replacements	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error
Born on operation, raised off-site	5.5	(1.6)	11.1	(1.3)	55.9	(16.2)	20.9	(5.1)
Purchased directly from other dairies	1.5	(0.2)	2.3	(0.3)	5.3	(1.0)	2.1	(0.2)
Purchased from a dealer	1.4	(0.3)	2.9	(0.5)	6.0	(1.0)	3.3	(0.5)
Purchased from auction markets	3.0	(1.0)	2.0	(0.7)	28.3	(17.1)	7.8	(3.9)
Purchased from other source	4.0	(0.0)	3.0	(1.1)	2.8	(0.8)	3.3	(0.5)
All	2.6	(0.6)	6.0	(0.8)	48.1	(12.3)	9.7	(1.9)

Source: NAHMS Dairy 2007.

Operations in the West region had more shipments of heifers born on the operation but raised off-site (65.8 per year) than operations in the East region (10.9 per year). The number of shipments received from other sources was similar for the West and East regions. Although the average number of shipments from auction markets for operations in the West region was higher than the East region, the standard error is large and suggests a large variability in shipments among operations in the West region.

b. Operation average number of shipments by source of cow replacements during the previous 12 months, and by region

	Operation Average Number of Shipments			
	Region			
	West		East	
Source of Cow Replacements	Average	Std. Error	Average	Std. Error
Born on operation, raised off-site	65.8	(24.0)	10.9	(1.3)
Purchased directly from other dairies	5.9	(1.8)	1.9	(0.2)
Purchased from a dealer	5.5	(1.1)	2.7	(0.4)
Purchased from auction markets	28.3	(17.3)	2.9	(0.9)
Purchased from other source	3.7	(1.3)	3.2	(0.6)
All	45.5	(14.4)	5.0	(0.5)

Source: NAHMS Dairy 2007.

4. Replacement heifer calves

The percentage of operations in which heifers were born and raised on the operation decreased from 2002 to 2007. Accordingly, the percentage of heifers that were born on the operation and raised off the operation increased from 2002 to 2007, while the percentage of heifers born off the operation decreased. In 2002 and 2007, the majority of heifers were born and raised on the same operation, and the majority of operations had heifers that were born and raised on the operation. In 2007, more than 9 of 10 operations (96.5 percent) had some heifers that were born and raised on the operation; these operations accounted for 87.4 percent of heifers. On 4.7 percent of operations, heifers were born on the operation and raised off-site; these operations accounted for 11.5 percent of heifers. Of the January 1, 2007, heifer inventory, 12.6 percent of heifers spent part of their lives at another facility; they were either born on the operation and raised elsewhere (11.5 percent) or born off the operation (1.1 percent).

a. Percentage of operations[1] and percentage of heifers[2], by source of heifer replacements

	Dairy 2002				Dairy 2007			
	Operations		Heifers		Operations		Heifers	
Source of Replacement Heifers	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Born and raised on operation	98.1	(0.3)	89.5	(1.0)	96.5	(0.4)	87.4	(1.2)
Born on operation, raised off operation	3.6	(0.4)	7.2	(0.8)	4.7	(0.5)	11.5	(1.2)
Born off operation	6.7	(0.7)	3.3	(0.8)	6.6	(0.8)	1.1	(0.2)
Total			100.0				100.0	

[1]Operations with any dairy cows.
[2]As a percentage of January 1 heifer inventory.

Less than 1 of 10 operations (9.3 percent) raised heifers off-site in 2007. The percentage of operations using off-site heifer raisers increased as herd size increased, which was true for all heifer classes. Nearly one-half of large operations (46.0 percent) raised heifers off-site, compared with a noticeably smaller percentage of medium (15.5 percent) and small (4.7 percent) operations. Preweaned heifers were raised off-site by over one-third of large operations (35.3 percent), compared with 7.1 percent of medium and 1.7 percent of small operations. Similar herd-size differences were also seen in the percentages of operations that raised weaned and bred heifers off-site.

b. Percentage of operations* that raised any heifers off-site, by heifer class and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Heifer Class	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Preweaned	1.7	(0.5)	7.1	(1.2)	35.3	(2.9)	4.6	(0.5)
Weaned	4.3	(0.7)	14.6	(1.6)	44.2	(2.9)	8.6	(0.7)
Bred	4.1	(0.7)	11.5	(1.5)	22.5	(2.3)	6.7	(0.6)
Any	4.7	(0.7)	15.5	(1.7)	46.0	(2.9)	9.3	(0.7)

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

A major biosecurity concern related to off-site rearing facilities is the potential for heifers from one operation to have contact with animals from another operation. These contacts increase the likelihood that heifers will be exposed to new pathogens that can be carried back to their operations of origin. Ideally, only calves from a single operation would be housed at an off-site rearing facility. In 2007, about one-third of operations (36.2 percent) sent heifers to rearing facilities where they had no contact with cattle from other operations. Nearly two-thirds of operations that sent heifers off-site to be raised (63.8 percent) sent heifers to rearing facilities where they had contact with cattle from other operations.

c. Percentage of operations* that sent heifers off-site to be raised, by primary off-site rearing facility

Off-site Rearing Facility	Percent Operations	Standard Error
Heifers sent to a single rearing facility and did not have contact with cattle from other operations	27.7	(3.3)
Heifers sent to multiple rearing facilities and did not have contact with cattle from other operations	8.5	(2.1)
Heifers sent to a single rearing facility and had contact (commingled) with cattle from other operations	51.3	(4.0)
Heifers sent to multiple rearing facilities and had contact (commingled) with cattle from other operations	12.5	(3.0)
Total	100.0	

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

5. Vaccination requirements

There are several ways to decrease the risk associated with introducing new animals. Vaccination, quarantine, pre-introduction screening tests, testing of the source herd, and preventive treatments are all management practices that can reduce the disease risks associated with introducing new animals.

Knowing the vaccination history and status of new cattle entering the operation and requiring vaccination of new cattle against specific diseases prior to entry can protect the herd from the risk of diseases introduced by the new cattle. In addition, the new cattle can be protected from diseases endemic to the operation through vaccination.

Of operations bringing dairy cattle from outside sources onto the operation, less than one-half (47.2 percent) required vaccination of new additions prior to arrival. The vaccinations most commonly required were: bovine viral diarrhea (BVD) [42.9 percent of operations]; infectious bovine rhinotracheitis (IBR) [41.9 percent of operations]; leptospirosis (38.8 percent of operations); and brucellosis (35.6 percent of operations). For the diseases listed in the following table, a lower percentage of small operations required vaccination of new additions prior to arrival than medium or large operations.

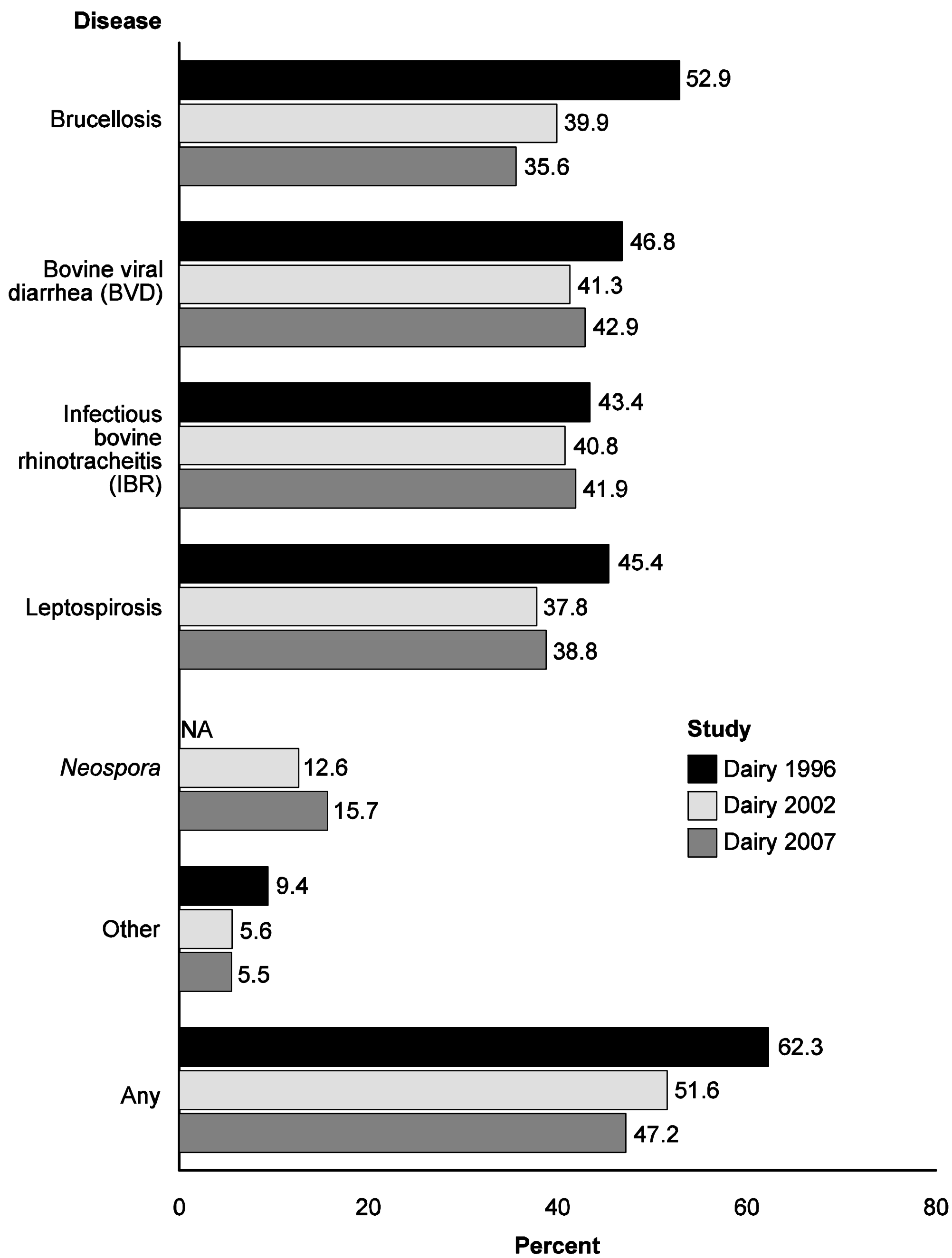
No change occurred from 1996 to 2007 in the percentages of operations that vaccinated new additions for BVD, IBR, and leptospirosis before the cattle were brought onto the operation. With the exception of *Neospora*, about one-third to one-half of operations vaccinated for the diseases mentioned in the following table. The percentage of operations that vaccinated for brucellosis decreased for each herd size from 1996 to 2007. Since many different ages of cattle were brought onto operations, the lower brucellosis vaccination percentages may partially be due to cattle too old for vaccination or to cattle that were already vaccinated for brucellosis at the time of purchase. *Neospora* vaccination remained unchanged in purchased cattle since 2002 for small, large, and all operations. The percentages of operations that vaccinated for any disease decreased for small, large, and all operations.

Percentage of operations* that normally required vaccination against the following diseases before bringing animals onto the operation, by herd size

	Percent Operations											
	Herd Size (Number of Cows)											
	Small (Fewer than 100)			Medium (100-499)			Large (500 or More)			All Operations		
Disease	**1996**	**2002**	**2007**	**1996**	**2002**	**2007**	**1996**	**2002**	**2007**	**1996**	**2002**	**2007**
Brucellosis	48.9 (2.5)	33.4 (2.5)	28.0 (2.6)	63.6 (2.9)	51.3 (2.7)	50.2 (3.5)	85.2 (3.0)	60.0 (3.1)	52.2 (3.9)	52.9 (2.0)	39.9 (1.9)	35.6 (2.0)
Bovine viral diarrhea (BVD)	43.1 (2.4)	36.2 (2.5)	34.8 (2.8)	59.4 (2.9)	51.2 (2.7)	59.9 (3.4)	58.8 (4.8)	53.9 (3.2)	56.7 (3.7)	46.8 (2.0)	41.3 (1.9)	42.9 (2.1)
Infectious bovine rhinotracheitis (IBR)	39.2 (2.3)	35.8 (2.6)	34.2 (2.8)	57.9 (2.9)	50.5 (2.7)	57.3 (3.4)	57.4 (4.8)	51.2 (3.2)	57.1 (3.7)	43.4 (1.9)	40.8 (1.9)	41.9 (2.1)
Leptospirosis	41.9 (2.4)	32.5 (2.5)	32.0 (2.7)	57.7 (2.9)	48.5 (2.7)	53.6 (3.4)	54.3 (4.8)	47.5 (3.2)	48.4 (3.8)	45.4 (2.0)	37.8 (1.8)	38.8 (2.1)
Neospora	NA	11.1 (1.6)	10.8 (1.7)	NA	15.5 (1.8)	26.6 (3.1)	NA	16.1 (2.3)	22.4 (3.3)	NA	12.6 (1.2)	15.7 (1.5)
Other	8.2 (1.1)	4.3 (0.8)	4.2 (1.1)	12.8 (2.2)	8.4 (1.4)	8.7 (1.8)	16.5 (3.6)	7.7 (1.5)	6.5 (1.6)	9.4 (1.0)	5.6 (0.7)	5.5 (0.9)
Any	58.0 (2.5)	44.6 (2.7)	37.7 (2.9)	74.8 (2.6)	64.0 (2.7)	65.2 (3.3)	88.8 (2.9)	71.9 (3.0)	68.5 (3.2)	62.3 (2.0)	51.6 (2.0)	47.2 (2.2)

*Operations with any dairy cows.
()=standard error.

Percentage of Operations* that Normally Required Vaccination Against the Following Diseases Before Bringing Animals onto the Operation



*Operations with any dairy cows.

6. Quarantine

For the purpose of this report, quarantine is defined as the physical separation of an animal or group of animals from other cattle on the operation. Purchased cattle should be quarantined for a minimum of 10 days and, ideally, up to 3 weeks (Villarroel et al., 2007). Quarantining can reduce the likelihood that new diseases will be introduced to the operation and usually provides sufficient time for the incubation and detection of some infectious diseases, namely: salmonellosis, vesicular stomatitis, foot-and-mouth disease, clinical BVD virus infections, and infections due to IBR virus. Quarantining is not effective in detecting infectious diseases with long incubation periods, such as Johne's disease and *Neospora* (Villarroel et al., 2007).

The objective of implementing a quarantine period is to prevent the transmission of respiratory, gastrointestinal, reproductive, and mastitis pathogens between animals. Quarantined animals should have no physical contact with other animals. Physical contact includes sniffing, touching, licking, nose-to-nose contact, shared fence lines, and shared waterers or feeders. Additionally, resident cattle should not have contact with the secretions, fluids, or manure of quarantined cattle, or the pen runoff from quarantined cattle. Moreover, the quarantine area should be far enough away from resident cattle to prevent airborne disease transmission.

In addition to the prevention of physical contact between new additions and resident cattle, attention must be paid to the people and equipment entering and leaving the quarantine area. Dedicating equipment and personnel exclusively to the quarantine area is the best way to prevent the spread of agents from quarantined animals. However, dedicating equipment and personnel exclusively to the quarantine area is not always feasible. In this case, equipment should be cleaned and disinfected before it is used outside the quarantine area. Personnel that care for both resident animals and quarantined new additions should work with the quarantined animals last and should wash their hands, change clothes, and clean and disinfect their boots before entering and leaving the quarantine area. Finally, personnel should be trained to recognize signs of illness in animals and frequently monitor the quarantined animals for signs of illness or disease.

Of operations that brought on new cattle in 2002 and 2007, approximately one of five (20.6 and 20.3 percent, respectively) quarantined new cattle. On operations that quarantined new cattle in 2007, the most common age groups quarantined were preweaned dairy or beef calves (44.2 percent of operations), beef heifers and cows (30.1 percent of operations), weaned steers (30.0 percent of operations), and dairy heifers, weaned but not bred (23.0 percent of operations). The most common additions to herds—bred dairy heifers, lactating cows, and dairy bulls—were quarantined on less than 20 percent of operations (14.5, 12.1, and 17.1 percent, respectively). There were no differences in the percentages of operations that quarantined new cattle of any class from 1996 to 2007.

a. Percentage of operations* that quarantined the following classes of cattle on arrival

	Percent Operations			Percent Operations			
Cattle Class	**Dairy 1996**	**Std. Error**	**Cattle Class**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Preweaned calves (dairy or beef)	26.9	(5.2)	Preweaned calves (dairy or beef)	37.0	(7.3)	44.2	(8.3)
Dairy heifers weaned, but not bred	24.9	(4.7)	Dairy heifers weaned, but not bred	23.9	(3.9)	23.0	(4.7)
Bred dairy heifers	16.0	(2.0)	Bred dairy heifers	19.6	(2.3)	14.5	(2.3)
Lactating dairy cows	6.2	(1.7)	Lactating dairy cows	9.5	(1.6)	12.1	(2.4)
Dry dairy cows	17.9	(4.8)	Dry dairy cows	7.1	(2.2)	15.9	(4.8)
Bulls (weaned)	11.2	(2.4)	Dairy bulls (weaned)	15.9	(2.4)	17.1	(2.9)
			Beef bulls (weaned)	23.6	(6.5)	20.3	(6.5)
Other heifers and cows (including beef)	15.7	(6.0)	Beef heifers and cows`	24.0	(8.5)	30.1	(9.8)
Steers (weaned)	21.0	(6.6)	Steers (weaned)	40.0	(11.4)	30.0	(9.6)
Any	16.2	(1.5)	Any	20.6	(1.6)	20.3	(1.7)

*Operations with any dairy cows.

The operation average number of days in quarantine for preweaned calves and weaned but not bred heifers were similar from 1996 to 2007. Preweaned calves spent about 40 days in quarantine and weaned but not bred heifers were quarantined for about 20 days. The length of quarantine for dry cows increased from an average of 8.9 days in 1996 to an average of 16.5 days in 2007.

b. Operation* average number of days new arrivals were quarantined, by cattle class

	Average Number of Days			Average Number of Days			
Cattle Class	Dairy 1996	Std. Error	Cattle Class	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Preweaned calves (dairy or beef)	40.8	(5.7)	Preweaned calves (dairy or beef)	49.2	(9.3)	42.4	(4.8)
Dairy heifers weaned, but not bred	21.5	(4.2)	Dairy heifers weaned, but not bred	28.2	(6.0)	20.0	(3.6)
Bred dairy heifers	16.8	(2.3)	Bred dairy heifers	23.7	(4.0)	22.0	(3.1)
Lactating dairy cows	11.7	(2.3)	Lactating dairy cows	20.1	(4.1)	15.6	(2.5)
Dry dairy cows	8.9	(2.1)	Dry dairy cows	21.4	(4.3)	16.5	(4.3)
Bulls (weaned)	21.0	(3.1)	Dairy bulls (weaned)	19.0	(2.5)	25.3	(3.5)
			Beef bulls (weaned)	32.0	(12.9)	31.9	(12.6)
Other heifers and cows (including beef)	24.3	(9.1)	Beef heifers and cows`	31.1	(6.6)	33.3	(12.1)
Steers (weaned)	41.5	(22.0)	Steers (weaned)	41.3	(14.0)	40.7	(18.7)

*Operations with any dairy cows.

7. Testing requirements

Testing individual animals for specific diseases before introducing them to the operation reduces the risk of introducing new diseases to the operation.

Nearly one-fourth of operations (23.3 percent) required testing for new additions in 2007. Of operations that brought beef or dairy cattle onto the operation, a higher percentage of large and medium operations (34.7 and 28.2 percent, respectively) than small operations (20.2 percent) required pre-introduction testing. The diseases most frequently tested for by all operations included: brucellosis, bovine tuberculosis (TB), and BVD (14.3, 13.8, and 13.3 percent of operations, respectively). There was no substantial change from 2002 to 2007 in the percentages of operations that tested new additions for brucellosis, Johne's disease, BVD, or TB.

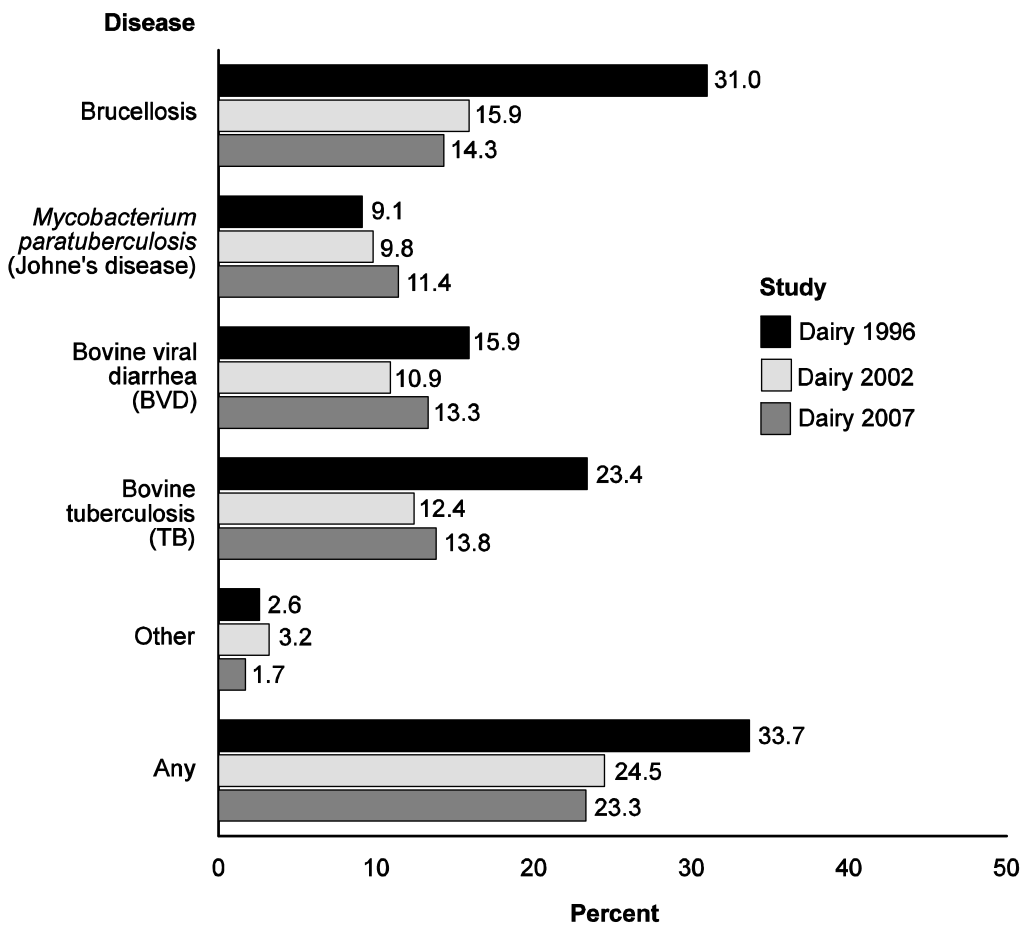
Brucellosis testing for new additions decreased across herd sizes from 1996 to 2007. TB testing also decreased for small, large, and all operations from 1996 to 2007. Testing for *Mycobacterium avium* subspecies *paratuberculosis* and BVD remained unchanged for all operations from 1996 to 2007. The percentage of operations that performed any testing decreased for small, large, and all operations from 1996 to 2007. Less than one of four operations that added new additions (23.3 percent) performed any testing during 2007.

a. Percentage of operations* that required testing of individual animals before introduction to the herd, by disease and by herd size

	Percent Operations											
	Herd Size (Number of Cows)											
	Small (Fewer than 100)			**Medium** (100-499)			**Large** (500 or More)			**All Operations**		
Disease	**1996**	**2002**	**2007**	**1996**	**2002**	**2007**	**1996**	**2002**	**2007**	**1996**	**2002**	**2007**
Brucellosis	28.5 (2.1)	13.1 (1.8)	11.6 (1.9)	38.3 (2.9)	19.5 (2.1)	19.8 (2.8)	50.6 (4.4)	29.9 (2.7)	19.0 (3.0)	31.0 (1.7)	15.9 (1.3)	14.3 (1.5)
Mycobacterium avium subspecies *paratuberculosis* (Johne's disease)	8.5 (1.3)	8.3 (1.4)	9.9 (1.8)	11.0 (2.3)	12.7 (1.9)	16.6 (2.7)	9.6 (2.9)	12.2 (1.9)	7.2 (1.8)	9.1 (1.1)	9.8 (1.1)	11.4 (1.4)
Bovine viral diarrhea (BVD)	15.1 (1.6)	8.6 (1.4)	10.7 (1.8)	18.4 (2.5)	15.6 (2.1)	19.4 (2.8)	19.4 (3.9)	15.0 (2.1)	15.8 (2.7)	15.9 (1.3)	10.9 (1.1)	13.3 (1.4)
Bovine tuberculosis (TB)	22.3 (1.9)	10.8 (1.5)	12.0 (1.8)	26.8 (2.7)	14.3 (1.7)	17.8 (2.7)	31.4 (4.2)	20.7 (2.3)	15.8 (2.3)	23.4 (1.6)	12.4 (1.1)	13.8 (1.4)
Contagious mastitis pathogens	NA	NA	10.5 (1.8)	NA	NA	13.1 (2.3)	NA	NA	16.3 (3.3)	NA	NA	11.7 (1.4)
Other	2.3 (0.5)	2.8 (0.8)	1.6 (0.6)	3.6 (1.4)	4.3 (1.3)	2.2 (1.0)	3.9 (2.1)	3.5 (1.1)	0.4 (0.2)	2.6 (0.5)	3.2 (0.6)	1.7 (0.5)
Any	31.3 (2.1)	21.2 (2.2)	20.2 (2.4)	40.0 (2.9)	29.4 (2.5)	28.2 (3.2)	54.3 (4.5)	38.8 (2.9)	34.7 (3.8)	33.7 (1.8)	24.5 (1.6)	23.3 (1.8)

*Operations with any dairy cows.
()=standard error.

Percentage of Operations* that Required Testing of Individual Animals Before Introduction to the Herd, by Disease



*Operations with any dairy cows.

Of operations that in 2007 did not require that new cattle be tested before introduction into the herd regardless of disease, about one-fourth reported that testing had been performed at the herd of origin or that the disease was not a concern to their operation. “Other” reasons for not requiring testing included: animals were not eligible for testing; animals were not at risk for disease transmission (such as testing weaned heifers or bulls for contagious mastitis pathogens); owners trusted the herd of origin; owners vaccinated and tested after the animals arrived; owners did not know how to vaccinate and/or test; and owners were bringing back their own cattle.

b. For operations that brought beef or dairy cattle onto the operation and did not require individual animal testing, percentage of operations* by reason for not testing and by disease

	Percent Operations									
	Disease									
	Brucellosis		Johne’s Disease		BVD		TB		Contagious Mastitis Pathogens	
Reason	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Tests already performed by herd of origin	25.6	(2.0)	22.3	(1.9)	25.9	(2.1)	25.1	(2.0)	23.8	(1.9)
Too expensive to test	4.3	(1.1)	5.9	(1.3)	4.1	(1.0)	4.2	(1.1)	4.3	(1.0)
Not enough time to test	9.5	(1.7)	8.9	(1.5)	9.9	(1.6)	9.4	(1.6)	10.7	(1.7)
Not recommended by veterinarian	7.7	(1.3)	6.8	(1.2)	6.1	(1.2)	7.4	(1.3)	5.7	(1.1)
Too many sources to test	2.5	(0.9)	1.8	(0.6)	2.7	(0.9)	2.3	(0.9)	2.8	(0.9)
Tests not reliable	0.2	(0.2)	4.4	(1.0)	1.0	(0.4)	0.7	(0.3)	0.7	(0.3)
Disease is not a concern to my operation	28.0	(2.3)	28.6	(2.2)	27.5	(2.2)	29.1	(2.3)	27.9	(2.2)
Other	22.2	(1.9)	21.3	(1.9)	22.8	(2.0)	21.8	(1.9)	24.1	(2.0)
Total	100.0		100.0		100.0		100.0		100.0	

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

8. Herd-of-origin disease status

Test results from the herd of origin can provide an indication of whether cattle from a particular herd may be infected with certain disease organisms. For many diseases, such as Johne's disease and contagious mastitis, knowing the disease status of the herd of origin can be more reliable than testing individual animals (Wells, 2000). In 2007 almost 3 of 10 operations (28.7 percent) required some information on the disease status of the herd of origin. The most commonly requested information was bulk-tank somatic cell count. The second and third most often requested test results were BVD status and Johne's disease status (18.9 and 17.2 percent of operations, respectively). The percentage of operations that required bulk-tank cultures for mastitis-causing organisms varied between small and large operations, with a lower percentage of small operations than large operations requiring cultures (10.1 and 20.9 percent, respectively).

a. Percentage of operations* by herd-of-origin information normally required by operation, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Herd-of-origin Information	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
BVD status	16.7	(2.3)	24.5	(3.0)	19.8	(3.0)	18.9	(1.7)
Johne's disease (*Mycobacterium paratuberculosis*) status	16.0	(2.2)	21.9	(2.9)	12.7	(2.3)	17.2	(1.7)
Bulk-tank milk somatic cell count	18.8	(2.4)	24.4	(3.1)	19.8	(2.9)	20.3	(1.8)
Bulk-tank milk culture	10.1	(1.7)	17.8	(2.8)	20.9	(2.9)	13.0	(1.4)
Other	2.8	(1.0)	2.3	(1.2)	1.3	(0.8)	2.6	(0.7)
Any information	25.4	(2.7)	36.0	(3.4)	32.9	(3.3)	28.7	(2.0)

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

For operations that did not require herd-of-origin information on the disease status for new arrivals in 2007, the most common reasons given for not requiring information (approximately 30 percent of operations across categories) were that the disease and/or bulk-tank milk somatic cell counts were not a concern to the operation. Additionally, 30.0 percent of these operations indicated that bulk-tank milk cultures from the herd of origin were not a concern to their operation, despite the fact that bulk-tank milk cultures are used to identify mastitis pathogens. Mastitis was the most prevalent disease-causing illness in cows, the second highest reported reason for removing cows from the herd, and the second highest reported cause of death. Similarly, 30.5 percent of operations that did not require herd-of-origin information indicated that BVD was not a concern to their operation, even though infertility—which can be associated with BVD—was the third most prevalent disease on operations. Moreover, reproductive problems, which include infertility, were the most common reason for permanently removing cows from the operation.

Other reasons for not evaluating herd-of-origin information were similar to reasons for not testing incoming cattle: trusted the herd of origin, owned the herd of origin, would address disease issues after cattle arrived, and did not know to test or inquire about these diseases.

b. For operations that brought beef or dairy cattle onto the operation and did not require the following herd-of-origin information, percentage of operations* by reason for not requiring information

	Percent Operations							
	Herd-of-origin Information							
	BVD Status		Johne's Disease Status		Bulk-tank Milk Somatic Cell Count		Bulk-Tank Milk Culture	
Reason Not Required	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Tests already performed by herd of origin	18.6	(1.8)	15.2	(1.6)	15.2	(1.6)	15.7	(1.6)
Too expensive to test	3.9	(1.1)	4.4	(1.2)	3.2	(1.0)	3.8	(1.1)
Not enough time to test	9.3	(1.6)	9.3	(1.5)	9.2	(1.6)	10.6	(1.6)
Not recommended by veterinarian	8.1	(1.4)	8.9	(1.4)	8.6	(1.4)	8.4	(1.4)
Too many sources to test	3.0	(1.0)	3.0	(1.0)	3.5	(1.1)	3.1	(1.0)
Tests not reliable	1.1	(0.4)	3.3	(0.9)	1.5	(0.5)	1.4	(0.5)
Not a concern to the operation	30.5	(2.4)	31.6	(2.3)	30.2	(2.3)	30.0	(2.3)
Other	25.5	(2.2)	24.3	(2.1)	28.6	(2.2)	27.0	(2.1)
Total	100.0		100.0		100.0		100.0	

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

C. On-farm Biosecurity and Biocontainment Practices

1. Employees and visitors

Employees or visitors—especially those who have contact with animals off the operation—can introduce disease agents via their boots, clothing, vehicles, or other equipment. As people travel more frequently throughout the world, the risk increases for inadvertent or intentional introduction of disease agents foreign to the United States. Establishing written policies or guidelines pertaining to visitor and employee animal contacts and travel is an important step in reducing the risk of disease introduction.

The percentage of operations that had employees increased from 47.2 percent in 2002 to 75.7 percent in 2007. The percentage of small operations with employees doubled from 32.2 percent in 2002 to 65.6 percent in 2007.

a. Percentage of operations that had employees during the previous 12 months, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Study Year	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
2002	32.2	(2.5)	84.2	(2.4)	99.0	(0.6)	47.2	(2.0)
2007*	65.6	(4.1)	95.0	(2.0)	98.0	(1.9)	75.7	(2.8)

*Question variation: 2007 estimates specifically exclude owners and family members.
Source: NAHMS Dairy 2007.

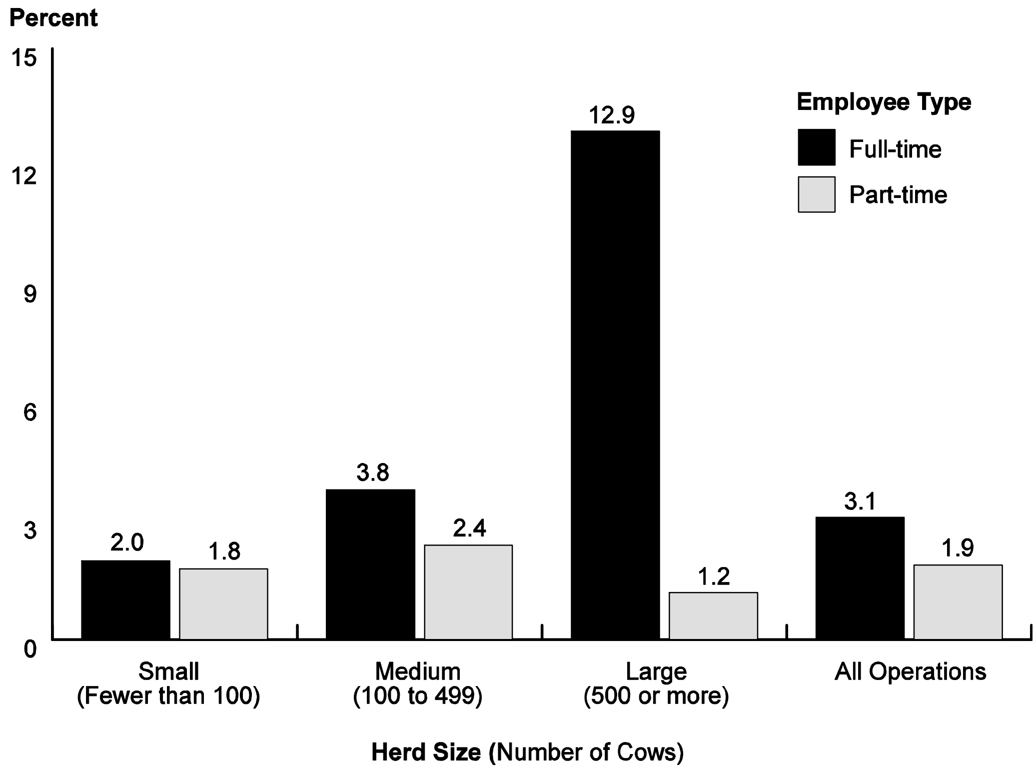
Not surprisingly, the number of full-time employees increased as herd size increased. Small operations averaged 2.0 full-time employees compared with 3.8 and 12.9 full-time employees on medium and large operations, respectively. Medium operations employed more part-time people on average than large operations (2.4 and 1.2 employees, respectively).

b. Operation average number of employees, by employee type and by herd size

	Operation Average Number Employees*							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Employee Type	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
Full-time	2.0	(0.1)	3.8	(0.1)	12.9	(0.8)	3.1	(0.1)
Part-time	1.8	(0.1)	2.4	(0.2)	1.2	(0.2)	1.9	(0.1)

*Paid and unpaid, including owners and family members assigned work duties directly related to the dairy's operation.
Source: NAHMS Dairy 2007.

Operation Average Number of Employees*, by Employee Type and by Herd Size



*Paid and unpaid, including owners and family members assigned work duties directly related to the dairy's operation.
Source: NAHMS Dairy 2007.

Operations in the West region averaged more full-time employees (7.8) than operations in the East region (2.7). Operations in the East region averaged more part-time employees than operations in the West region. These differences were likely related to the larger herd sizes in the West region.

c. Operation average number of employees, by employee type and by region

	Operation Average Number Employees*			
	Region			
	West		East	
Employee Type	Average	Std. Error	Average	Std. Error
Full-time	7.8	(0.7)	2.7	(0.1)
Part-time	1.0	(0.1)	2.0	(0.1)

*Paid and unpaid, including owners and family members assigned work duties directly related to the dairy's operation.
Source: NAHMS Dairy 2007.

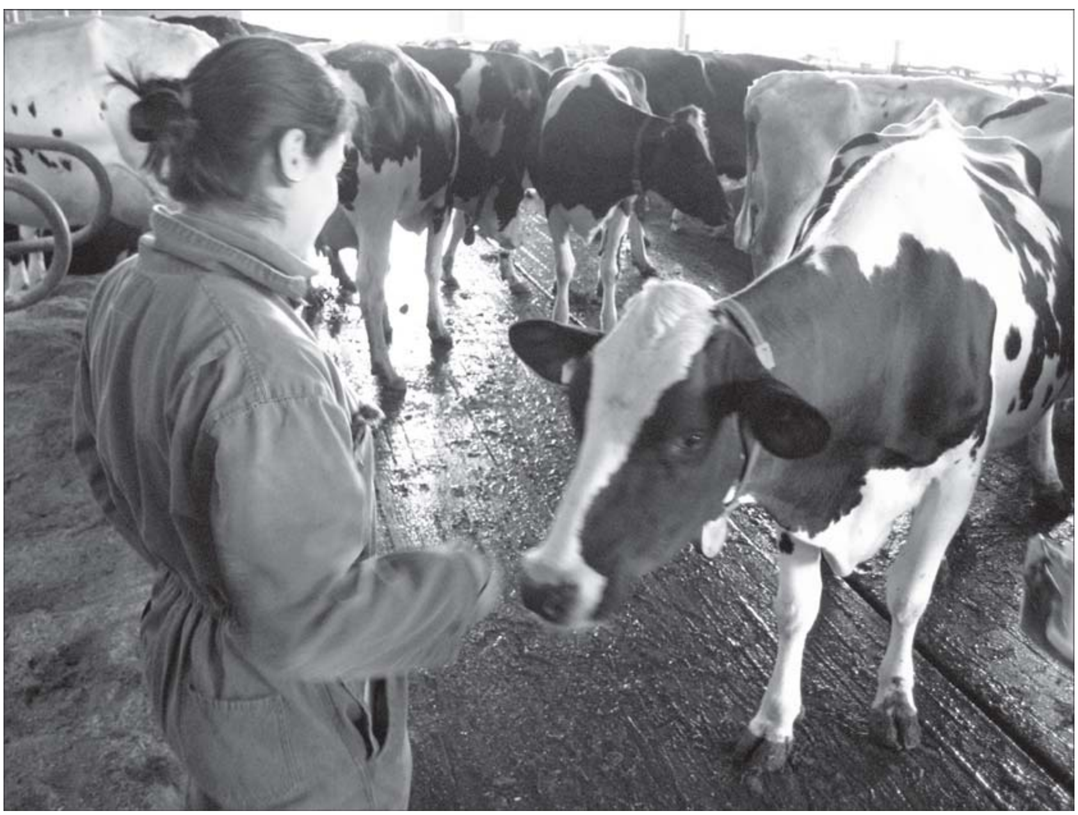


Photo courtesy of Dr. Jason Lombard.

In addition to employees, dairy operations have regular and frequent visits from a variety of people doing business with the operation, including delivery people, milk haulers, cattle haulers, artificial insemination technicians, nutritionists, and veterinarians. These people, who may or may not have contact with cattle on the operation and multiple other operations, have the potential to carry diseases from one operation to another.

In an average week, over one-half of all operations (51.6 percent) had between 1 and 14 visits by people coming onto the operation. Nearly two-thirds of small operations reported between 1 and 14 visits, and one-fifth of small operations reported 29 or more visits per week. As expected, the number of visits per week increased as herd size increased. Nearly three-fourths of large operations (72.2 percent) reported 29 or more visits per week compared with about one-half of medium operations (47.6 percent) and one-fifth of small operations (20.0 percent).

d. Percentage of operations by number of visits* per week and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Number of Visits (per Week)	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1 to 7	35.6	(3.7)	13.7	(3.0)	1.2	(0.7)	28.0	(2.7)
8 to 14	28.4	(3.6)	16.5	(3.3)	0.8	(0.5)	23.6	(2.6)
15 to 21	9.0	(2.0)	12.5	(2.8)	13.7	(4.8)	10.2	(1.6)
22 to 28	7.0	(1.7)	9.7	(2.6)	12.1	(4.0)	8.0	(1.4)
29 or more	20.0	(3.1)	47.6	(4.1)	72.2	(5.3)	30.2	(2.4)
Total	100.0		100.0		100.0		100.0	

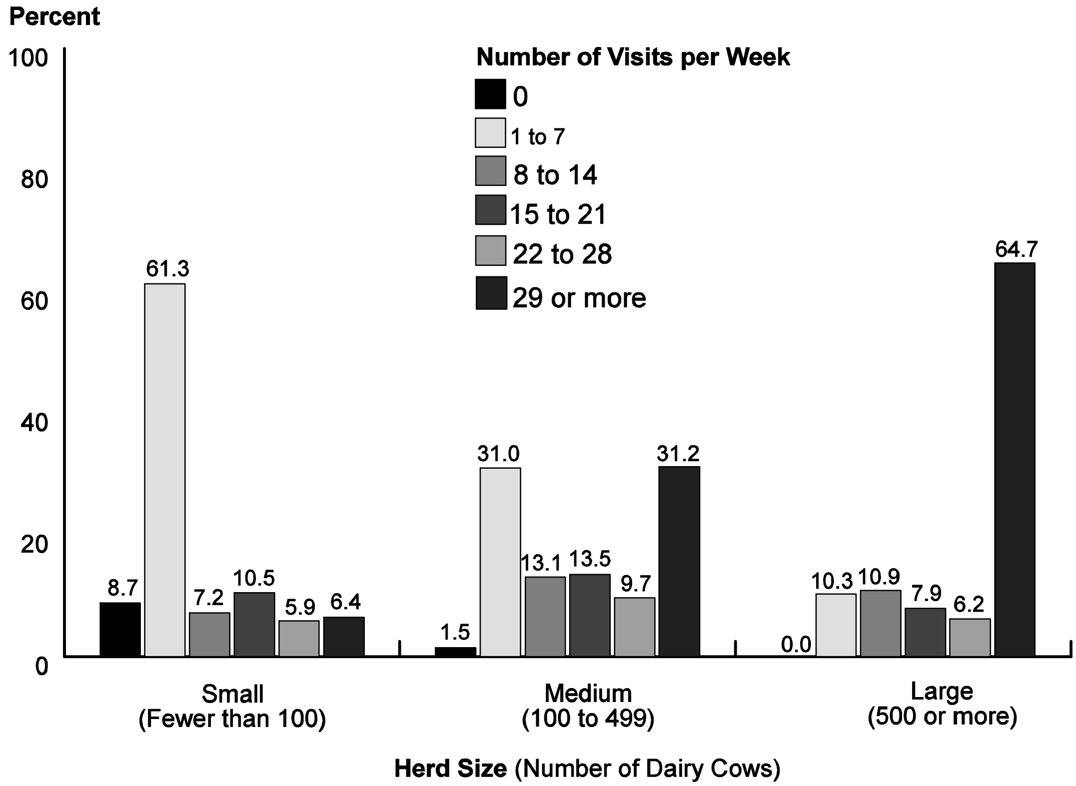
*Includes employees, veterinarians, neighbors, nutritionists, milk haulers, etc.
Source: NAHMS Dairy 2007.

For operations in which any visits to the operation involved contact with animals on the operation, about one-half of operations (50.7 percent) had one to seven visits per week that involved contact with animals on the operation. About 1 of 6 operations (16.0 percent) had 29 or more visits that resulted in contact with animals. The number of visits that involved animal contact increased as herd size increased.

e. Percentage of operations by number of visits per week that involved animal contact, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Number of Visits (Per Week)	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
0 or None	8.7	(1.9)	1.5	(0.7)	0.0	(0.0)	6.4	(1.3)
1 to 7	61.3	(3.7)	31.0	(3.8)	10.3	(3.7)	50.7	(2.8)
8 to 14	7.2	(1.9)	13.1	(2.8)	10.9	(3.8)	8.9	(1.5)
15 to 21	10.5	(2.4)	13.5	(3.1)	7.9	(3.4)	11.1	(1.8)
22 to 28	5.9	(1.8)	9.7	(2.2)	6.2	(3.1)	6.9	(1.4)
29 or more	6.4	(1.8)	31.2	(3.6)	64.7	(5.4)	16.0	(1.6)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Number of Visits per Week that Involved Animal Contact, and by Herd Size



2. Specific biosecurity practices

Implementing biosecurity practices reduces the introduction of disease. Since employees and visitors are potential sources of disease, operations should have restrictions and guidelines for employees and visitors designed to limit disease introduction.

Specific biosecurity practices that help keep human and vehicle traffic in animal areas to a minimum include: controlling the number of visitors and their contact with animals, establishing a designated farm entrance and visitor parking, and requiring that visitors check in at the office. In addition, locating feed storage areas and areas for carcass pickup at the perimeter of the operation restricts vehicle contact with animal areas on the operation. Requiring visitors who enter animal areas to have clean boots and clothing, or providing them with boots and coveralls, also helps reduce the risk of disease introduction.

Approximately one of five operations with employees (18.1 percent) had restrictions on employee ownership of livestock outside the operation in 2007. Overall, about 1 of 10 operations had guidelines regarding foreign travel by employees: 14.7 percent of large, 16.0 percent of medium, and 9.7 percent of small operations had such guidelines.

Biosecurity plans are easiest to implement if they are in writing and reviewed and adjusted periodically to meet the changing needs of the operation (Center for Food Security and Public Health-b). Written plans can be referred to at any time for review and to address questions about the plan’s requirements. In 2007, only 1 of 10 operations (12.2 percent) had written standard operating procedures (SOPs) for procedures other than milking. A higher percentage of large operations (23.0 percent) had written SOPs than medium and small operations (13.2 and 10.9 percent, respectively).

Training employees in proper practices is also critical to the success of any biosecurity program. For a plan to be successful, all team members must understand and support the plan. A higher percentage of large operations (47.3 percent) trained employees in performing biosecurity practices in 2007 compared with medium and small operations (23.7 and 17.8 percent, respectively).

The percentage of operations that placed restrictions on employee ownership of livestock outside the operation, had guidelines regarding foreign travel by employees, and trained employees in performing biosecurity practices declined from 2002 to 2007. Alternatively, the percentage of operations that had written SOPs (other than milking procedures) increased from 5.1 percent in 2002 to 12.2 percent in 2007.

a. Percentage of operations by employee biosecurity practices used and by herd size

	Percent Operations															
	Herd Size (Number of Cows)															
	Small (Fewer than 100)				Medium (100-499)				Large (500 or More)				All Operations			
	2002		2007		2002		2007		2002		2007		2002		2007	
Employee Biosecurity Practice	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Restrictions on employee livestock ownership outside this operation	19.7	(3.5)	17.4	(3.7)	34.6	(3.1)	18.6	(3.5)	38.6	(4.1)	20.1	(4.7)	27.7	(2.2)	18.1	(2.5)
Guidelines regarding foreign travel by employees	19.9	(4.1)	9.7	(2.7)	22.6	(2.6)	16.0	(3.6)	28.8	(3.9)	14.7	(3.7)	21.8	(2.3)	12.0	(2.0)
Written SOP (other than milking procedures)	7.4	(2.4)	10.9	(2.7)	6.7	(1.4)	13.2	(2.9)	18.9	(13.1)	23.0	(4.8)	5.1	(0.8)	12.2	(2.0)
Training for employees in performing biosecurity practices	35.0	(4.5)	17.8	(3.4)	48.5	(3.3)	23.7	(3.6)	50.9	(4.2)	47.3	(6.2)	42.1	(2.7)	21.9	(2.5)

In 2007, 3 of 10 operations (30.4 percent) had guidelines for determining which visitors were allowed in animal areas, and 6.9 percent had footbaths for visitors entering animal areas. About twice the percentage of large operations (12.1 percent) had footbaths compared with medium and small operations (7.2 and 6.3 percent, respectively). Over one-fourth of operations that had visitors (28.3 percent) provided disposable or clean boots to visitors entering animal areas. A higher percentage of medium and large operations (42.1 and 36.3 percent, respectively) provided footwear compared with small operations (22.7 percent). Over one-half of operations (51.3 percent) had restrictions on vehicles entering animal areas.

A higher percentage of operations in 2007 than in 2002 required disposable or clean boots for visitors entering animal areas and had restrictions on vehicles entering animal areas. The percentage of operations that had guidelines regarding which visitors were allowed in animal areas or that had footbaths for visitors entering animal areas remained unchanged from 2002 to 2007.

b. Percentage of operations by visitor biosecurity practices used and by herd size

	Percent Operations															
	Herd Size (Number of Cows)															
	Small (Fewer than 100)				**Medium** (100-499)				**Large** (500 or More)				**All Operations**			
	2002		**2007**		**2002**		**2007**		**2002**		**2007**		**2002**		**2007**	
Visitor Biosecurity Practice	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Guidelines regarding which visitors are allowed in animal areas	33.3	(2.9)	28.0	(3.4)	49.9	(3.3)	35.2	(4.3)	55.2	(4.4)	39.9	(5.9)	38.6	(2.0)	30.4	(2.6)
Footbaths for visitors entering animal areas	4.6	(1.2)	6.3	(1.7)	10.1	(1.8)	7.2	(1.9)	12.7	(2.1)	12.1	(3.5)	6.3	(1.0)	6.9	(1.3)
Disposable or clean boots for visitors entering animal areas	13.2	(2.0)	22.7	(3.3)	31.5	(3.0)	42.1	(4.2)	39.0	(4.2)	36.3	(5.5)	18.9	(1.6)	28.3	(2.6)
Restrictions on vehicles entering animal areas	40.4	(3.0)	51.0	(3.8)	46.3	(3.2)	54.5	(4.1)	39.0	(4.3)	41.9	(6.1)	41.8	(2.3)	51.3	(2.9)

The majority of operations used insect and rodent control practices during 2002 and 2007. Nearly one-half of operations limited cattle contact with other livestock, elk, and deer and controlled access to feed by other livestock and wildlife. There were no differences in the percentages of all operations that implemented a specific biosecurity practice from 2002 to 2007.

In 2007, over one-half of operations (56.2 percent) had closed herds, defined as all replacements come from the operation and the herd has no contact with cattle from other operations. A higher percentage of small operations than large operations (60.1 and 40.6 percent, respectively) were closed herds.

c. Percentage of operations that used the following biosecurity practices during the previous 12 months to prevent disease, by herd size

	Percent Operations															
	Herd Size (Number of Cows)															
	Small (Fewer than 100)				Medium (100-499)				Large (500 or More)				All Operations			
	2002		2007		2002		2007		2002		2007		2002		2007	
Biosecurity Practice	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Insect control	93.8	(1.3)	86.5	(2.7)	88.7	(2.1)	88.3	(2.7)	92.8	(2.0)	93.6	(3.0)	92.5	(1.1)	87.4	(2.0)
Rodent control	96.0	(1.1)	95.7	(1.4)	91.7	(1.9)	91.8	(2.0)	88.6	(2.7)	90.3	(3.4)	94.7	(0.9)	94.4	(1.1)
Bird control	25.2	(2.4)	29.4	(3.6)	38.8	(3.0)	44.3	(4.2)	42.1	(4.0)	41.4	(5.6)	29.1	(1.9)	33.8	(2.7)
Limit cattle contact with other livestock, elk, and deer	36.4	(2.7)	44.8	(3.8)	53.7	(3.0)	55.7	(4.2)	58.9	(4.1)	59.6	(5.6)	41.4	(2.1)	48.5	(2.8)
Control access to cattle feed by other livestock and wildlife	52.1	(2.7)	52.0	(3.9)	58.7	(2.9)	46.8	(4.2)	52.0	(4.2)	40.1	(5.4)	53.7	(2.1)	49.9	(2.9)
Closed herd*	64.5	(2.7)	60.1	(3.9)	47.6	(3.1)	49.5	(4.2)	38.4	(4.2)	40.6	(5.6)	59.5	(2.1)	56.2	(2.9)

*All replacements are from the operation; no contact with cattle from other operations.

3. Calving/ maternity areas

Parturition presents disease risks to cows and newborn calves. Periparturient cows may be immunosuppressed, and newborn calves have immature immune systems, placing both groups at high risk for contracting disease (McGuirk and Collins, 2004). Newborn calves are susceptible to respiratory and enteric pathogens, including *Mycobacterium avium* subspecies *paratuberculosis*, which causes Johne's disease. Having a dedicated maternity area separate from lactating cows reduces the risk of disease transmission to both newborn calves and their dams.

Nearly two-thirds of operations (60.0 percent) had a separate maternity area from lactating cows in 2007. About 9 of 10 large operations and 8 of 10 medium operations (90.4 and 80.8 percent, respectively) had separate maternity areas compared with 5 of 10 small operations (51.5 percent). A higher percentage of small and medium operations in 2007 than in 1996 housed maternity cows separately from lactating cows. The use of separate maternity housing increased from 45.4 percent of operations in 1996 to 60.0 percent in 2007.

a. Percentage of operations* in which maternity housing was separate from housing used for lactating cows, by herd size

	Percent Operations					
Herd Size (Number of Cows)	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Small (fewer than 100)	39.1	(1.3)	43.5	(1.6)	51.5	(1.7)
Medium (100 to 499)	72.6	(2.1)	81.6	(1.7)	80.8	(1.8)
Large (500 or more)	94.5	(1.8)	91.9	(1.5)	90.4	(2.0)
All operations	45.4	(1.2)	53.1	(1.3)	60.0	(1.3)

*Operations with any dairy cows.

The usual calving area was defined as an area designated specifically for calving and separate from housing for lactating cows. Tie stalls or stanchions were not considered usual calving areas for the purpose of this report. The percentage of operations with a usual calving area ranged from 62.5 percent of small operations to 98.2 percent of large operations.

b. Percentage of operations that had a usual calving area, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Percent	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
62.5	(3.8)	83.7	(3.3)	98.2	(1.2)	70.1	(2.7)

Source: NAHMS Dairy 2007.

In 2007 nearly 90 percent of calves on operations with a usual calving area were born in the calving area. Large operations had a higher percentage of calves born in a usual calving area (93.6 percent) than small operations (79.9 percent).

c. For the 70.1 percent of operations with a usual calving area, percentage of calves born in a usual calving area, by herd size

Percent Calves							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
79.9	(2.0)	89.0	(1.3)	93.6	(1.3)	89.8	(0.9)

Source: NAHMS Dairy 2007.

A higher percentage of small operations (37.6 percent) had between 0.0 and 75.9 percent of calves born in a usual calving area compared with medium and large operations (14.9 and 7.3 percent, respectively). In addition, 91.0 percent or more of calves were born in a usual calving area on 33.8, 56.1, and 68.7 percent of small, medium, and large operations, respectively.

d. Percentage of operations by percentage of calves born in a usual calving area, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Percent Calves	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
0.0 to 50.9	19.3	(3.8)	8.4	(2.5)	3.7	(2.0)	14.7	(2.5)
51.0 to 75.9	18.3	(3.9)	6.5	(2.3)	3.6	(2.0)	13.5	(2.5)
76.0 to 90.9	28.6	(4.3)	29.0	(4.2)	24.0	(4.5)	28.3	(3.0)
91.0 to 99.9	16.6	(3.2)	38.4	(4.5)	45.8	(5.7)	25.6	(2.5)
100	17.2	(3.3)	17.7	(3.3)	22.9	(5.5)	17.9	(2.3)
Total	100.0		100.0		100.0		100.0	

Source: NAHMS Dairy 2007.

In 2007, 70.0 percent of operations used multiple-animal areas or pens for calving. A higher percentage of medium operations (79.8 percent) used a multiple-animal area/pen for calving compared with small operations (65.6 percent).

Slightly more than one-fourth of operations (25.5 percent) used an individual calving area/ pen that was cleaned between calvings, and one-fourth of operations (26.2 percent) used an individual calving area/pen that was cleaned after two or more calvings.

e. Percentage of operations by area usually used for calving and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Calving Area	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Multiple animal area/pen	65.6	(3.5)	79.8	(3.5)	78.5	(4.3)	70.0	(2.6)
Individual animal area/pen cleaned between each calving	30.6	(3.4)	14.6	(3.3)	13.5	(3.9)	25.5	(2.5)
Individual animal area/pen cleaned after two or more calvings	25.4	(3.3)	27.4	(3.7)	30.3	(5.6)	26.2	(2.5)
Other	5.1	(1.7)	3.6	(1.4)	3.1	(1.7)	4.6	(1.2)

Source: NAHMS Dairy 2007.

Of operations with a usual calving area in 2007, 39.9 percent moved cows into the calving area within a day prior to calving. Over 40 percent of operations in the East region (41.4 percent) placed cows in calving pens/areas within 1 day of calving compared with less than 3 of 10 operations in the West region (28.6 percent). Operations in the West region moved cows into calving pens earlier than operations in the East region.

f. For the 70.1 percent of operations with a usual calving area, percentage of operations by number of days cows remained in a usual calving area/pen *prior* to calving, and by region

	Percent Operations					
	Region					
	West		East		All Operations	
Number of Days	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1 or less	28.6	(4.9)	41.4	(3.6)	39.9	(3.2)
1.1 to 3.0	8.3	(2.9)	15.4	(2.6)	14.6	(2.3)
3.1 to 14.0	36.4	(5.6)	25.3	(3.1)	26.6	(2.8)
14.1 or more	26.7	(4.9)	17.9	(2.5)	18.9	(2.3)
Total	100.0		100.0		100.0	

Source: NAHMS Dairy 2007.

In 2007, few operations (12.9 percent) removed cows from the calving area in the first hour after calving. A higher percentage of small operations (25.0 percent) left cows in the calving area for more than 14 hours compared with large operations (6.2 percent). On 41.4 percent of operations, cows spent 3.1 to 14.0 hours in a calving area/pen after calving.

g. For the 70.1 percent of operations with a usual calving area, percentage of operations by number of hours cows remained in the usual calving area/pen *after* calving, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Number of Hours	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Removed immediately	4.4	(1.8)	2.7	(1.3)	7.2	(3.0)	4.2	(1.2)
0.25 to 1.0	8.0	(2.3)	7.8	(2.1)	16.5	(3.8)	8.7	(1.6)
1.1 to 3.0	22.5	(4.0)	26.1	(4.0)	28.0	(5.4)	24.1	(2.8)
3.1 to 14.0	40.1	(4.6)	44.0	(4.4)	42.1	(5.5)	41.4	(3.2)
14.1 or more	25.0	(4.2)	19.4	(3.9)	6.2	(3.2)	21.6	(2.8)
Total	100.0		100.0		100.0		100.0	

Source: NAHMS Dairy 2007.

No regional differences were observed in the length of time cows spent in the calving area after calving in 2007.

h. For the 70.1 percent of operations with a usual calving area, percentage of operations by number of hours cows remained in the usual calving area/pen *after* calving, and by region

	Percent Operations			
	Region			
	West		East	
Number of Hours	Percent	Std. Error	Percent	Std. Error
Removed immediately	6.7	(2.7)	3.9	(1.3)
0.25 to 1.0	7.3	(2.7)	8.9	(1.7)
1.1 to 3.0	22.6	(4.9)	24.3	(3.1)
3.1 to 14.0	44.6	(5.8)	41.0	(3.5)
14.1 or more	18.8	(4.9)	21.9	(3.2)
Total	100.0		100.0	

Source: NAHMS Dairy 2007.

Keeping sick cows in the calving area is a potential source of disease for dams and newborn calves. Over one-third of operations (34.2 percent) allowed sick cows in the calving area in 2007. A higher percentage of small operations (37.3 percent) allowed sick cows in the calving area compared with large operations (16.5 percent). Almost one-half of operations (51.6 percent) allowed lame cows into the calving area.

i. For the 70.1 percent of operations with a usual calving area, percentage of operations that allowed sick and/or lame cows in the calving area, by cattle class and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Cattle Class	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Sick cows	37.3	(4.6)	33.0	(4.5)	16.5	(4.4)	34.2	(3.2)
Lame cows	51.8	(4.6)	57.9	(4.4)	28.6	(4.5)	51.6	(3.1)
Other	5.4	(2.0)	5.8	(2.3)	4.1	(2.2)	5.4	(1.4)
Any of the above	56.4	(4.6)	62.3	(4.2)	30.7	(4.6)	55.8	(3.1)

Source: NAHMS Dairy 2007.

The percentage of operations participating in a Johne's disease control or certification program has increased for each herd size category and for all operations since 1996. Less than 1 percent of operations participated in a Johne's disease control or certification program in 1996 compared with 11.2 percent in 2002 and 31.7 percent in 2007.

j. Percentage of operations that participated in any Johne's disease control or certification program, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Study	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Dairy 1996*	1.0	(0.4)	0.5	(0.4)	0.4	(0.4)	0.9	(0.3)
Dairy 2002*	9.5	(1.7)	16.5	(2.3)	11.3	(2.3)	11.2	(1.4)
Dairy 2007	27.7	(3.3)	42.1	(4.1)	33.3	(4.5)	31.7	(2.5)

*Question variation: In 1996: "Is this operation currently on a Johne's certification program." In 2002: "Does operation participate in a Johne's disease herd status, control, or certification program."

A Johne's disease control program may include testing individual animals in order to identify those shedding *Mycobacterium avium* subspecies *paratuberculosis*, which present a risk to uninfected animals on the operation. The percentage of operations that tested for Johne's disease increased across herd sizes from 1996 to 2002 and for all operations from 1996 to 2007: 13.1 percent of operations tested for Johne's in 1996, 25.7 percent tested in 2002, and 35.3 percent tested in 2007. A higher percentage of medium operations (47.6 percent) tested for Johne's disease in 2007 compared with small operations (30.7 percent). Based on the percentage of operations that participated in a control program (see previous table), a substantial percentage of operations performed testing without being formally enrolled in a Johne's disease control or certification program.

k. Percentage of operations that performed any testing for Johne's disease, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Study Year	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1996*	10.5	(1.3)	22.0	(2.4)	19.9	(4.3)	13.1	(1.1)
2002	20.4	(2.5)	39.5	(3.3)	38.3	(4.0)	25.7	(1.9)
2007	30.7	(3.4)	47.6	(4.1)	37.5	(5.7)	35.3	(2.6)

*Question variation: 1996 estimate was operations that tested in the last 24 months, while the 2002 and 2007 estimates are for testing performed in the previous 12 months.

Cows test-positive for Johne's disease can contaminate the calving area and transmit the disease to newborn calves. Test-positive animals should not be allowed in the calving area or other calf areas. There was no herd-size difference in the percentage of operations that allowed Johne's disease test-positive animals into the calving area; 15.5 percent of operations that tested for Johne's disease allowed test-positive cows in the calving area in 2007.

l. For operations with a usual calving area and that tested for Johne's disease, percentage of operations that allowed Johne's test-positive cows in the usual calving area, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
12.0	(4.5)	18.0	(5.0)	30.2	(8.3)	15.5	(3.2)

Source: NAHMS Dairy 2007.

4. Newborn calf risks and contact with other cattle

Separating newborn calves from their dams soon after they are born helps prevent disease transmission that can occur through nursing or contact with adult cow feces in maternity areas. Milk from dams infected with *Mycoplasma, Salmonella, E. coli, Mycobacterium avium* subspecies *paratuberculosis*, or BVD can transmit these diseases to calves (Wells, 2000; Nielsen et al., 2008). Feeding preweaned calves pasteurized milk, milk replacer, or milk from known disease-free cows is recommended.

The percentage of operations that separated newborn calves from their dams immediately after they were born doubled from 1991 to 2007 (28.0 to 55.9 percent of operations, respectively). In 2007, 22.2 percent of operations allowed calves to nurse from their dams but removed them from their dams less than 12 hours following birth. In 2007, about two-thirds of calves (65.6 percent) were on operations that removed calves from their dams immediately following birth. Less than 1 of 10 operations (7.3 percent)—representing 2.6 percent of calves—allowed calves to stay with their dams for more than 24 hours.

a. Percentage of operations* by number of hours following birth that calves were separated from their dams

	Percent Operations			Percent Operations					
Number of Hours	**NDHEP 1991**	**Std. Error**	**Number of Hours**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Removed immediately	28.0	(1.7)	Removed immediately	47.9	(1.3)	52.9	(1.3)	55.9	(1.4)
Less than 12	39.6	(1.7)	After nursing, but less than 12 hours	20.8	(1.0)	22.5	(1.1)	22.2	(1.2)
12 to 24	22.0	(1.4)	12 to 24	17.4	(1.1)	15.9	(1.0)	14.6	(1.0)
More than 24	10.4	(1.0)	More than 24	13.9	(1.0)	8.7	(0.8)	7.3	(0.8)
Total	100.0		Total	100.0		100.0		100.0	

*Operations with any dairy cows.

Keeping preweaned calves separate from older animals is an effective way to reduce their exposure to disease. Preweaned calves are more susceptible to disease than older, healthy animals because their immune system is not yet fully developed (BAMN, 2001b). Physical contact between preweaned calves and cattle from older age groups (including nose-to-nose, sniffing, touching, licking, or contact across fence lines) increases the risk of exposing the calves to diseases such as salmonellosis, Johne's disease, and upper respiratory diseases.

The percentage of operations in which preweaned heifers were not exposed to weaned calves, bred heifers, or adult cattle increased from 1996 to 2007.

b. Percentage of operations[1] in which after separation from the dam preweaned heifers did not have physical contact[2] with the following cattle classes

<table>
<tr><th></th><th colspan="8">Percent Operations</th></tr>
<tr><th>Cattle Class</th><th>NDHEP 1991</th><th>Std. Error</th><th>Dairy 1996</th><th>Std. Error</th><th>Dairy 2002</th><th>Std. Error</th><th>Dairy 2007</th><th>Std. Error</th></tr>
<tr><td>Weaned calves less than approximately 4 months of age</td><td>68.5</td><td>(2.0)</td><td rowspan="2">67.0</td><td rowspan="2">(1.3)</td><td rowspan="2">77.2</td><td rowspan="2">(1.2)</td><td rowspan="2">76.0</td><td rowspan="2">(1.2)</td></tr>
<tr><td>Calves from approximately 4 months of age to breeding</td><td>89.6</td><td>(1.3)</td></tr>
<tr><td>Bred heifers not yet calved</td><td>95.4</td><td>(0.9)</td><td>81.2</td><td>(1.1)</td><td>86.7</td><td>(0.9)</td><td>86.8</td><td>(1.0)</td></tr>
<tr><td>Adult cattle</td><td>89.8</td><td>(1.3)</td><td>79.8</td><td>(1.1)</td><td>84.6</td><td>(1.0)</td><td>84.3</td><td>(1.1)</td></tr>
</table>

[1] Operations with any dairy cows
[2] Physical contact = possible nose-to-nose contact or sniffing/touching/licking each other, including through a fence.

5. Colostrum feeding

Feeding calves high quality colostrum immediately following birth helps provide calves with the antibodies needed to withstand disease challenges and is recommended to maximize calf health (BAMN, 2001b). The effectiveness of colostral transfer of immunity to calves depends on the antibody mass delivered to calves, the timing of feeding, and the health status of the calves. Antibody mass is a function of antibody concentration and the volume of colostrum delivered to the calves. Administering colostrum to calves rather than allowing calves to obtain colostrum by nursing their dams enables producers to evaluate colostrum quality, determine the timing of the first feeding, and the total amount of colostrum calves receive. Calves that receive colostrum solely through nursing might not receive the proper quantity or quality of colostrum in a timely manner (BAMN, 2001b). Additionally, if the calving area is not properly maintained, calves might ingest manure and pathogens from the environment while searching for teats and suckling colostrum.

"A Guide to Colostrum and Colostrum Management for Dairy Calves", published by The Bovine Alliance on Management and Nutrition, recommends that calves get 3 quarts of high quality colostrum by nipple bottle within 1 hour of birth and an additional 3 quarts in 12 hours, or 4 quarts of high quality colostrum by esophageal feeder within 1 hour of birth (BAMN, 2001b).

On average, calves received hand-fed colostrum 3.3 hours following birth.

a. For operations that immediately removed calves from their dams and hand-fed colostrum, operation* average number of hours following birth that heifer calves received their first colostrum feeding, by herd size

Operation Average Hours							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Hours	**Std. Error**	**Hours**	**Std. Error**	**Hours**	**Std. Error**	**Hours**	**Std. Error**
3.4	(0.1)	3.3	(0.1)	2.8	(0.2)	3.3	(0.1)

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

During all study years, about one-third of operations allowed heifers to get colostrum during their first nursing.

b. Percentage of operations* by method normally used for heifers' first feeding of colostrum

	Percent Operations							
Method	**NDHEP 1991**	**Std. Error**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
First nursing	33.7	(1.7)	33.5	(1.2)	30.5	(1.2)	36.3	(1.4)
Hand-fed from bucket or bottle	64.0	(1.7)	62.5	(1.2)	64.8	(1.3)	59.2	(1.4)
Hand-fed using esophageal feeder	2.3	(0.6)	3.6	(0.4)	4.4	(0.5)	4.3	(0.5)
No colostrum	0.0	(0.0)	0.4	(0.2)	0.3	(0.1)	0.2	(0.1)
Total	100.0		100.0		100.0		100.0	

*Operations with any dairy cows.

Photo courtesy of Dr. Jason Lombard.

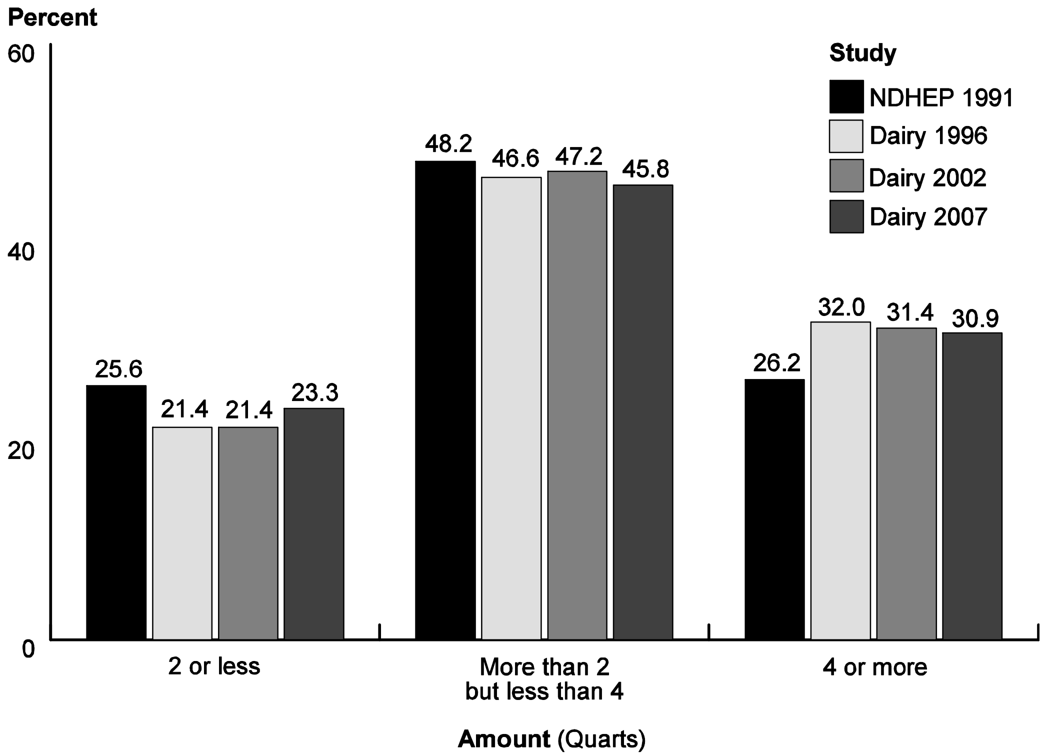
From 1991 to 2007, operations provided calves about the same amount of colostrum during their first 24 hours of life: about one-fourth of operations fed calves 2 quarts or less and about one-third fed calves 4 quarts or more. Nearly one-half of operations (45.8 percent) fed newborn dairy heifers more than 2 quarts but less than 4 quarts of colostrum. An additional 30.9 percent of operations fed 4 or more quarts of colostrum to newborn dairy heifers during their first 24 hours.

c. For operations that normally hand-fed colostrum to heifers, percentage of operations* by amount of colostrum fed during the first 24 hours

	Percent Operations							
Amount (Quarts)	**NDHEP 1991**	**Std. Error**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
2 or less	25.6	(1.8)	21.4	(1.3)	21.4	(1.4)	23.3	(1.6)
More than 2, but less than 4	48.2	(2.1)	46.6	(1.6)	47.2	(1.7)	45.8	(1.9)
4 or more	26.2	(1.9)	32.0	(1.5)	31.4	(1.5)	30.9	(1.7)
Total	100.0		100.0		100.0		100.0	

*Operations with any dairy cows.

For Operations that Normally Hand-fed Colostrum to Heifers, Percentage of Operations* by Amount of Colostrum Fed During the First 24 Hours



*Operations with any dairy cows.

6. Measuring passive transfer of immunity

Measuring immunoglobulin G (IgG) or serum total protein levels in calves within the first 3 days of life is a relatively simple way to measure passive transfer of immunity and the effectiveness of the colostrum management program. Overall, in 2007 only 2.1 percent of operations routinely measured passive transfer via serum total proteins. Of large operations, 14.5 percent measured serum proteins, while only 2.4 percent of medium operations and 1.1 percent of small operations measured total serum proteins.

a. Percentage of operations* that routinely monitored serum proteins (as a measure of passive transfer) in heifers within the first 3 days of life, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1.1	(0.4)	2.4	(0.6)	14.5	(1.7)	2.1	(0.3)

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

Measuring immunoglobulin levels in colostrum is one way to evaluate its quality. Of operations that hand-fed colostrum in 2007, 13.0 percent either estimated immunoglobulin levels or evaluated colostrum quality before feeding it to newborn calves, compared with 5.2 percent of operations in 2002. The percentage of operations that estimated immunoglobulin levels in colostrum or evaluated its quality increased across herd sizes from 2002 to 2007. A higher percentage of large operations (45.2 percent) evaluated colostrum than medium or small operations (19.8 and 7.6 percent, respectively) in 2007.

b. For operations that hand-fed colostrum, percentage of operations* that estimated immunoglobulin levels of colostrum or evaluated its quality, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Study Year	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
2002	2.1	(1.6)	10.6	(1.5)	32.2	(2.8)	5.2	(0.5)
2007	7.6	(1.3)	19.8	(2.3)	45.2	(3.2)	13.0	(1.1)

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

The most commonly used methods of evaluating colostrum were a colostrometer and visual appearance (43.7 and 41.6 percent of operations, respectively).

c. For the 13.0 percent of operations that estimated immunoglobulin levels in colostrum or evaluated its quality, percentage of operations* by primary method used for measuring immunoglobulin

Primary Method	Percent	Std. Error
Colostrometer	43.7	(4.2)
Visual appearance	41.6	(4.3)
Volume of first milking colostrum (pounds)	9.7	(2.8)
Other	5.0	(2.7)
Total	100.0	

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

7. Colostrum pooling and storage

Pooling colostrum from several cows to feed calves increases the risk of spreading disease-causing agents (including the agent causing Johne's disease) to more than one calf (BAMN, 2001b). The percentage of large and medium operations that pooled colostrum decreased from 2002 to 2007. Of operations that normally fed colostrum to newborn calves in 2007, 21.0 percent pooled colostrum; 56.9 percent of large operations, and 26.0 and 16.0 percent of medium and small operations, respectively, pooled colostrum in 2007.

a. For operations that normally hand-fed colostrum to newborn calves, percentage of operations* that pooled colostrum from more than one cow, by herd size

	Percent Operations			
Herd Size (Number of Cows)	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Small (fewer than 100)	22.1	(1.4)	16.0	(1.7)
Medium (100 to 499)	37.4	(2.0)	26.0	(2.4)
Large (500 or more)	70.6	(2.4)	56.9	(3.1)
All operations	27.0	(1.1)	21.0	(1.3)

*Operations with any dairy cows.

The proper handling and storage of excess colostrum is important in protecting its quality. Storing colostrum at warm, ambient temperatures rapidly increases bacterial growth (McGuirk and Collins, 2004). Refrigerating colostrum results in intermediate rates of bacterial proliferation. The use of a preservative and refrigeration to store colostrum results in lower rates of bacterial growth than refrigeration alone. For long-term storage, colostrum should be frozen (McGuirk and Collins, 2004).

The percentages of operations by methods used for storing colostrum remained essentially unchanged from 2002 to 2007, with the highest percentage of operations not storing colostrum. Approximately 6 of 10 operations did not store colostrum in 2002 or 2007.

b. For operations that hand-fed colostrum to newborn calves, percentage of operations* by primary method used for storing colostrum

	Percent Operations			
Method	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Stored without refrigeration	4.4	(0.6)	3.9	(0.7)
Stored in refrigerator	7.8	(0.6)	11.1	(0.9)
Stored in freezer	27.7	(1.1)	28.2	(1.6)
Other	0.5	(0.2)	0.0	(--)
Not stored	59.6	(1.3)	56.8	(1.8)
Total	100.0		100.0	

*Operations with any dairy cows.

8. Pasteurization of colostrum

Pasteurization is a proven method for reducing pathogens in colostrum (Godden et al., 2006). A high-temperature, short-time (HTST) system is one method of pasteurizing colostrum. HTST pasteurizers, however, cause colostrum to gel and reduce the amount of antibodies present, particularly IgG. A batch pasteurizer uses a lower temperature and longer heating time compared with HTST. Batch pasteurizers do not cause colostrum to gel and do not significantly reduce IgG concentrations (Godden et al., 2006). Although pasteurization decreases the pathogens in colostrum, it does not improve the quality of the colostrum in terms of increasing maternal antibodies. Although pasteurization is commonly used for milk and can be used for colostrum, the technical issues inherent in pasteurization may be one reason that dairies have been slow to adopt this management practice.

The percentage of operations that pasteurized colostrum did not change from 2002 to 2007. In 2007, less than 1 percent of operations that hand-fed colostrum (0.8 percent) pasteurized the colostrum before feeding it to newborn calves. Large operations were more likely to pasteurize colostrum (6.4 percent) than medium and small operations (0.9 and 0.2 percent, respectively).

a. For operations that hand-fed colostrum to newborn calves, percentage of operations* that pasteurized colostrum, by herd size

	Percent Operations			
Herd Size (Number of Cows)	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Small (fewer than 100)	0.4	(0.2)	0.2	(0.2)
Medium (100 to 499)	0.8	(0.3)	0.9	(0.4)
Large (500 or more)	3.6	(0.9)	6.4	(1.6)
All operations	0.6	(0.2)	0.8	(0.2)

*Operations with any dairy cows.

Colostrum from Johne's test-positive cows can transmit the disease to calves. Therefore, producers should feed colostrum from test-negative cows or pasteurize it prior to feeding. In 2007, only 4.9 percent of operations fed newborn calves colostrum from Johne's test-positive cows.

b. For operations that tested for Johne's disease, percentage of operations in which newborn calves were fed colostrum from cows that tested positive for Johne's disease, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
6.0	(2.9)	3.8	(2.8)	0.6	(0.4)	4.9	(2.0)

Source: NAHMS Dairy 2007.

9. Calf-feeding equipment

To prevent the spread of disease from one calf to another, calf-feeding equipment (bottles, buckets, and nipples) should be cleaned and disinfected between calves. In 2007, about one-fourth of operations (24.4 percent) cleaned calf-feeding equipment between calves. A higher percentage of large and medium operations (39.1 and 30.9 percent, respectively) cleaned calf-feeding equipment between calves compared with small operations (21.4 percent).

Over one-half of operations across herd sizes cleaned calf-feeding equipment daily. A higher percentage of medium and small operations (5.2 and 7.0 percent, respectively) cleaned calf-feeding equipment weekly compared with large operations (1.3 percent). A high percentage of operations that listed "other" for cleaning frequency indicated that they cleaned calf-feeding equipment twice a day, but not between calves.

Percentage of operations[1] by frequency calf-feeding equipment[2] was cleaned and disinfected, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Frequency	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Between calves	21.4	(1.5)	30.9	(2.2)	39.1	(2.7)	24.4	(1.2)
Daily	59.8	(1.8)	55.9	(2.3)	51.8	(2.8)	58.5	(1.4)
Weekly	7.0	(1.0)	5.2	(0.9)	1.3	(0.9)	6.4	(0.8)
Monthly	3.8	(0.7)	1.4	(0.6)	2.2	(1.0)	3.2	(0.5)
Other	8.0	(1.0)	6.6	(1.1)	5.6	(1.3)	7.5	(0.8)
Total	100.0		100.0		100.0		100.0	

[1]Operations with any dairy cows.
[2] Bottles, buckets, nipples.
Source: NAHMS Dairy 2007.

10. Physical contact with other animals

Other animals can be the source of many different diseases. These diseases can be spread by direct contact or through ingestion of contaminated feed or water. For example, *Neospora* is a parasitic disease that is shed via the feces of dogs and other canids and can cause abortions in cattle, if ingested. Malignant catarrhal fever is spread to cattle by sheep. In some parts of the country, populations of deer are infected with TB, which can be spread to cattle.

Dogs, cats, and members of the deer family were the three animal types most often reported as having contacts with dairy cattle. The percentage of operations in which pigs, sheep, or beef cattle had physical contact with dairy cattle and/or their feed, minerals, or water was lower in 2007 than in 1991. Dairy cattle contact with the other listed animals remained unchanged from 1991 to 2007.

a. Percentage of operations[1] in which the following animals had physical contact with dairy cattle and/or their feed, minerals, or water

	Percent Operations							
Animal Type	NDHEP 1991	Std. Error	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Chickens/other poultry	10.6	(1.4)	7.5	(0.8)	6.8	(0.7)	8.3	(0.8)
Horses or other equids[2]	15.0	(1.6)	11.6	(0.9)	12.8	(0.9)	13.3	(1.0)
Pigs	5.5	(1.0)	3.9	(0.6)	2.3	(0.4)	2.0	(0.4)
Sheep	3.0	(0.6)	2.3	(0.5)	1.3	(0.3)	0.9	(0.3)
Goats	3.1	(0.7)	3.0	(0.5)	2.8	(0.5)	2.5	(0.4)
Beef cattle	17.3	(1.7)	18.5	(1.1)	10.5	(0.8)	11.3	(1.0)
Exotic species	NA		0.8	(0.2)	0.6	(0.2)	0.7	(0.2)
Deer or other cervidae[3]	56.1	(2.2)	49.3	(1.1)	53.1	(1.3)	49.3	(1.4)
Dogs	NA		77.8	(1.1)	70.6	(1.2)	68.9	(1.3)
Cats	NA		90.2	(0.8)	87.8	(0.8)	85.2	(0.9)

[1] Operations with any dairy cows
[2] In 1991, “horses” was the animal type; “other equids” was not listed.
[3] In 1991, “deer” was the animal type; “other cervidae” was not listed.

TB is transmitted most commonly by the respiratory route, whereby invisible droplets (aerosols) containing TB bacteria are exhaled or coughed by infected animals and then inhaled by susceptible animals or humans. The risk of exposure is greatest in enclosed areas; however, livestock can become infected if they share a common eating or watering place contaminated with the saliva and other discharges from infected deer or other animals. Direct contact between cattle and deer infected with TB increases the risk cattle contracting TB.

On operations in which deer or other members of the deer family had contact with cattle and/or their feed or water in 2007, 90.8 percent of operations reported that cattle could possibly or sometimes have face-to-face contact with deer. There were no differences by region in the percentages of operations that reported face-to-face contact between cattle and deer.

b. For operations in which deer had physical contact with cattle and/or their feed, minerals, or water, percentage of operations* by frequency that members of the deer family had face-to-face contact with cattle, and by region

	Percent Operations					
	Region					
	West		East		All Operations	
Frequency	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Never	4.8	(2.1)	9.4	(1.2)	9.2	(1.2)
Possibly	56.3	(8.0)	64.3	(2.1)	64.1	(2.0)
Sometimes	38.9	(7.9)	26.3	(1.9)	26.7	(1.9)
Total	100.0		100.0		100.0	

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

11. Equipment handling for manure and feed

Using the same equipment for both manure removal and feed handling increases the risk of contaminating feed with disease-causing organisms, especially *Salmonella* and *Mycobacterium avium* subspecies *paratuberculosis*. On some operations it may not be feasible to have equipment dedicated solely to feed handling or manure removal. In those cases, implementing procedures for cleaning and disinfecting equipment between uses and training employees to use those procedures will reduce the likelihood of feed contamination with feces and pathogens.

About one-third of operations (32.2 percent) routinely used the same equipment to handle manure and to feed cattle in 2007; another one-third (35.6 percent) rarely used the same equipment, and another one-third (32.2 percent) never used the same equipment to handle both manure and feed. No differences were observed across herd sizes.

a. Percentage of operations by frequency that the same equipment was used to handle manure and feed cattle during the previous 12 months, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Frequency	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Routinely	34.1	(3.6)	29.8	(3.9)	20.3	(4.7)	32.2	(2.7)
Rarely	34.4	(3.6)	36.4	(4.0)	46.0	(5.6)	35.6	(2.7)
Never	31.5	(3.6)	33.8	(3.9)	33.7	(5.5)	32.2	(2.7)
Total	100.0		100.0		100.0		100.0	

Source: NAHMS Dairy 2007.

For operations that used the same equipment to handle manure and feed cattle, about 5 percent washed and chemically disinfected the equipment between uses in 2002 and 2007. The majority of operations washed equipment with water or steam, and less than 1 percent of operations used chemical disinfectants only. The majority of the 23.2 percent of operations that used "other" procedures in 2007 used separate loader buckets. More than 1 of 10 operations that used the same equipment to handle manure and feed cattle performed no procedures on the equipment between uses in 2002 or 2007.

b. For operations that used the same equipment to handle manure and feed cattle, percentage of operations by procedure that best describes what was usually done with equipment after handling manure

	Percent Operations			
Procedure	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Wash equipment with water or steam only	54.2	(2.9)	61.0	(3.4)
Chemically disinfect only	0.0	(--)	0.1	(0.1)
Wash equipment and chemically disinfect	5.7	(1.5)	4.6	(1.5)
Other	24.9	(2.5)	23.2	(3.1)
No procedures done	15.2	(2.2)	11.1	(2.3)
Total	100.0		100.0	

12. Equipment sharing with other livestock operations

Sharing equipment between operations can spread disease from one operation to another. Sanitation and disinfection procedures should be used to ensure that all shared equipment is cleaned prior to use. In 2002 and 2007, about one of three operations shared equipment with other livestock operations.

a. Percentage of operations that shared any heavy equipment (tractors, feeding equipment, manure spreaders, trailers, etc.) with other livestock operations, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Study Year	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
2002	40.0	(2.7)	33.4	(2.8)	28.0	(3.7)	38.0	(2.1)
2007	35.9	(3.7)	41.0	(4.1)	21.3	(4.3)	36.2	(2.8)

Photo courtesy of Dr. Jason Lombard.

The majority of all operations (63.8 percent) had not shared any heavy equipment with other livestock operations during the previous 12 months. More than 12 percent of operations across all herd sizes shared equipment at least six times during the previous 12 months.

b. Percentage of operations by number of times heavy equipment was shared during the previous 12 months, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Number of Times	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
0	64.1	(3.7)	59.0	(4.1)	78.7	(4.3)	63.8	(2.8)
1 to 2	11.1	(2.6)	15.5	(3.1)	5.3	(2.3)	11.8	(2.0)
3 to 5	12.6	(2.5)	7.0	(2.4)	3.1	(1.1)	10.6	(1.8)
6 or more	12.2	(2.3)	18.5	(3.4)	12.9	(3.8)	13.8	(1.8)
Total	100.0		100.0		100.0		100.0	

Source: NAHMS Dairy 2007.

For the 36.2 percent of operations that shared equipment with other operations in 2007, the majority of operations performed no cleaning procedures prior to using the equipment on their own operations (63.0 percent), while 26.6 percent washed equipment with water or steam.

c. For operations that shared equipment with other livestock operations, percentage of operations by cleaning procedure usually performed on equipment shared with other operations prior to use on the operation

Procedure	Percent Operations	Standard Error
Wash equipment with water or steam only	26.6	(3.9)
Chemically disinfect only	0.0	(--)
Wash equipment and chemically disinfect	0.5	(0.3)
Other	9.9	(3.2)
No procedures done	63.0	(4.6)
Total	100.0	

Source: NAHMS Dairy 2007.

13. Water sources for cows

Water sources for cows have changed since 1996. For example, the use of a single cup/bowl by only one cow decreased from 52.5 percent of operations in 1996 to 11.4 percent in 2007. The percentage of operations that used a single cup/bowl for multiple cows increased from 50.0 percent of operations in 1996 to 64.1 percent in 2007. The percentage of operations that used a water tank or trough increased from 77.9 percent in 1996 to 93.2 percent in 2007. The changes in water sources mirror the changes in housing, in which cows are in loose housing rather than restricted to a single stall and water source.

a. Percentage of operations by source of drinking water for cows

	Percent Operations					
Water Source	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Single cup/bowl waterer used by one cow only	52.5	(1.6)	10.7	(1.4)	11.4	(2.0)
Single cup/bowl waterer used by multiple cows	50.0	(1.8)	61.7	(1.8)	64.1	(2.4)
Water tank or trough (covered or uncovered)	77.9	(1.5)	89.1	(1.4)	93.2	(1.5)
Lake, pond, stream, river, etc.	37.1	(1.7)	35.1	(2.0)	33.4	(2.7)
Other source	1.1	(0.4)	2.1	(0.7)	3.9	(1.3)

Source: NAHMS Dairy 2007.

For operations that used a water tank or trough, the percentage of operations that cleaned water tanks/troughs 13 or more times a year increased from 13.6 percent of operations in 1996 to 34.2 percent of operations in 2007.

b. For operations that used a water tank or trough, percentage of operations by average number of times per year water tank or trough was drained *and* cleaned

	Percent Operations					
Number of Times	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
0	8.4	(1.2)	6.2	(1.1)	4.6	(1.4)
1 to 4	51.8	(2.1)	46.5	(2.3)	37.1	(3.2)
5 to 12	26.2	(1.9)	22.3	(1.9)	24.1	(2.8)
13 or more	13.6	(1.4)	25.0	(1.9)	34.2	(2.8)
Total	100.0		100.0		100.0	

From 1996 to 2007, about 9 percent of operations chlorinated drinking water for cows.

c. Percentage of operations that usually chlorinated drinking water for cows

Percent Operations					
Dairy 1996	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
10.7	(1.0)	9.8	(1.0)	8.7	(1.2)

14. Milking personnel and training

Owners of large operations were usually more involved in overall management of the operation rather than in specific labor-intensive procedures such as milking cows. In 2007, the percentage of operations in which owners/operators milked the majority of cows decreased from 74.8 percent of small operations to 0.0 percent of large operations. Family members milked the majority of cows on 17.4 percent of small operations and 14.3 percent of medium operations. No large operations reported family members performing the majority of milking.

The number of employees increased as herd size increased. Large operations averaged almost 13 full-time employees (including owners and family members), while small operations averaged 2 (see table b. p 40). The percentage of operations in which hired workers milked the majority of cows increased as herd size increased. Hired workers milked the majority of cows on 100.0 percent of large operations.

a. Percentage of operations by personnel who milked the majority of cows, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Personnel	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Owner/operator	74.8	(3.3)	33.7	(3.9)	0.0	(--)	59.8	(2.5)
Family member(s) of operator	17.4	(3.0)	14.3	(3.1)	0.0	(--)	15.6	(2.2)
Hired worker(s)	7.8	(1.8)	52.0	(3.9)	100.0	(0.0)	24.6	(1.7)
Total	100.0		100.0		100.0		100.0	

Source: NAHMS Dairy 2007.

Good milking practices include training milkers in proper procedures such as hygiene, the correct attachment of milking units, and how to recognize the signs of mastitis. Training is usually an ongoing processes, as milking protocols are often modified or updated.

In 2007, milker training increased as herd size increased, with 50.3 percent of small operations training milking personnel compared with 79.0 percent of medium operations and 97.8 percent of large operations. About one of four operations (42.5 percent) trained new employees only, while about one-third (37.3 percent) provided no milker training. A lower percentage of small operations (3.2 percent) performed training one to two times per year for all milkers compared with medium and large operations (14.9 and 25.5 percent, respectively).

b. For the 75.7 percent of operations with employees, percentage of operations by how frequently milking personnel were trained, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Frequency	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
As new employees only	39.6	(4.4)	48.4	(4.2)	42.3	(5.7)	42.5	(3.1)
1 to 2 times/year for all milkers	3.2	(1.2)	14.9	(3.0)	25.5	(5.4)	8.5	(1.3)
3 to 4 times/year for all milkers	2.8	(1.7)	4.3	(1.4)	14.0	(3.8)	4.2	(1.2)
5 times/year or more for all milkers	1.4	(1.2)	7.0	(2.5)	10.8	(3.5)	3.8	(1.1)
Other	3.3	(1.6)	4.4	(1.9)	5.2	(2.6)	3.7	(1.2)
No milker training	49.7	(4.5)	21.0	(3.7)	2.2	(2.2)	37.3	(3.1)
Total	100.0		100.0		100.0		100.0	

Source: NAHMS Dairy 2007.

A higher percentage of operations in the West region than in the East region provided milker training (89.0 and 59.6 percent, respectively). A higher percentage of operations in the West region than in the East region provided milker training one or two times per year for all milkers (20.8 and 7.1 percent, respectively).

c. For the 75.7 percent of operations with employees, percentage of operations by how frequently milking personnel were trained, and by region

	Percent Operations			
	Region			
	West		East	
Frequency	Percent	Std. Error	Percent	Std. Error
As new employees only	57.1	(5.6)	40.7	(3.4)
1 to 2 times/year for all milkers	20.8	(4.2)	7.1	(1.3)
3 to 4 times/year for all milkers	7.2	(3.1)	3.8	(1.3)
5 times/year or more for all milkers	1.7	(1.0)	4.1	(1.2)
Other	2.2	(1.5)	3.9	(1.3)
No milker training	11.0	(3.4)	40.4	(3.4)
Total	100.0		100.0	

Source: NAHMS Dairy 2007.

Almost all operations that trained milkers (97.1 percent) used on-the-job training. Almost one-third of operations (31.9 percent) used discussion/lecture to train milkers, while less than 1 of 10 (6.9 percent) used video training.

d. For the 62.7 percent of operations that trained milking personnel, percentage of operations by training method used

Method	Percent Operations	Standard Error
Video training	6.9	(1.1)
Discussion/lecture	31.9	(3.2)
On-the-job training	97.1	(0.9)
Other	3.9	(1.0)

Source: NAHMS Dairy 2007.

15. Milking biosecurity practices

The percentage of operations in which milkers wore gloves to milk all cows increased from 32.9 percent in 2002 to 55.2 percent in 2007. The percentage of cows on operations in which milkers wore gloves increased from 48.7 in 2002 to 76.8 percent in 2007.

a. Percentage of operations (and percentage of cows on these operations) in which milkers wore gloves to milk all cows

Percent Operations				Percent Cows			
Dairy 2002		Dairy 2007		Dairy 2002		Dairy 2007	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
32.9	(1.9)	55.2	(2.8)	48.7	(1.9)	76.8	(2.5)

To reduce the exposure of noninfected cows to mastitis organisms, cows with clinical mastitis should be milked at the end of milking, with a separate milking unit, or in a separate string. Across herd sizes, about one of three operations used a separate milking unit to milk cows with mastitis. A higher percentage of large operations (83.4 percent) milked cows with mastitis in a separate string from healthy cows compared with medium and small operations (33.4 and 29.8 percent, respectively).

b. Percentage of operations by method used for milking cows with clinical mastitis, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Method	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Separate milking unit from healthy cows	38.5	(3.7)	25.7	(3.6)	31.5	(5.3)	34.9	(2.7)
Separate string from healthy cows	29.8	(3.5)	33.4	(3.8)	83.4	(4.7)	34.1	(2.6)

Source: NAHMS Dairy 2007.

About 6 of 10 operations in the West region (59.9 percent) milked cows with clinical mastitis in a separate string from healthy cows compared with approximately 3 of 10 operations in the East region (31.6 percent) in 2007.

c. Percentage of operations by method used to milk cows with clinical mastitis, and by region

	Percent Operations			
	Region			
	West		East	
Method	Percent	Std. Error	Percent	Std. Error
Separate milking unit from healthy cows	27.5	(4.9)	35.6	(2.9)
Separate string from healthy cows	59.9	(5.0)	31.6	(2.8)

Source: NAHMS Dairy 2007.

D. Vaccination and Prevention Practices

1. Heifer vaccination

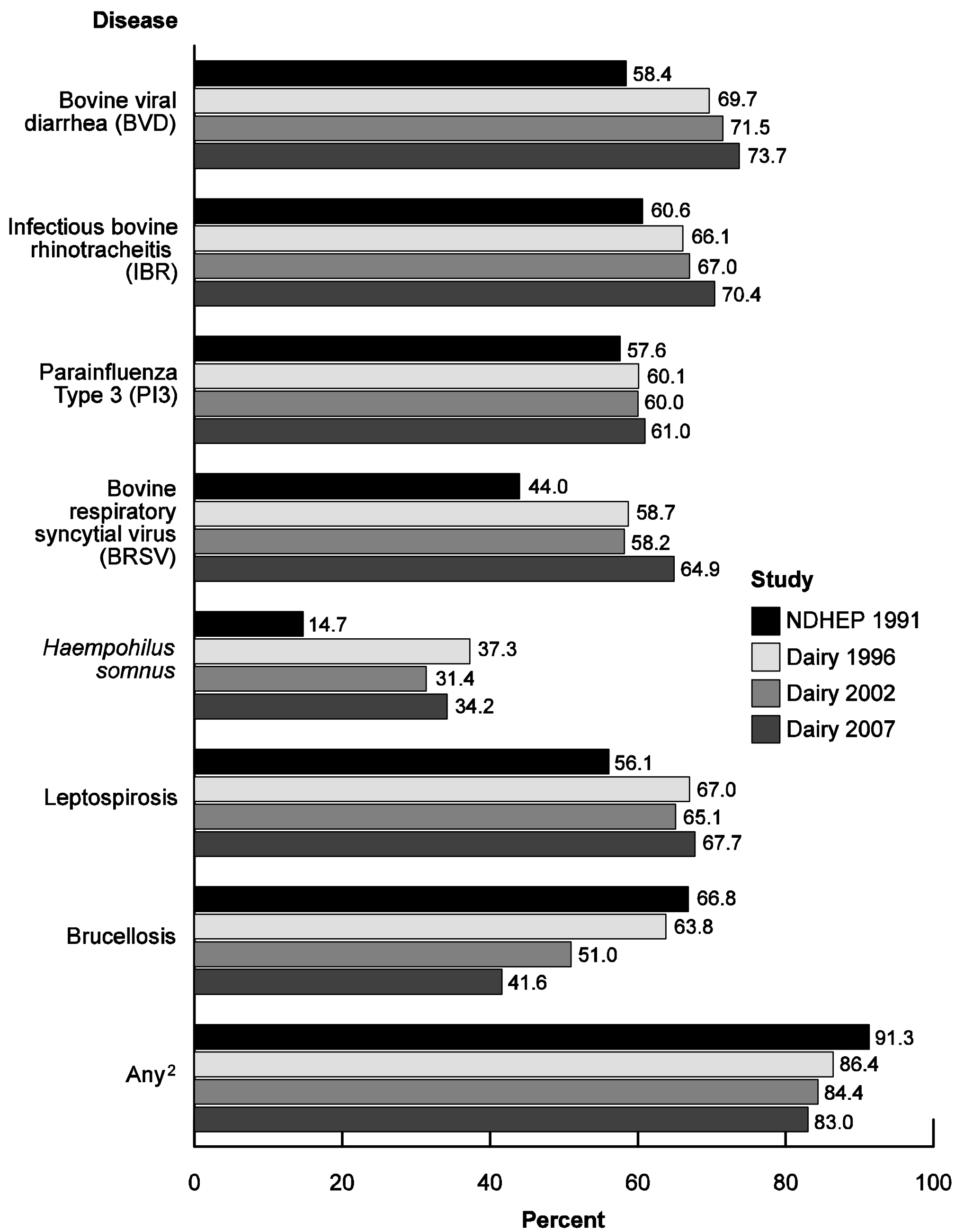
The percentage of operations that administered any vaccine to heifers decreased from 91.3 percent in 1991 to 83.0 percent in 2007. With the exceptions of parainfluenza (PI3), brucellosis, and Johne’s disease vaccines, use of vaccines for other diseases increased or remained the same. Interestingly, only the use of brucellosis vaccine has decreased since 1991. The percentage of operations that vaccinated heifers against brucellosis decreased from 66.8 percent in 1991 to 41.6 percent in 2007. This decrease may be due to the fact that many States switched from a mandatory to a voluntary brucellosis program from 1991 to 2007. In addition, the number of States that were certified brucellosis-free increased from 34 in 1996 to 49 in 2007, which may have impacted how many operations vaccinated against brucellosis.

Percentage of operations* that normally vaccinated heifers against the following diseases

	Percent Operations							
Disease	NDHEP 1991	Std. Error	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Bovine viral diarrhea (BVD)	58.4	(2.1)	69.7	(1.3)	71.5	(1.2)	73.7	(1.3)
Infectious bovine rhinotracheitis (IBR)	60.6	(2.1)	66.1	(1.3)	67.0	(1.3)	70.4	(1.3)
Parainfluenza Type 3 (PI3)	57.6	(2.1)	60.1	(1.3)	60.0	(1.3)	61.0	(1.4)
Bovine respiratory syncytial virus (BRSV)	44.0	(2.1)	58.7	(1.3)	58.2	(1.3)	64.9	(1.4)
Haemophilus somnus	14.7	(1.4)	37.3	(1.3)	31.4	(1.2)	34.2	(1.3)
Leptospirosis	56.1	(2.2)	67.0	(1.3)	65.1	(1.3)	67.7	(1.3)
Salmonella	NA		18.9	(1.0)	16.8	(1.0)	21.5	(1.1)
E. coli mastitis	NA		18.1	(0.9)	21.3	(1.0)	24.1	(1.1)
Clostridia (blackleg/ malignant edema)	20.7	(1.4)	32.3	(1.1)	32.8	(1.1)	34.6	(1.3)
Brucellosis	66.8	(1.9)	63.8	(1.3)	51.0	(1.3)	41.6	(1.3)
Mycobacterium avium subspecies *paratuberculosis* (Johne’s disease)	NA		5.4	(0.6)	4.6	(0.5)	5.0	(0.6)
Neospora	NA		NA		3.6	(0.4)	6.3	(0.6)
Other	NA		7.3	(0.6)	6.9	(0.6)	6.8	(0.7)
Any	91.3	(1.3)	86.4	(1.0)	84.4	(1.1)	83.0	(1.1)

*Operations with any dairy cows.

Percentage of Operations[1] that Normally Vaccinated Heifers Against the Following Diseases



[1] Operations with any dairy cows.
[2] Includes vaccines for the diseases listed above plus *Salmonella*, *E. coli* mastitis, clostridia, Johne's disease, *Neospora,* and "Other."

2. Cow vaccination

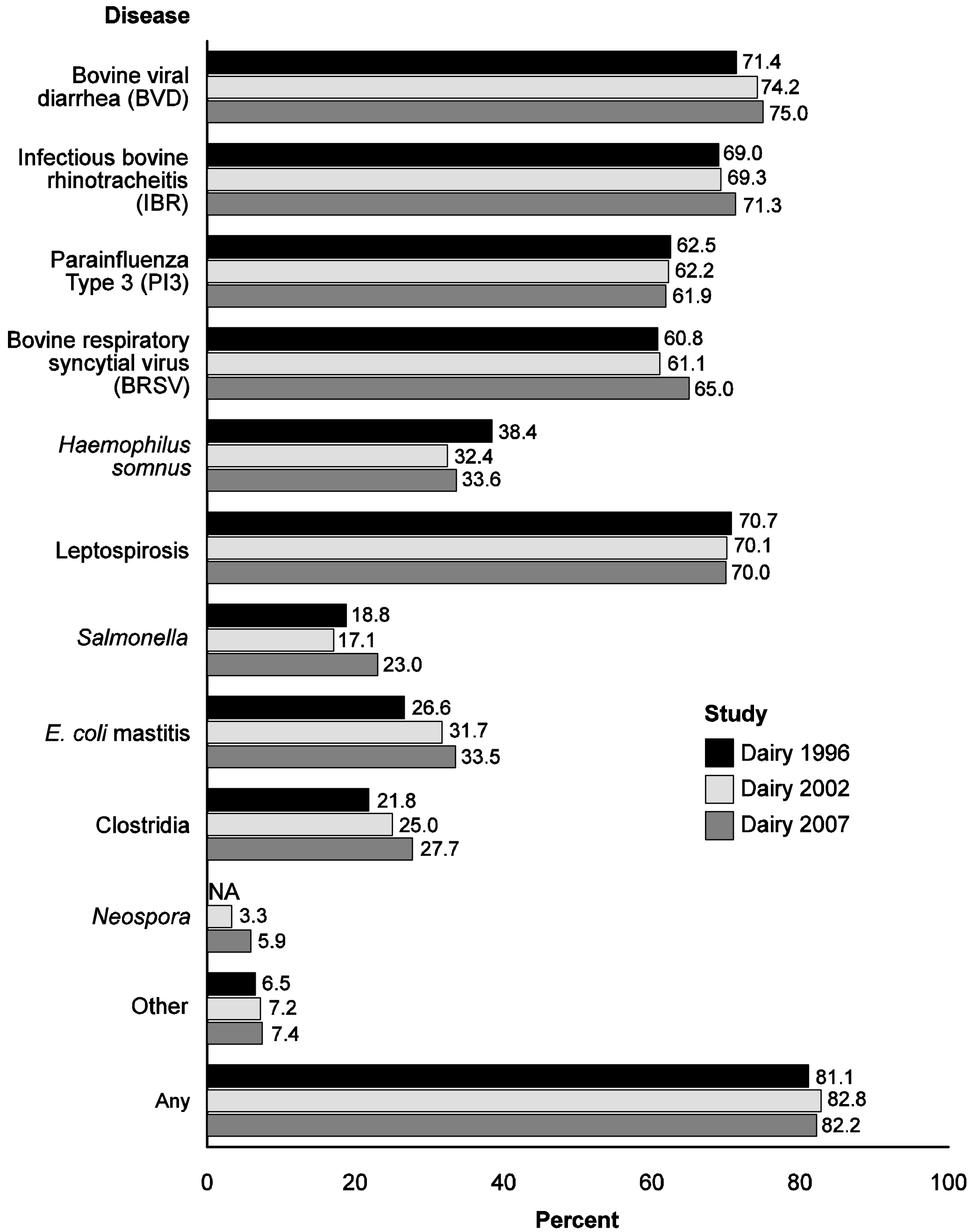
About four of five operations (82.2 percent) vaccinated cows in 2007. The use of *Salmonella*, *E. coli*, and clostridia vaccines has increased since 1996. The use of the most common vaccines (BVD, IBR, PI3, BRSV, and leptospirosis) has remained steady since 1996.

Percentage of operations* that normally vaccinated cows against the following diseases

	Percent Operations					
Disease	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Bovine viral diarrhea (BVD)	71.4	(1.3)	74.2	(1.2)	75.0	(1.3)
Infectious bovine rhinotracheitis (IBR)	69.0	(1.3)	69.3	(1.3)	71.3	(1.3)
Parainfluenza Type 3 (PI3)	62.5	(1.3)	62.2	(1.3)	61.9	(1.4)
Bovine respiratory syncytial virus (BRSV)	60.8	(1.3)	61.1	(1.3)	65.0	(1.4)
Haemophilus somnus	38.4	(1.3)	32.4	(1.2)	33.6	(1.3)
Leptospirosis	70.7	(1.3)	70.1	(1.3)	70.0	(1.3)
Salmonella	18.8	(1.0)	17.1	(1.0)	23.0	(1.1)
E. coli mastitis	26.6	(1.1)	31.7	(1.2)	33.5	(1.2)
Clostridia	21.8	(1.0)	25.0	(1.1)	27.7	(1.2)
Neospora	NA		3.3	(0.4)	5.9	(0.6)
Other	6.5	(0.6)	7.2	(0.6)	7.4	(0.7)
Any	81.1	(1.1)	82.8	(1.1)	82.2	(1.1)

*Operations with any dairy cows.

Percentage of Operations* that Normally Vaccinated Cows Against the Following Diseases



*Operations with any dairy cows.

3. BVD vaccinations

In 1996, the majority of operations that administered BVD vaccines to heifers gave killed vaccines (58.4 percent of operations). In 2007, the majority gave modified live vaccines (62.2 percent of operations).

a. For operations that gave BVD vaccinations to heifers, percentage of operations* by type of BVD vaccine given

	Percent Operations					
Type of BVD Vaccine	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Killed	58.4	(1.5)	50.6	(1.6)	43.1	(1.6)
Modified live	40.7	(1.5)	49.2	(1.6)	62.2	(1.5)

*Operations with any dairy cows.

Although the majority of operations administered killed BVD vaccines to cows in 1996, 2002, and 2007, the percentage of operations that used modified live vaccines increased from 29.3 percent in 1996 to 48.9 percent in 2007. The use of killed BVD vaccines decreased slightly during the same period.

b. For operations that gave BVD vaccinations to cows, percentage of operations* by type of BVD vaccine given

	Percent Operations					
Type of BVD Vaccine	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Killed	65.4	(1.4)	61.9	(1.5)	56.3	(1.6)
Modified live	29.3	(1.3)	36.7	(1.5)	48.9	(1.6)

*Operations with any dairy cows.

A higher percentage of operations used a combination of Type I and Type II BVD vaccines in 2007 compared with 2002 (60.8 and 39.4 percent, respectively). Producers are becoming more aware of the type of BVD vaccine they use, as the percentage of operations that did not know which vaccine was used decreased from 47.6 percent in 2002 to 27.2 percent in 2007. Interestingly, a Type II only vaccine is not currently available, suggesting that these producers did not know which strain they were administering, or gave a combination and were primarily concerned with the Type II strain.

c. For operations that gave any BVD vaccinations, percentage of operations* by strain of BVD contained in vaccine administered

	Percent Operations			
BVD Strain	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Type I only	5.4	(0.6)	4.3	(0.6)
Type II only	7.6	(0.9)	7.7	(0.8)
Combination (Type I and Type II)	39.4	(1.4)	60.8	(1.5)
Did not know	47.6	(1.5)	27.2	(1.4)
Total	100.0		100.0	

*Operations with any dairy cows.

The percentage of operations that gave annual BVD booster injections was similar in 1996, 2002, and 2007, with about 80 percent of operations giving booster injections.

d. For operations that gave BVD vaccinations to cows, percentage of operations* that gave annual BVD booster injections

Percent Operations					
Dairy 1996	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
77.4	(1.3)	82.9	(1.2)	80.2	(1.3)

*Operations with any dairy cows.

4. BVD testing

Animals persistently infected with BVD virus (BVDV) become infected while in utero and shed large quantities of BVDV following birth. This shedding can infect susceptible animals and create the next generation of persistently infected animals. The most efficient method of determining if the dam and her calf are persistently infected with BVDV is to test the calf. Since a persistently infected cow will always produce a persistently infected calf, the dam is negative if the calf tests negative. In 2007, few operations (4.0 percent) routinely tested dairy heifer replacements for persistent infection with BVDV. The percentage of operations that did test increased as herd size increased.

a. Percentage of operations* that routinely tested heifer replacements to determine if animals were persistently infected with BVDV, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1.9	(0.5)	6.7	(1.1)	21.2	(2.4)	4.0	(0.4)

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

Of operations that tested dairy heifer replacements for persistent infection with BVDV, the majority (66.8 percent) used individual ear-notch tests, while 21.1 percent tested individual serum samples.

b. For operations that routinely tested heifer replacements to determine if animals were persistently infected with BVDV, percentage of operations* by testing method used

Testing Method	Percent Operations	Standard Error
Individual ear notch	66.8	(5.7)
Pooled ear notch	11.4	(4.0)
Individual serum sample	21.1	(5.4)
Pooled serum sample	6.0	(3.0)
Other	6.5	(2.4)

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

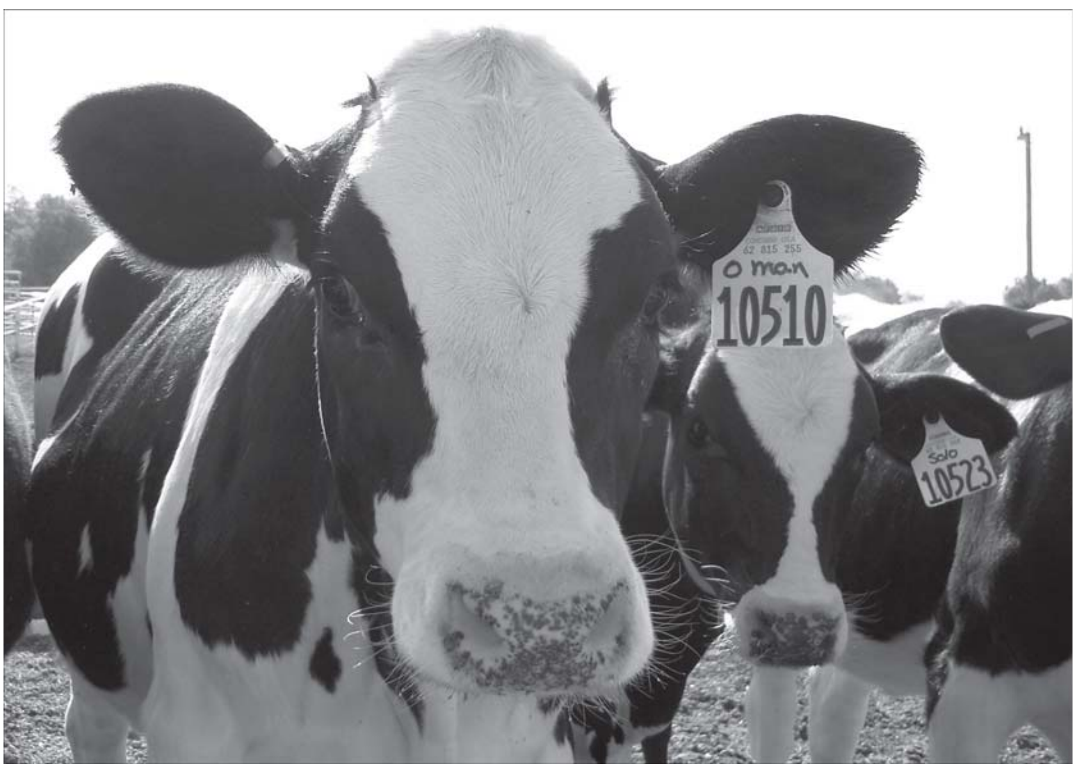


Photo courtesy of Dr. Jason Lombard

5. Mastitis vaccinations

Although the efficacy of certain mastitis vaccines has been questioned, coliform vaccines have generally provided good protection. Coliform vaccines were used on at least some cows on 37.6 percent of operations in 2007, compared with vaccines for *Salmonella* (13.4 percent), siderophore receptors and porins (4.1 percent), *Mycoplasma* (1.8 percent), and *Staphylococcus aureus* (7.3 percent). *Salmonella* vaccine might also help prevent coliform mastitis.

a. Percentage of operations by type of vaccine used and by proportion of cows vaccinated

	Percent Operations						
	Proportion of Cows						
	All		Some		None		
Vaccine Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Total
Coliform mastitis	32.6	(2.4)	5.0	(1.1)	62.4	(2.6)	100.0
Salmonella	11.1	(1.5)	2.3	(0.7)	86.6	(1.6)	100.0
Siderophore receptors and porins (SRPs) vaccine	3.3	(0.7)	0.8	(0.4)	95.9	(0.8)	100.0
Mycoplasma	1.4	(0.5)	0.4	(0.2)	98.2	(0.6)	100.0
Staphylococcus aureus	5.7	(1.1)	1.6	(0.6)	92.7	(1.2)	100.0

Source: NAHMS Dairy 2007.

Regional differences in vaccine use were observed for coliform mastitis and *Salmonella* vaccines. More operations in the West region vaccinated their cows against coliforms and *Salmonella* in 2007 than operations in the East region.

b. Percentage of operations that vaccinated at least some cows, by vaccine type and by region

	Percent Operations			
	Region			
	West		East	
Vaccine Type	Percent	Std. Error	Percent	Std. Error
Coliform mastitis	65.1	(4.7)	35.0	(2.8)
Salmonella	36.4	(4.8)	11.1	(1.7)
Siderophore receptors and porins (SRPs) vaccine	9.2	(2.9)	3.6	(0.8)
Mycoplasma	4.1	(2.5)	1.6	(0.6)
Staphylococcus aureus	13.2	(3.5)	6.7	(1.3)

Source: NAHMS Dairy 2007.

There were no changes from 2002 to 2007 in the percentages of operations that administered coliform mastitis and *Salmonella* vaccines. As reported in 2002 and 2007, about 4 of 10 operations vaccinated for coliform mastitis and about 1 of 10 vaccinated for *Salmonella*.

c. Percentage of operations by type of vaccination used

	Percent Operations			
Vaccine Type	Dairy 2002*	Std. Error	Dairy 2007	Std. Error
Coliform mastitis	35.8	(2.0)	37.6	(2.6)
Salmonella	10.4	(1.3)	13.4	(1.6)

*Question variation: majority of cows.

6. Preventive practices

Preventive practices such as deworming and the use of coccidiostats, vitamin and mineral supplements, and ionophores can help ensure that cattle are not parasitized and can more efficiently utilize nutrients. In addition, these practices can help cattle withstand the stresses associated with transport and arrival at a new facility.

The use of specific preventive practices for heifers has remained stable or increased since 1991; over 90 percent of all operations used at least one preventive practice on heifers in all four studies. In 2007, the most commonly used preventive practices were the use of vitamin A-D-E supplements in feed (74.4 percent of operations), selenium supplementation in feed (69.3 percent of operations), and dewormers (69.4 percent of operations). The largest increases in the use of preventive practices since 1991 were observed for coccidiostats in feed, vitamins A-D-E in feed, and selenium in feed.

a. Percentage of operations* by preventive practices normally used for heifers

	Percent Operations							
Preventive Practice	**NDHEP 1991**	**Std. Error**	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Dewormers	62.2	(2.2)	67.3	(1.3)	69.0	(1.2)	69.4	(1.3)
Coccidiostats in feed	37.8	(2.0)	46.5	(1.2)	44.4	(1.3)	46.5	(1.4)
Vitamins A-D-E injection	11.8	(1.3)	16.3	(1.0)	15.3	(1.0)	10.4	(0.7)
Vitamins A-D-E in feed	57.4	(2.2)	76.9	(1.1)	72.7	(1.2)	74.4	(1.2)
Selenium injection	16.2	(1.8)	12.7	(0.8)	13.3	(0.9)	13.2	(0.9)
Selenium in feed	50.3	(2.2)	70.8	(1.2)	67.6	(1.3)	69.3	(1.3)
Ionophores in feed (e.g., Rumensin®, Bovatec®)	40.0	(2.2)	42.2	(1.2)	44.2	(1.3)	45.2	(1.4)
Probiotics	NA		13.1	(0.9)	14.2	(0.9)	20.0	(1.1)
Anionic salts in feed	NA		NA		20.6	(1.1)	20.9	(1.1)
Other	NA		4.8	(0.6)	3.8	(0.5)	4.6	(0.7)
Any	91.7	(1.1)	93.6	(0.7)	94.9	(0.6)	94.6	(0.7)

*Operations with any dairy cows.

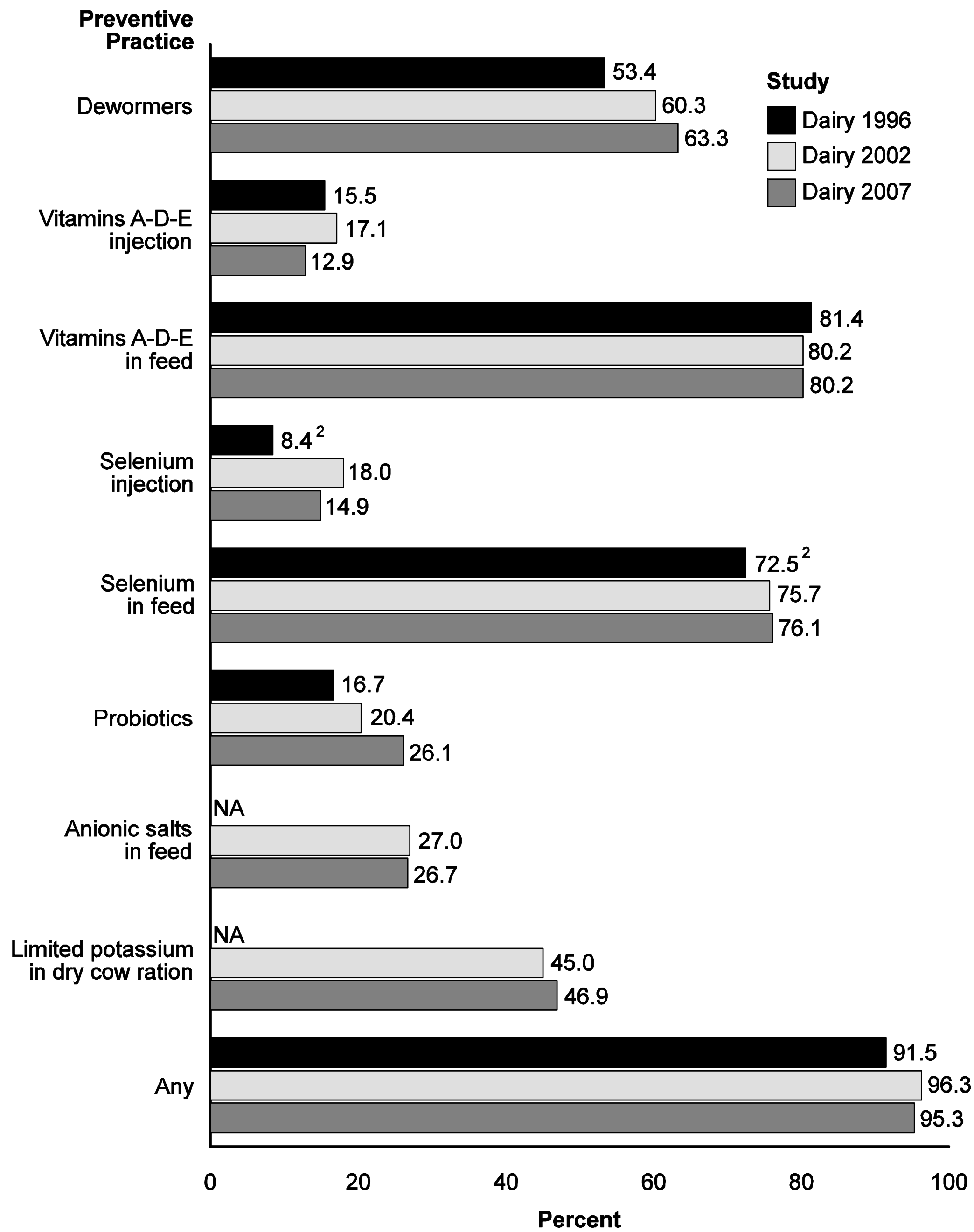
Nearly all operations (95.3 percent) used some preventive practice on their cows in 2007. The most frequent practices used included supplementing feed with vitamins A-D-E or selenium and dewormers. Since 1996, the use of dewormers, selenium injections, and probiotics has increased.

b. Percentage of operations[1] by preventive practices normally used for cows

	Percent Operations					
Preventive Practice	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Dewormers	53.4	(1.3)	60.3	(1.3)	63.3	(1.4)
Vitamins A-D-E injection	15.5	(0.9)	17.1	(1.0)	12.9	(0.8)
Vitamins A-D-E in feed	81.4	(1.1)	80.2	(1.1)	80.2	(1.2)
Selenium injection	8.4[2]	(0.6)	18.0	(1.0)	14.9	(0.9)
Selenium in feed	72.5[2]	(1.2)	75.7	(1.1)	76.1	(1.2)
Probiotics	16.7	(0.9)	20.4	(1.0)	26.1	(1.2)
Anionic salts in feed	NA		27.0	(1.2)	26.7	(1.2)
Limited potassium in dry cow ration	NA		45.0	(1.3)	46.9	(1.4)
Ionophores in feed	NA		NA		26.8	(1.1)
Other	4.4	(0.5)	5.4	(0.6)	3.6	(0.6)
Any	91.5	(0.8)	96.3	(0.6)	95.3	(0.7)

[1] Operations with any dairy cows.
[2] Lactating cows only.

Percentage of Operations[1] by Preventive Practices Normally Used for Cows



[1]Operations with any dairy cows.

[2]Lactating cows only.

E. Incidence of Disease or Illness

1. Cow morbidity

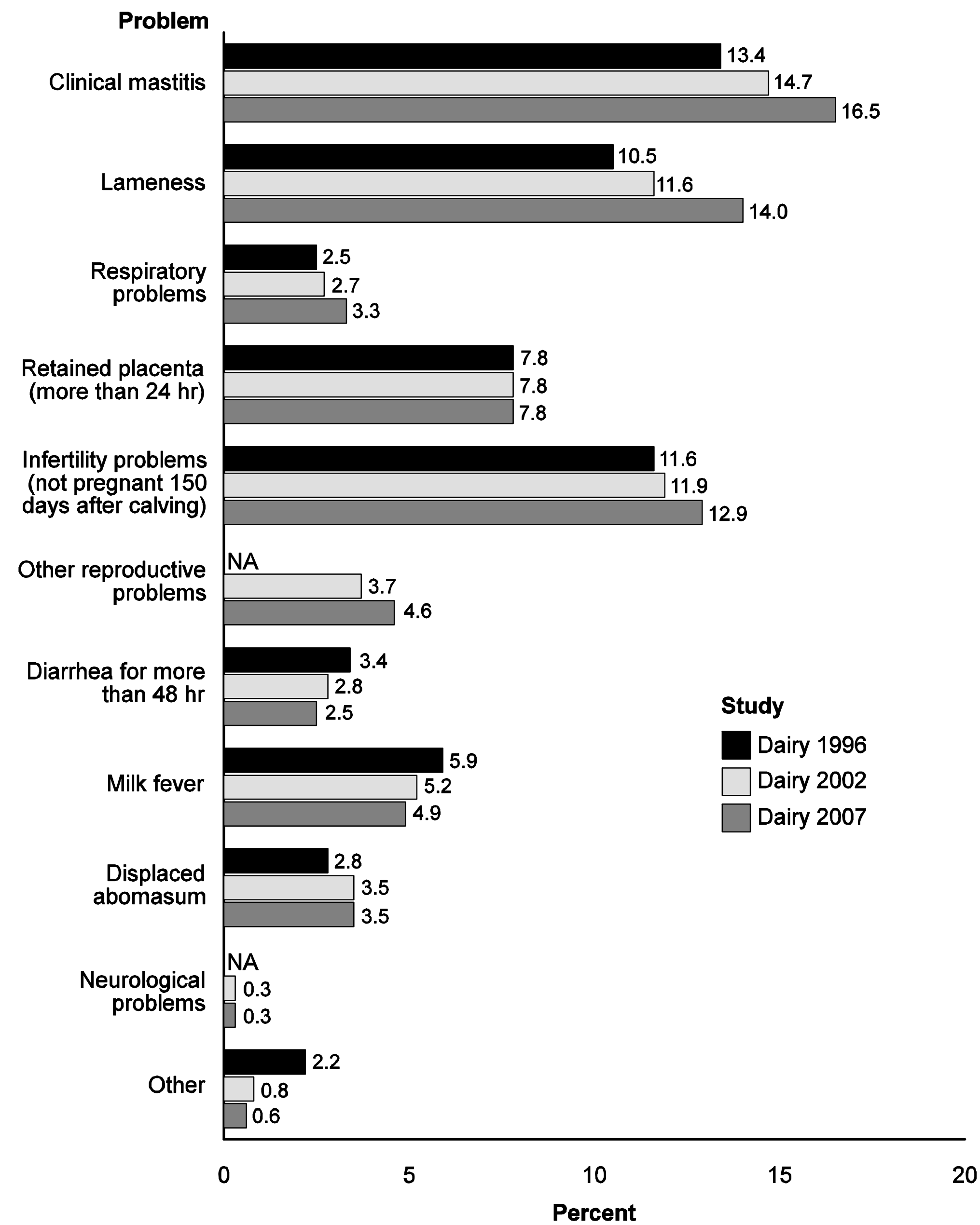
The percentage of cows with clinical mastitis, lameness, respiratory problems, infertility problems, or displaced abomasum increased from 1996 to 2007. The percentage of cows with diarrhea for more than 48 hours or milk fever decreased from 1996 to 2007. The three most common conditions identified by producers in 2007 were clinical mastitis, lameness, and infertility problems (16.5, 14.0, and 12.9 percent of cows, respectively).

Percentage of cows by health problem

	Percent Cows*					
Problem	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Clinical mastitis	13.4	(0.3)	14.7	(0.3)	16.5	(0.5)
Lameness	10.5	(0.3)	11.6	(0.3)	14.0	(0.4)
Respiratory problems	2.5	(0.1)	2.7	(0.1)	3.3	(0.1)
Retained placenta (more than 24 hours)	7.8	(0.2)	7.8	(0.2)	7.8	(0.2)
Infertility problems (not pregnant 150 days after calving)	11.6	(0.3)	11.9	(0.3)	12.9	(0.3)
Other reproductive problems (e.g., dystocia, metritis)	NA		3.7	(0.2)	4.6	(0.3)
Diarrhea for more than 48 hours	3.4	(0.2)	2.8	(0.2)	2.5	(0.2)
Milk fever	5.9	(0.1)	5.2	(0.1)	4.9	(0.1)
Displaced abomasum	2.8	(0.1)	3.5	(0.1)	3.5	(0.1)
Neurological problems	NA		0.3	(0.0)	0.3	(0.0)
Other health-related problems	2.2	(0.2)	0.8	(0.1)	0.6	(0.1)

*As a percentage of January 1 respective-year cow inventory on operations with any dairy cows.

Percentage of Cows* by Health Problem



*As a percentage of January 1 respective-year cow inventory on operations with any dairy cows.

2. Disease confirmation

The timely recognition of signs of illness among cattle and the timely diagnosis and treatment of disease are significant in limiting the spread of disease. Decreased milk production, cows with fever, deaths, and/or abortions could indicate that a new disease has been introduced into the herd. On average in 2007, an operation would have to have a 20.6 percent decrease in milk production before a veterinarian would be contacted for assistance or consultation. Large operations had a lower threshold (12.9 percent reduction) compared with small operations (22.3 percent reduction). Operations reported that a veterinarian would be contacted if 9.6 percent of cows exhibited a fever, 5.8 percent of cows died within a short period, or 6.8 percent of cows aborted.

a. Operation average percentage change at which a veterinarian would be contacted for assistance, by potential problem sign and by herd size

	Operation Average Percent Change							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Potential Problem Sign	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error
Decline in total daily milk production	22.3	(1.2)	18.0	(1.1)	12.9	(1.2)	20.6	(0.9)
Milk cows exhibiting fever within a short time period	10.7	(1.2)	7.3	(0.9)	6.0	(1.8)	9.6	(0.9)
Milk cows dying within a short time period	6.8	(1.1)	3.2	(0.7)	4.2	(1.9)	5.8	(0.8)
Milk cows aborting within a short time period	8.1	(1.1)	3.9	(0.7)	4.6	(1.8)	6.8	(0.8)

Source: NAHMS Dairy 2007.

Operations in the West region would seek veterinary assistance if daily milk production declined by 14.1 percent, while operations in the East region would do so at a 21.3 percent decline. For the other three potential problem signs, there were no regional differences in the average percentage change at which operations would seek assistance from a veterinarian.

b. Operation average percentage change at which a veterinarian would be contacted for assistance, by potential problem sign and by region

	Operation Average Percent Change			
	Region			
	West		East	
Potential Problem Sign	**Average**	**Std. Error**	**Average**	**Std. Error**
Decline in total daily milk production	14.1	(1.1)	21.3	(1.0)
Milk cows exhibiting fever within a short time period	5.7	(1.3)	10.0	(0.9)
Milk cows dying within a short time period	3.8	(1.3)	5.9	(0.9)
Milk cows aborting within a short time period	4.5	(1.3)	7.0	(0.9)

Source: NAHMS Dairy 2007.

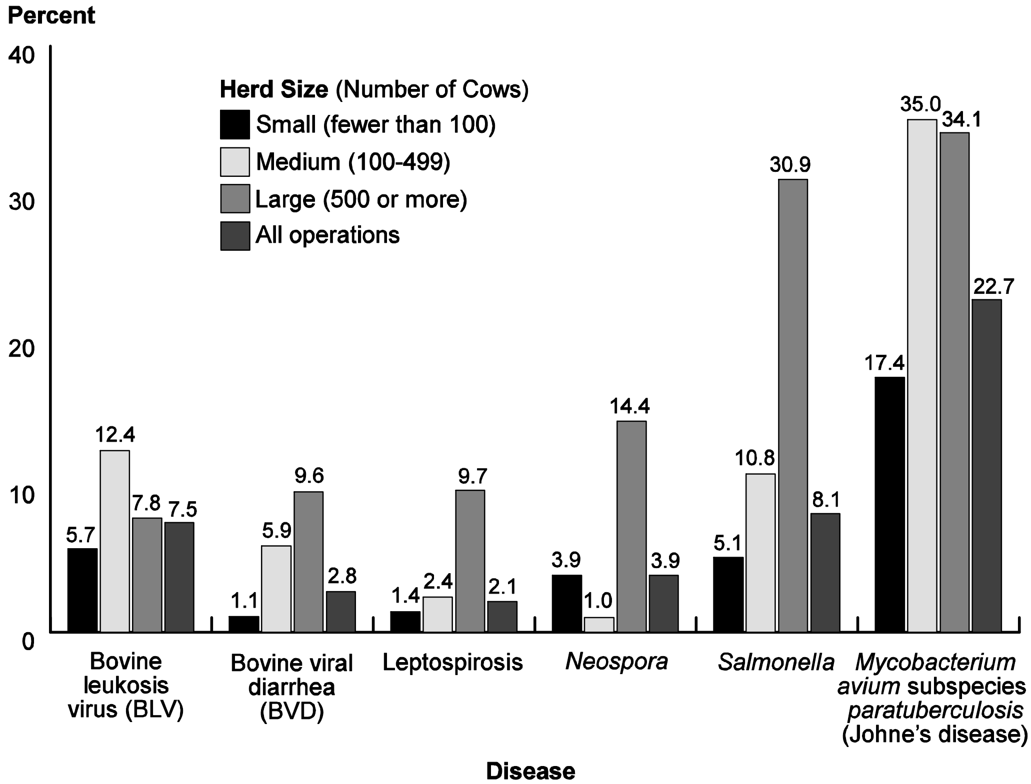
Laboratory testing is essential in determining the cause of many diseases and allows for the implementation of appropriate preventive or control measures. More than one of five operations in 2007 (22.7 percent) reported that Johne's disease was confirmed via laboratory testing. A lower percentage of small operations (17.4 percent) received a laboratory diagnosis for Johne's disease compared with medium and large operations (35.0 and 34.1 percent, respectively). Less than 10 percent of all operations reported a laboratory confirmation for the other listed diseases. *Salmonella* was more frequently diagnosed via laboratory testing on large operations than on medium and small operations.

c. Percentage of operations in which the following diseases in cattle on the operation were confirmed via laboratory testing during the previous 12 months, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Disease	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Bovine leukosis virus (BLV)	5.7	(1.9)	12.4	(2.9)	7.8	(2.9)	7.5	(1.5)
Bovine viral diarrhea (BVD)	1.1	(0.7)	5.9	(2.0)	9.6	(3.3)	2.8	(0.7)
Leptospirosis	1.4	(0.8)	2.4	(1.1)	9.7	(3.8)	2.1	(0.7)
Neospora	3.9	(1.6)	1.0	(0.6)	14.4	(4.4)	3.9	(1.1)
Salmonella	5.1	(1.8)	10.8	(2.3)	30.9	(5.9)	8.1	(1.4)
Mycobacterium avium subspecies *paratuberculosis* (Johne's disease)	17.4	(3.0)	35.0	(3.9)	34.1	(4.8)	22.7	(2.3)

Source: NAHMS Dairy 2007.

Percentage of Operations in which the Following Diseases in Cattle on the Operation were Confirmed via Laboratory Testing, by Herd Size



During the previous 12 months, there were no differences by region in the percentages of operations reporting laboratory confirmation for the listed diseases.

d. Percentage of operations in which the following diseases in cattle on the operation were confirmed via laboratory testing during the previous 12 months, by region

	Percent Operations			
	Region			
	West		East	
Disease	Percent	Std. Error	Percent	Std. Error
Bovine leukosis virus (BLV)	4.3	(2.0)	7.8	(1.7)
Bovine viral diarrhea (BVD)	5.3	(2.3)	2.5	(0.7)
Leptospirosis	5.2	(2.4)	1.9	(0.7)
Neospora	10.8	(3.5)	3.2	(1.2)
Salmonella	17.2	(4.2)	7.3	(1.5)
Mycobacterium avium subspecies *paratuberculosis* (Johne's disease)	12.8	(3.2)	23.6	(2.5)

Source: NAHMS Dairy 2007.

Bovine leukosis virus (BLV) was most frequently diagnosed via blood samples (88.5 percent of operations) in 2007. Blood, ear notches, tissues at necropsy, and aborted fetuses were the most frequently used samples for diagnosing BVD. Leptospirosis and Johne's disease were most frequently diagnosed via blood samples (69.6 and 70.3 percent of operations, respectively). *Neospora* was confirmed using aborted fetuses, blood, and tissues at necropsy. *Salmonella* was most frequently confirmed using fecal samples (49.3 percent of operations).

e. For operations in which disease was confirmed via laboratory testing, percentage of operations by diagnostic samples used to confirm disease, and by confirmed disease

	Percent Operations											
	Confirmed Disease											
	Bovine Leukosis Virus (BLV)		Bovine Viral Diarrhea (BVD)		Lepto-spirosis		*Neospora*		*Salmonella*		Johne's Disease	
Diagnostic Sample	**Pct.**	**Std. Err.**	**Pct.**	**Std. Err.**	**Pct.**	**Std. Err.**	**Pct.**	**Std. Err.**	**Pct.**	**Std. Err.**	**Pct.**	**Std. Err.**
Aborted fetus	NA		13.9	(6.7)	22.8	(11.2)	59.0	(14.2)	7.9	(4.9)	NA	
Blood	88.5	(4.8)	47.5	(12.9)	69.6	(12.5)	40.6	(14.2)	16.9	(5.5)	70.3	(5.3)
Ear notch	NA		41.3	(12.5)	NA		NA		NA		NA	
Feces	NA		7.5	(4.4)	NA		NA		49.3	(9.1)	36.4	(5.5)
Milk	NA		0.6	(0.4)	NA		NA		20.0	(9.9)	12.4	(3.5)
Tissues at necropsy	6.3	(3.5)	15.7	(7.9)	10.3	(7.4)	18.5	(10.1)	15.4	(4.7)	0.1	(0.1)
Urine	NA		NA		8.8	(5.4)	NA		NA		NA	
Other	15.5	(6.3)	3.0	(2.9)	0.0	(--)	9.0	(8.5)	5.0	(4.2)	1.7	(1.6)

Source: NAHMS Dairy 2007.

3. Milk cultures

Milk cultures can identify the most prevalent cause of clinical mastitis, help direct mastitis therapy, and screen purchased animals or milking strings for contagious mastitis pathogens.

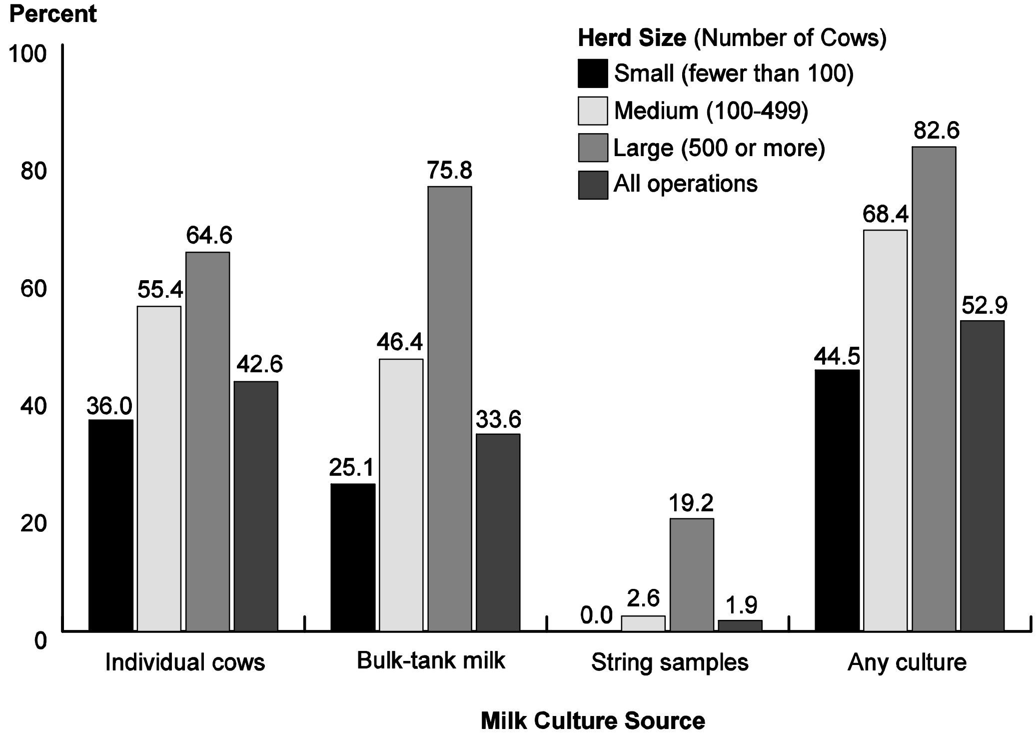
A lower percentage of small operations performed individual cow, bulk-tank milk, string sample, or any cultures compared with medium and large operations. A higher percentage of large operations performed bulk-tank milk or string-sample cultures compared with medium and small operations. More than one-half of operations (52.9 percent) had performed milk cultures during the previous 12 months. More than 8 of 10 large operations (82.6 percent) had performed any culture, compared with about 7 of 10 medium operations (68.4 percent) and 4 of 10 small operations (44.5 percent).

a. Percentage of operations by source of milk cultures performed during the previous 12 months, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Milk Culture Source	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Individual cows	36.0	(3.6)	55.4	(4.2)	64.6	(5.3)	42.6	(2.7)
Bulk-tank milk	25.1	(3.3)	46.4	(4.1)	75.8	(5.1)	33.6	(2.5)
String samples	0.0	(--)	2.6	(0.8)	19.2	(3.9)	1.9	(0.3)
Any culture	44.5	(3.8)	68.4	(3.9)	82.6	(4.6)	52.9	(2.8)

Source: NAHMS Dairy 2007.

Percentage of Operations by Source of Milk Cultures Performed During the Previous 12 Months, and by Herd Size



Source: NAHMS Dairy 2007.

A higher percentage of operations in the West region performed bulk-tank milk or string-sample cultures compared with operations in the East region.

b. Percentage of operations by source of milk cultures performed during the previous 12 months, and by region

	Percent Operations			
	Region			
	West		East	
Milk Culture Source	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Individual cows	43.4	(5.3)	42.6	(2.9)
Bulk-tank milk	60.6	(5.1)	31.0	(2.7)
String samples	11.0	(3.0)	1.0	(0.2)
Any culture	65.1	(5.0)	51.7	(3.1)

Source: NAHMS Dairy 2007.

For operations that performed milk cultures during the previous 12 months, a higher percentage of large operations than small operations performed on-farm cultures (20.8 and 4.2 percent, respectively). A higher percentage of medium operations (45.5 percent) had cultures performed at a State or university diagnostic laboratory compared with small operations (24.1 percent). There were no herd-size differences in the percentage of operations that used a commercial laboratory; about 4 of 10 operations (41.5 percent) used a commercial laboratory to culture milk. Almost 50 percent of operations that performed milk cultures (49.2 percent) used a private veterinary laboratory or clinic, with no differences across herd sizes.

c. For the 52.9 percent of operations that performed milk cultures during the previous 12 months, percentage of operations by facility used to perform cultures and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Facility	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
On-farm, by farm personnel	4.2	(2.0)	14.0	(3.8)	20.8	(4.8)	9.0	(1.8)
State or university diagnostic laboratory	24.1	(4.9)	45.5	(5.0)	31.2	(4.4)	31.8	(3.3)
Commercial laboratory	38.9	(5.6)	45.3	(5.0)	43.8	(6.0)	41.5	(3.6)
Private veterinary laboratory (veterinary clinic)	50.5	(5.7)	43.2	(5.1)	60.8	(6.3)	49.2	(3.7)

Source: NAHMS Dairy 2007.

The only regional difference in the percentage of operations that used a specific facility to perform milk cultures was observed for State or university diagnostic laboratory, which was used by 13.0 percent of operations in the West region compared with 34.0 percent in the East region.

d. For the 52.9 percent of operations that performed milk cultures during the previous 12 months, percentage of operations by facility used to perform cultures and by region

	Percent Operations			
	Region			
	West		East	
Facility	Percent	Std. Error	Percent	Std. Error
On-farm, by farm personnel	13.0	(4.6)	8.5	(1.9)
State or university diagnostic laboratory	13.0	(4.2)	34.0	(3.7)
Commercial laboratory	59.2	(6.4)	39.4	(4.0)
Private veterinary laboratory (veterinary clinic)	52.5	(6.6)	48.8	(4.1)

Source: NAHMS Dairy 2007.

Milk was cultured most often from cows with chronic clinical disease and from clinical cases that did not respond to treatment (59.1 and 54.0 percent of operations, respectively). A higher percentage of large operations performed cultures on milk from individual fresh cows and from all clinical cases compared with medium and small operations.

e. For the 42.6 percent of operations that performed cultures on milk from individual cows during the previous 12 months, percentage of operations by cow type and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cow Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Fresh cows	8.0	(3.5)	14.9	(3.8)	47.2	(6.6)	13.9	(2.5)
All clinical cases	22.2	(5.4)	35.4	(5.5)	65.4	(6.4)	30.5	(3.7)
Chronic clinical cases	54.8	(6.4)	64.5	(5.3)	67.0	(7.6)	59.1	(4.2)
Clinical cases that did not respond to treatment	50.1	(6.5)	61.1	(5.6)	53.5	(7.9)	54.0	(4.3)
High somatic cell count cows	37.9	(5.7)	49.6	(5.8)	31.5	(6.2)	41.1	(3.9)
Other	11.0	(4.8)	7.0	(2.5)	8.6	(4.4)	9.5	(3.0)

Source: NAHMS Dairy 2007.

A higher percentage of operations in the West region performed cultures on milk from individual fresh cows and all clinical cases (49.8 and 60.7 percent, respectively) compared with operations in the East region (10.5 and 27.7 percent, respectively).

f. For the 42.6 percent of operations that performed cultures on milk from individual cows during the previous 12 months, percentage of operations by cow type and by region

	Percent Operations			
	Region			
	West		East	
Cow Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Fresh cows	49.8	(7.9)	10.5	(2.6)
All clinical cases	60.7	(8.3)	27.7	(4.0)
Chronic clinical cases	55.4	(8.5)	59.4	(4.5)
Clinical cases that did not respond to treatment	43.9	(8.1)	54.9	(4.7)
High somatic cell count cows	46.6	(8.2)	40.6	(4.1)
Other	4.8	(2.6)	9.9	(3.2)

Source: NAHMS Dairy 2007.

Similar percentages of all operations that performed milk cultures during the previous 12 months detected *Staphylococcus aureus*, *E. coli/Klebsiella/*other gram-negative, or environmental strep (*Strep.* spp.). A higher percentage of large operations (21.4 percent) identified *Mycoplasma* compared with medium and small operations (3.8 and 4.0 percent, respectively). A lower percentage of small operations identified *E. coli/Klebsiella/*other gram-negative or coagulase-negative staph (*Staph.* spp. non-*aureus*) organisms compared with large operations.

g. For the 52.9 percent of operations that performed milk cultures during the previous 12 months, percentage of operations by organism identified and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Organism	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Strep. agalactiae	29.4	(5.4)	42.2	(5.0)	35.6	(5.7)	34.4	(3.6)
Staph. aureus	50.5	(6.1)	51.4	(5.1)	64.4	(6.1)	52.3	(3.9)
Mycoplasma	4.0	(3.2)	3.8	(1.9)	21.4	(4.7)	5.7	(1.9)
E. coli/Klebsiella/ other gram-negative	41.8	(5.9)	64.3	(4.8)	78.9	(5.4)	53.3	(3.8)
Coagulase-negative staph (*Staph.* spp. non-*aureus*)	25.3	(5.5)	37.6	(4.8)	63.4	(6.0)	33.5	(3.5)
Environmental strep (*Strep.* spp. non-*agalactiae*)	52.4	(6.1)	67.0	(4.8)	78.3	(5.1)	60.1	(3.8)

Source: NAHMS Dairy 2007.

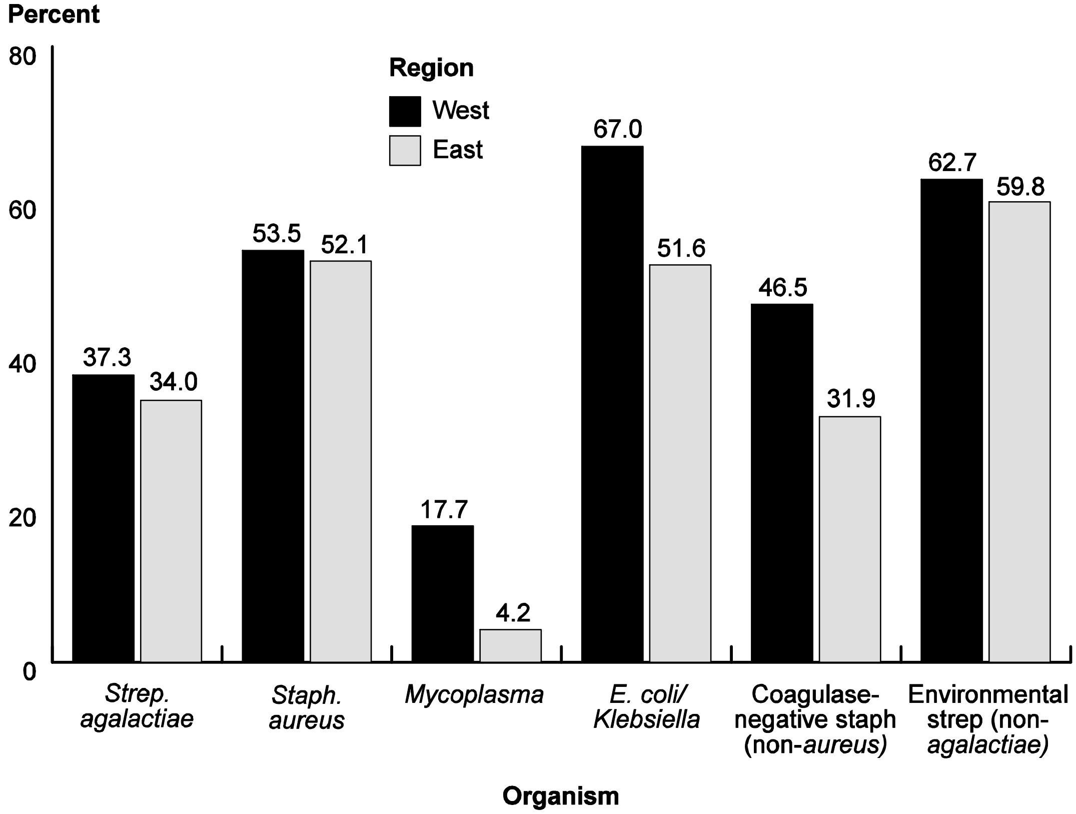
Mycoplasma was isolated from a higher percentage of operations in the West region (17.7 percent) than in the East region (4.2 percent).

h. For the 52.9 percent of operations that performed milk cultures during the previous 12 months, percentage of operations by organism identified and by region

	Percent Operations			
	Region			
	West		East	
Organism	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Strep. agalactiae	37.3	(6.2)	34.0	(3.9)
Staph. aureus	53.5	(6.4)	52.1	(4.3)
Mycoplasma	17.7	(4.5)	4.2	(2.1)
*E. coli/Klebsiella/*other gram-negative	67.0	(6.3)	51.6	(4.2)
Coagulase-negative staph (*Staph.* spp. non-*aureus*)	46.5	(6.5)	31.9	(3.9)
Environmental strep (*Strep.* spp. non-*agalactiae*)	62.7	(6.5)	59.8	(4.2)

Source: NAHMS Dairy 2007.

For the 52.9 Percent of Operations that Performed Milk Cultures During the Previous 12 Months, Percentage of Operations by Organism Identified and by Region



Source: NAHMS Dairy 2007.

4. Abortions

Abortion is a term generally used to describe the expulsion of a dead fetus at 45 to 265 days of gestation (Virginia Cooperative Extension, 2009). Abortions in cattle can be due to a variety of conditions: congenital problems with the calf that cause spontaneous abortions; disease processes that cause sporadic abortions; and infectious diseases such as *Campylobacter* or brucellosis, which can cause economically damaging abortion "storms." Determining the cause of abortions can help diagnose health problems in the herd, lead to the reduction or prevention of additional abortions, and result in the birth of more healthy calves.

The percentage of operations in which at least one abortion occurred increased from 1996 to 2007.

a. Percentage of operations that had at least one cow or heifer abort

Percent Operations					
Dairy 1996	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
66.3	(1.2)	72.9	(1.3)	86.6	(2.2)

Optimally, no more than 2 percent of cows and heifers should abort each year, although up to 5 percent is considered acceptable. The abortion percentage for cows and heifers combined increased from 3.5 percent in 1996 to 4.5 percent in 2007.

b. Percentage of heifers and cows* that aborted, by herd size

	Percent Heifers/Cows Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Study Year	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1996	3.2	(0.1)	3.3	(0.1)	4.3	(0.3)	3.5	(0.1)
2002	3.6	(0.1)	3.4	(0.1)	4.9	(0.3)	4.0	(0.1)
2007	3.7	(0.1)	3.7	(0.1)	5.3	(0.3)	4.5	(0.2)

*As a percentage of cow inventory on January 1 of each respective year on operations with any dairy cows.

The percentages of operations by abortion percentages were similar across study years.

c. Percentage of operations[1] by abortion percentage

	Percent Operations					
Percent Abortions[2]	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Less than 2.0	42.7	(1.3)	39.3	(1.3)	38.2	(1.4)
2.0 to 4.9	36.2	(1.2)	34.6	(1.2)	34.3	(1.3)
5.0 to 9.9	16.2	(0.9)	20.3	(1.1)	20.6	(1.1)
10.0 to 14.9	3.2	(0.5)	4.7	(0.7)	4.9	(0.6)
15.0 or more	1.7	(0.4)	1.1	(0.3)	2.0	(0.4)
Total	100.0		100.0		100.0	

[1]Operations with any dairy cows
[2]As a percentage of cow inventory at time of interview.

Determining the cause of abortion can be difficult. In many cases, the event that caused the fetus to die occurred days to weeks before the actual abortion. Frequently, the cause of an abortion is not detectable, or the fetus is too decomposed to evaluate or is never found at all. A diagnosis is determined in 50 percent or less of abortion samples submitted to diagnostic laboratories. To improve the chances of diagnosing the cause of an abortion, a detailed history and the proper diagnostic specimens should be submitted to the laboratory. Specific samples recommended for submission include sera from the dam, the entire fetus, or specific tissues and placenta.

About one of eight operations (12.4 percent) submitted samples to determine the cause of abortion in 2007.

d. For the 86.6 percent of operations that had any cows or heifers abort, percentage of operations that submitted any samples for diagnosis

Percent Operations	Standard Error
12.4	(1.7)

Source: NAHMS Dairy 2007.

For operations that submitted samples, 70.2 percent submitted serum from the dam and 32.7 percent submitted the placenta.

e. For operations that submitted samples to determine cause of abortion, percentage of operations by type of sample submitted

Sample Type	Percent Operations	Standard Error
Placenta	32.7	(6.9)
Entire fetus	53.8	(7.6)
Serum of dam	70.2	(6.6)
Other	4.0	(3.2)

Source: NAHMS Dairy 2007.

The majority of operations that reported any abortions but did not submit samples for diagnosis (69.6 percent) did not perceive abortion as a problem on their operation.

f. For any aborted fetuses that were not submitted for diagnosis, percentage of operations by reason for not submitting fetus

Reason	Percent Operations	Standard Error
Cost	2.5	(1.0)
Lack of information obtained from previous abortion submissions	6.6	(1.3)
Inconvenience	7.0	(1.7)
Abortion not perceived as a problem on the operation	69.6	(2.7)
Other	14.3	(2.0)
Total	100.0	

Source: NAHMS Dairy 2007.

Although only 12.4 percent of operations that reported any abortions submitted samples for diagnosis, more than 8 of 10 operations (82.0 percent) would submit aborted fetuses for diagnosis if testing was performed at no cost, and 48.5 percent of aborted fetuses would be submitted for diagnosis.

g. Percentage of operations that would submit aborted fetuses to a veterinary diagnostic laboratory if testing was performed at no cost, and percentage of aborted fetuses that would be submitted

Percent Operations	Standard Error	Operation Average Percent Aborted Fetuses	Standard Error
82.0	(2.3)	48.5	(4.9)

Source: NAHMS Dairy 2007.

Photo courtesy of Keith Weller, ARS.

F. Mortality, Necropsy, and Carcass Disposal

1. Mortality

A lower percentage of small operations had any deaths in each of the cattle classes compared with medium and larger operations. All large herds had at least one death in each cattle class, which was expected since these operations have more animals at risk.

a. Percentage of operations that had at least one death* in the following cattle classes, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Cattle Class	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Preweaned heifers	59.8	(1.8)	100.0	(0.0)	100.0	(0.0)	69.9	(1.4)
Weaned heifers	29.9	(1.6)	73.1	(2.3)	100.0	(0.0)	41.6	(1.3)
Cows	76.5	(1.5)	99.1	(0.4)	100.0	(0.0)	82.6	(1.1)

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

The percentages of preweaned and weaned heifer calves that died decreased from 1996 to 2007. The percentage of preweaned heifer calves that died decreased from 10.8 percent in 1996 to 7.8 percent in 2007. Weaned heifer calf deaths increased from 2.2 percent in 1991 to 2.8 percent in 2002 and then decreased to 1.8 percent in 2007.

b. Number of preweaned and weaned heifer deaths*, as a percentage of heifers born alive…

	…or moved onto the operation NDHEP 1991		Dairy 1996		Dairy 2002		Dairy 2007	
Heifer Class	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Preweaned	8.4	(0.4)	10.8	(0.4)	10.5	(0.3)	7.8	(0.2)
Weaned	2.2	(0.1)	2.4	(0.1)	2.8	(0.1)	1.8	(0.1)

*Operations with any dairy cows.

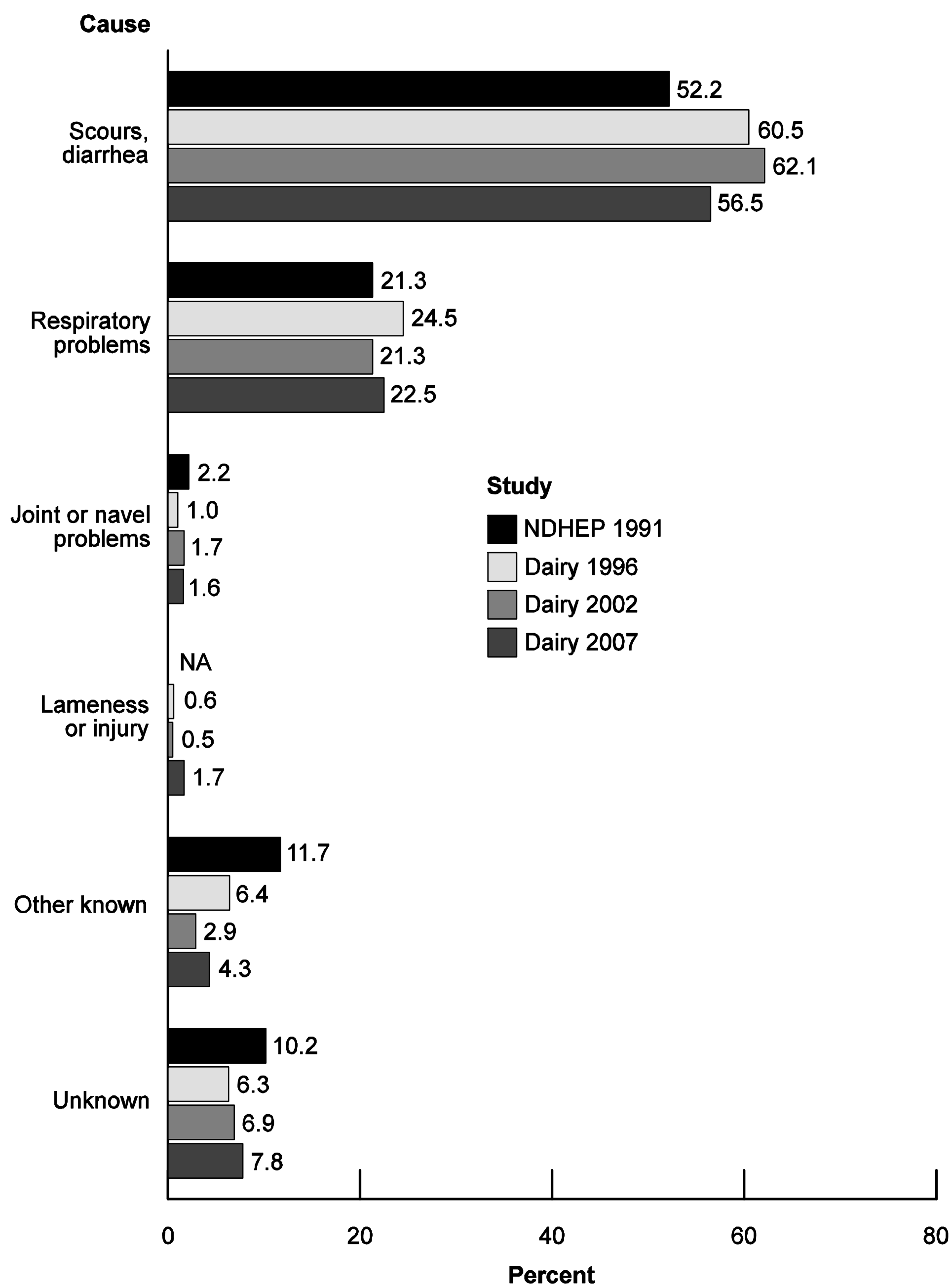
Scours/diarrhea accounted for more than 50 percent of preweaned heifer deaths in each study year since 1991, while respiratory problems accounted for 21 to 25 percent of deaths during the same period.

c. Percentage of preweaned heifer deaths*, by cause

	Percent Deaths							
Cause	NDHEP 1991	Std. Error	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Scours/ diarrhea	52.2	(2.6)	60.5	(1.2)	62.1	(1.1)	56.5	(1.3)
Respiratory problems	21.3	(1.6)	24.5	(1.0)	21.3	(0.9)	22.5	(0.9)
Joint or navel problems	2.2	(0.7)	1.0	(0.1)	1.7	(0.2)	1.6	(0.3)
Lameness or injury	NA		0.6	(0.1)	0.5	(0.1)	1.7	(0.3)
Lack of coordination/ severe depression	NA		0.4	(0.1)	0.4	(0.1)	0.3	(0.1)
Poison	NA		0.3	(0.1)	0.1	(0.0)	0.0	(0.0)
Calving problems	NA		NA		4.1	(0.6)	5.3	(0.7)
Trauma	2.4	(0.8)	NA		NA		NA	
Other known	11.7	(1.8)	6.4	(1.1)	2.9	(0.4)	4.3	(0.7)
Unknown	10.2	(1.4)	6.3	(0.9)	6.9	(0.8)	7.8	(0.9)
Total	100.0		100.0		100.0		100.0	

*Operations with any dairy cows

Percentage of Preweaned Heifer Deaths*, by Cause



*Operations with any dairy cows.

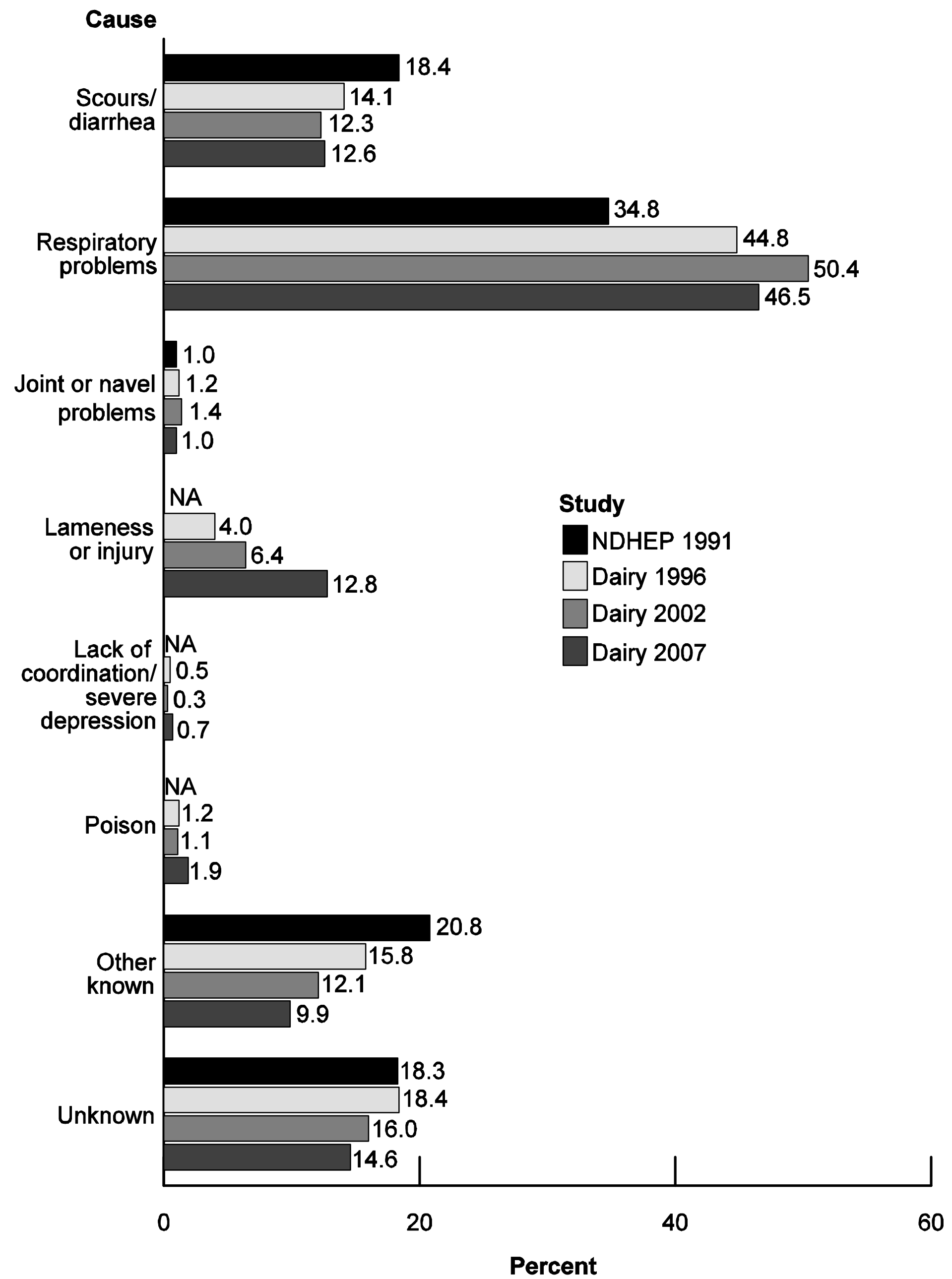
The percentage of weaned heifer deaths caused by respiratory problems increased from 34.8 percent of deaths in 1991 to 46.5 percent in 2007. Weaned heifer deaths caused by lameness or injury increased from 4.0 percent of deaths in 1996 to 12.8 percent in 2007.

d. Percentage of weaned heifer deaths*, by cause

	Percent Deaths							
Cause	NDHEP 1991	Std. Error	Dairy 1996	Std. Error	Dairy 2002	Std. Error	Dairy 2007	Std. Error
Scours/ diarrhea	18.4	(2.6)	14.1	(1.6)	12.3	(1.0)	12.6	(1.0)
Respiratory problems	34.8	(3.5)	44.8	(2.1)	50.4	(1.6)	46.5	(1.7)
Joint or navel problems	1.0	(0.4)	1.2	(0.5)	1.4	(0.3)	1.0	(0.3)
Lameness or injury	NA		4.0	(0.5)	6.4	(0.6)	12.8	(1.0)
Lack of coordination/ severe depression	NA		0.5	(0.1)	0.3	(0.1)	0.7	(0.2)
Poison	NA		1.2	(0.3)	1.1	(0.4)	1.9	(0.9)
Trauma	6.7	(0.9)	NA		NA		NA	
Other known	20.8	(2.0)	15.8	(2.4)	12.1	(1.2)	9.9	(1.0)
Unknown	18.3	(2.1)	18.4	(1.4)	16.0	(1.1)	14.6	(1.2)
Total	100.0		100.0		100.0		100.0	

*Operations with any dairy cows.

Percentage of Weaned Heifer Deaths*, by Cause



*Operations with any diary cows.

The percentage of cows that died increased across herd sizes from 1996 to 2007. The overall percentage of cows that died increased from 3.8 percent in 1996 to 5.7 percent in 2007.

e. Percentage of cows deaths*, as a percentage of January 1 inventory, by herd size

	Percent Cows					
Herd Size (Number of Cows)	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Small (fewer than 100)	3.6	(0.1)	4.4	(0.1)	4.8	(0.1)
Medium (100 to 499)	3.9	(0.1)	5.0	(0.1)	5.8	(0.2)
Large (500 or more)	4.0	(0.2)	4.9	(0.1)	6.1	(0.2)
All operations	3.8	(0.1)	4.8	(0.1)	5.7	(0.1)

*Operations with any dairy cows.

The percentage of cow deaths due to lameness or injury increased from 12.7 percent in 1996 to 20.0 percent in 2007. Conversely, the percentage of cow deaths due to calving problems and other known reasons decreased from 1996 to 2007.

f. Percentage of cow deaths*, by cause

	Percent Deaths					
Cause	**Dairy 1996**	**Std. Error**	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Scours, diarrhea, or other digestive problems	9.0	(1.0)	8.6	(0.5)	10.4	(0.5)
Respiratory problems	9.6	(0.7)	10.3	(0.5)	11.3	(0.7)
Poison	0.9	(0.2)	0.4	(0.1)	0.4	(0.1)
Put down due to lameness or injury	12.7	(0.7)	13.9	(0.6)	20.0	(0.8)
Lack of coordination or severe depression	1.4	(0.2)	1.4	(0.2)	1.0	(0.1)
Mastitis	16.3	(0.8)	17.1	(0.6)	16.5	(0.7)
Calving problems	18.3	(0.7)	17.4	(0.7)	15.2	(0.7)
Other known reasons	17.0	(0.9)	11.1	(0.6)	10.2	(0.8)
Unknown reasons	14.8	(0.8)	19.8	(0.9)	15.0	(1.1)
Total	100.0		100.0		100.0	

*Operations with any dairy cows.

2. Necropsy

Determining the cause of death is important in preventing future deaths and improving the health of the herd. A relatively low percentage of operations performed necropsies on dead preweaned heifers, weaned heifers, or cows (8.0, 7.1, and 13.0 percent, respectively) to determine cause of death. With the exception of weaned heifers, the percentage of operations that performed any necropsy for a particular cattle class increased as herd size increased. Less than 1 of 10 small operations (8.4 percent) performed necropsies on cows, while 3 of 10 large operations (33.3 percent) performed necropsies.

a. For operations* that had at least one death in the following cattle classes, percentage of operations that performed necropsies to determine the cause of death, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Cattle Class	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Preweaned heifers	4.4	(0.9)	11.9	(1.4)	22.6	(2.5)	8.0	(0.7)
Weaned heifers	5.8	(1.4)	6.9	(1.2)	13.5	(2.1)	7.1	(0.9)
Cows	8.4	(1.0)	20.2	(1.8)	33.3	(2.7)	13.0	(0.9)

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

About 4 percent of animals that died within any cattle class were necropsied to determine the cause of death. There were no substantial differences in the percentages of deaths necropsied among cattle classes or herd sizes.

b. For operations* that had at least one death in the following cattle classes, percentage of preweaned heifer deaths, weaned heifer deaths, and cow deaths in which necropsies were performed to determine cause of death, by herd size

	Percent Deaths Necropsied							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Preweaned heifers	1.8	(0.4)	4.7	(1.1)	3.8	(0.5)	3.5	(0.4)
Weaned heifers	3.9	(1.0)	4.8	(1.5)	3.7	(0.7)	4.1	(0.6)
Cows	4.4	(0.7)	6.0	(0.9)	3.5	(0.4)	4.4	(0.4)

*Operations with any dairy cows.
Source: NAHMS Dairy 2007.

3. Carcass disposal

Prompt removal and disposal of dead animals from pens before other animals, rodents, or birds have contact with them reduces the risk that disease agents from the carcasses will be spread to other animals.

The percentage of operations that used rendering to dispose of dead calves decreased from 43.8 percent in 2002 to 36.5 percent in 2007, while the percentage of operations that composted dead calves increased from 10.1 to 24.2 percent during the same period.

a. Percentage of operations* by primary method used to dispose of dead calves

	Percent Operations			
Disposal Method	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Buried	35.3	(1.3)	32.6	(1.3)
Burned/incinerated	2.8	(0.4)	2.0	(0.4)
Rendered	43.8	(1.3)	36.5	(1.3)
Composted	10.1	(0.8)	24.2	(1.2)
Landfill	2.4	(0.4)	1.7	(0.3)
Other	5.6	(0.6)	3.0	(0.5)
Total	100.0		100.0	

*Operations with any dairy cows.

Although rendering remained the primary method of dead-cow disposal, the percentage of operations that used this method decreased from 62.4 percent in 2002 to 56.9 percent in 2007. Conversely, the use of composting increased from 6.9 percent of operations in 2002 to 16.8 percent in 2007. These changes in dead-cow disposal are similar to those observed in disposing of dead calves.

b. Percentage of operations* by primary method used to dispose of dead cows

	Percent Operations			
Disposal Method	**Dairy 2002**	**Std. Error**	**Dairy 2007**	**Std. Error**
Buried	22.7	(1.1)	20.3	(1.1)
Burned/incinerated	2.2	(0.4)	1.8	(0.4)
Rendered	62.4	(1.2)	56.9	(1.3)
Composted	6.9	(0.7)	16.8	(1.0)
Landfill	1.9	(0.3)	1.7	(0.3)
Other	3.9	(0.5)	2.5	(0.4)
Total	100.0		100.0	

*Operations with any dairy cows.

Section II: Methodology Dairy 2007

Note: For methodology documentation for studies in 1991, 1996, and 2002, see previous study reports. Also see Appendices III and IV for an overview.

A. Needs Assessment

NAHMS develops study objectives by exploring existing literature and contacting industry members about their informational needs and priorities during a needs-assessment phase. The objective of the needs assessment for the NAHMS Dairy 2007 study was to collect information from U.S. dairy producers and other dairy specialists about what they perceived to be the most important dairy health and productivity issues. A driving force of the needs assessment was the desire of NAHMS researchers to receive as much input as possible from a variety of producers, industry experts and representatives, veterinarians, extension specialists, universities, and dairy organizations. Information was collected via focus groups and through a Needs Assessment Survey.

Focus group teleconferences and meetings were held to help determine the focus of the study:

Teleconference, March 30, 2006
National Johne's Working Group

Meeting, Louisville, KY, April 2, 2006
National Johne's Working Group
National Institute for Animal Agriculture

Meeting, Louisville, KY, April 3, 2006
National Milk Producers Federation
Animal Health Committee

Teleconference, December 15, 2006
Bovine Alliance on Management and Nutrition

In addition, a Needs Assessment Survey was designed to ascertain the top three management issues, diseases/disorders, and producer incentives from producers, veterinarians, extension personnel, university researchers, and allied industry groups. The survey, created in SurveyMonkey, was available online from early February through late April 2006 and was promoted via electronic newsletters, magazines, and Web sites. Organizations and magazines promoting the study included Vance Publishing's "Dairy Herd Management–Dairy Alert," "Dairy Today," "Hoard's Dairyman," NMC, "Journal of the American Veterinary Medical Association," and the American Association of Bovine Practitioners. E-mail messages requesting input were also sent to cooperative members of the National Milk Producers Federation as well as State and Federal personnel. A total of 313 people completed the survey questionnaire.

Respondents to the Needs Assessment Survey represented

- University/extension personnel—23 percent,
- Producers—22 percent,
- Veterinarians/consultants—20 percent,
- Federal or State government personnel—15 percent,
- Nutritionists—8 percent,
- Allied industry personnel—8 percent, and
- Other—4 percent.

CEAH Focus Group meeting
Fort Collins, CO, May 18, 2006

Draft objectives for the Dairy 2007 study were based on input from teleconferences, face-to-face meetings, and the online survey, and were developed prior to the focus group meeting. Attendees included producers, university/extension personnel, veterinarians, and government personnel. The day-long meeting culminated in the formulation of eight objectives for the study:

1. Describe trends in dairy cattle health and management practices.
2. Evaluate management factors related to cow comfort and removal rates.
3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease-prevention practices.
4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVD).
5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens.
6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis* (Johne’s disease).
7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices.
8. Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns.

B. Sampling and Estimation

1. State selection

The preliminary selection of States to be included in the study was done in February 2006 using the National Agricultural Statistics Service (NASS) January 27, 2006, “Cattle Report.” A goal for NAHMS national studies is to include States that account for at least 70 percent of the animals and producer population in the United States. The initial review of States identified 16 major States representing 82.0 percent of the U.S. milk cow inventory and 79.3 percent of U.S. operations with milk cows (dairy herds). The States were California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Washington, and Wisconsin.

A memo identifying these 16 States was provided in March 2006 to the USDA–APHIS–VS–CEAH Director and, in turn, the VS Regional Directors. Each Regional Director sought input from the respective States about being included in or excluded from the study. Virginia expressed interest in participating and was included, bringing the total number of States to 17.

2. Operation selection

The list sampling frame was provided by NASS. Within each State a stratified random sample was selected. The size indicator was the number of milk cows for each operation. NASS selected a sample of dairy producers in each State for making the January 1 cattle estimates. The list sample from the January 2006 survey was used as the screening sample. Among producers reporting 1 or more milk cows on January 1, 2006, a total of 3,554 operations were selected from the sample for contact in January 2007 during Phase I.

Operations with 30 or more dairy cows that had participated in Phase I were invited to participate in data collection for Phase II of the study. A total of 1,077 operations agreed via written consent to be contacted by veterinary medical officers to determine whether to complete Phase II.

3. Population inferences

a. Phase I: General Dairy Management Report

Inferences cover the population of dairy producers with at least 1 milk cow in the 17 participating States. As of January 1, 2007, these States accounted for 82.5 percent (7,536,000 head) of U.S. milk cows and 79.5 percent (59,640) of U.S. operations with milk cows. (See Appendix II, p 139, for respective data on individual States.) All respondent data were statistically weighted to reflect the population from which they were selected. The inverse of the probability of selection for each operation was the initial selection weight. This selection weight was adjusted for nonresponse within each State and size group to allow for inferences back to the original population from which the sample was selected.

b. Phase II: VS Initial and Second Visits

Inferences cover the population of dairy producers with 30 or more milk cows in the 17 participating States. For operations eligible for Phase II data collection (those with 30 or more dairy cows), weights were adjusted to account for operations that did not want to continue to Phase II. In addition, weights were adjusted for nonresponse to the questionnaire in each visit. The 17-State target population of operations with 30 or more dairy cows represented 82.5 percent of U.S. dairy cows and 84.7 percent of U.S. dairy operations with 30 or more milk cows (Appendix II).

C. Data Collection

1. Phase I: General Dairy Management Report

From January 1 to 31, 2007, NASS enumerators administered the General Dairy Management Report questionnaire. The interview took slightly over 1 hour.

2. Phase II: VS Initial Visit

From February 26 to April 30, 2007, Federal and State veterinary medical officers (VMOs) and/or animal health technicians (AHTs) collected data from producers during an interview that lasted approximately 2 hours.

3. Phase II: VS Second Visit

From May 1 to August 31, 2007, Federal and State VMOs and/or AHTs collected data from producers during an interview that lasted approximately 2 hours.

D. Data Analysis

Validation

a. Phase I: Validation—General Dairy Management Report

Initial data entry and validation for the General Dairy Management Report were performed in individual NASS State offices. Data were entered into a SAS data set. NAHMS national staff performed additional data validation on the entire data set after data from all States were combined.

b. Phase II: Validation—VS Initial and Second Visit Questionnaires

After completing the VS Initial and Second Visit questionnaires, data collectors sent them to their respective State NAHMS Coordinators, who reviewed the questionnaire responses for accuracy and sent them to NAHMS. Data entry and validation were completed by NAHMS staff using SAS.

E. Sample Evaluation

The purpose of this section is to provide various performance measurement parameters. Historically, the term “response rate” has been used as a catch-all parameter, but there are many ways to define and calculate response rates. Therefore, the table below presents an evaluation based on a number of measurement parameters, which are defined with an “x” (see table on next page) in categories that contribute to the measurement.

1. Phase I: General Dairy Management Report (GDMR)

A total of 3,554 operations were selected for the survey. Of these operations, 3,304 (93.0 percent) were contacted. There were 2,519 operations that provided usable inventory information (70.9 percent of the total selected and 76.2 percent of those contacted). In addition, there were 2,194 operations (61.7 percent) that provided “complete” information for the questionnaire. Of the 2,067 operations that provided complete information and were eligible to participate in Phase II of the study, 1,077 (52.1 percent) consented to be contacted for consideration/discussion about further participation.

			Measurement Parameter		
Response Category	Number Operations	Percent Operations	Contacts	Usable[1]	Complete[2]
Survey complete and VMO consent	1,077	30.3	x	x	x
Survey complete, refused VMO consent	990	27.9	x	x	x
Survey complete, ineligible[3] for VMO	127	3.6	x	x	x
No dairy cows on January 1, 2007	214	6.0	x	x	
Out of business	111	3.1	x	x	
Out of scope (prison, research farm, etc.)	6	0.2			
Refusal of GDMR	785	22.1	x		
Office hold (NASS elected not to contact)	126	3.5			
Inaccessible	118	3.3			
Total	3,554	100.0	3,304	2,519	2,194
Percent of total operations			93.0	70.9	61.7
Percent of total operations weighted[4]			94.0	74.1	59.6

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—fewer than 30 head of milk cows on January 1, 2007.
[4]Weighted response—the rate was calculated using the initial selection weights.

2. Phase II: VS Initial Visit

There were 1,077 operations that provided consent during Phase I to be contacted by a VMO for Phase II. Of these 1,077 operations, 582 (54.0 percent) agreed to continue in Phase II of the study and completed the VS Initial Visit Questionnaire; 380 (35.3 percent) refused to participate. Approximately 10 percent of the 1,077 operations were not contacted, and 0.4 percent were ineligible because they had no dairy cows at the time they were contacted by the VMO during Phase II.

			Measurement Parameter		
Response Category	**Number Operations**	**Percent Operations**	**Contacts**	**Usable[1]**	**Complete[2]**
Survey complete	582	54.0	x	x	x
Survey refused	380	35.3	x		
Not contacted	111	10.3			
Ineligible[3]	4	0.4	x	x	
Total	1,077	100.0	966	586	582
Percent of total operations			89.7	54.4	54.0
Percent of total operations weighted[4]			87.5	50.8	50.4

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—no dairy cows at time of interview, which occurred from February 26 through April 30, 2007
[4]Weighted response—the rate was calculated using the turnover weights.

3. Phase II: VS Second Visit

Of the 582 operations that completed the VS Initial Visit Questionnaire, 519 (including one operation that did not complete the VS Initial Visit on time) completed the VS Second Visit Questionnaire; 47 (8.1 percent) refused to participate. Approximately 3 percent of the 583 operations were not contacted, and 0.3 percent were ineligible because they had no dairy cows at the time of the VS Second Visit.

			Measurement Parameter		
Response Category	Number Operations	Percent Operations	Contacts	Usable[1]	Complete[2]
Survey complete	519	89.0	x	x	x
Survey refused	47	8.1	x		
Not contacted	15	2.6			
Ineligible[3]	2	0.3	x	x	
Total	583	100.0	568	521	519
Percent of total operations			97.4	89.4	89.0
Percent of total operations weighted[4]			98.1	90.6	90.3

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—no dairy cows at time of interview, which occurred from May 1 through August 31, 2007.
[4]Weighted response—the rate was calculated using the turnover weights.

Appendix I: Sample Profile
Dairy 2007

A. Responding Operations

1. Number of responding operations, by herd size

	Phase I: General Dairy Management Report	Phase II: VS Initial Visit	Phase II: VS Second Visit
Herd Size (Number of Cows)	**Number of Responding Operations**		
Fewer than 100	1,028	233	211
100 to 499	691	215	188
500 or more	475	134	120
Total	2,194	582	519

2. Number of responding operations, by region

	Phase I: General Dairy Management Report	Phase II: VS Initial Visit	Phase II: VS Second Visit
Region	**Number of Responding Operations**		
West	426	108	93
East	1,768	474	426
Total	2,194	582	519

Appendix II: U.S. Milk Cow Population and Operations

Number of milk cows on January 1, 2007*

		Number of Milk Cows, January 1, 2007 (Thousand Head)		Number of Operations 2007		Average Herd Size	
Region	State	Milk cows on operations with 1 or more head	Milk cows on operations with 30 or more head	Operations with 1 or more head	Operations with 30 or more head	Operations with 1 or more head	Operations with 30 or more head
West	California	1,790	1,788.2	2,200	1,920	813.6	931.4
	Idaho	502	501.0	800	620	627.5	808.1
	New Mexico	360	358.9	450	180	800.0	1,993.9
	Texas	347	344.2	1,300	660	266.9	521.5
	Washington	235	234.3	790	540	297.5	433.9
	Total	3,234	3,226.6	5,540	3,920	583.8	823.1
East	Indiana	166	154.4	2,100	1,150	79.0	134.3
	Iowa	210	203.7	2,400	1,870	87.5	108.9
	Kentucky	93	86.5	2,000	1,180	46.5	73.3
	Michigan	327	320.5	2,700	1,910	121.1	167.8
	Minnesota	455	441.3	5,400	4,800	84.3	91.9
	Missouri	114	108.3	2,600	1,400	43.8	77.4
	New York	628	612.3	6,400	5,100	98.1	120.1
	Ohio	274	252.1	4,300	2,400	63.7	105.0
	Pennsylvania	550	536.3	8,700	7,000	63.2	76.6
	Vermont	140	137.2	1,300	1,100	107.7	124.7
	Virginia	100	97.0	1,300	820	76.9	118.3
	Wisconsin	1,245	1,213.9	14,900	12,800	83.6	94.8
	Total	4,302	4,163.5	54,100	41,530	79.5	100.3
Total (17 States)		7,536	7,390.1	59,640	45,450	126.4	162.6
Percent of U.S.		82.5	82.5	79.5	84.7		
Total U.S. (50 States)		9,132.0	8,958.5	74,980	53,680	121.8	166.9

*Source: NASS Cattle report, February 1, 2008, and NASS Farms, Land in Farms, and Livestock Operations 2007 Summary report, February 1, 2008. An operation is any place having one or more head of milk cows, excluding cows used to nurse calves, on hand at any time during the year.

Appendix III: Methodology Overview, Phase I (1991–2007)

	NAHMS Dairy Studies			
	1991	1996	2002	2007
Data collection dates	4/1991-7/1992	1/1-1/26 1996	12/31/2001-2/12/2002	1/1-1/31 2007
Minimum number of dairy cattle	30	1	1	1
Number of States	28	20	21	17
Data collectors	National Agricultural Statistics Service enumerators			
States as a percentage of U.S. population coverage				
Operations	76.3	80.4	83.0	79.5
Cows	81.3	83.1	85.7	82.5
Respondent Sample profile (herd size)				
Small (fewer than 100 cows)	931	1,480	1,131	1,028
Medium (100-499 cows)	705	873	820	691
Large (500 or more cows)	175	189	510	475
Response category				
Survey complete	1,811	2,542	2,461	2,194
Percent of total	54.1	56.3	63.5	61.7
No milk cows	NA	646	227	214
Out of business/ no milk sold in 1995		179	183	111
Out of scope (prison, research farm, etc.)		16	45	6
Refused		969	821	785
Did not contact		NA	2	126
Inaccessible		164	137	118
Total	3,346	4,516	3,876	3,554

Appendix IV: Methodology Overview, Phase II VS Initial Visit (1996–2007)

	NAHMS Dairy Studies		
	1996	2002	2007
Data collection dates	2/20-5/24	2/25-4/30	2/26-4/30
Minimum number of dairy cattle	30	30	30
Number of States	20	21	17
Data collectors	State and Federal VMOs and AHTs		
Participating States as a percentage of U.S. population coverage			
Operations	85.6	86.6	84.7
Cows	82.7	85.5	82.5
Respondent Sample profile (herd size)			
Small (fewer than 100 cows)	630	400	233
Medium (100-499 cows)	502	392	215
Large (500 or more cows)	87	221	134
Response category			
Survey complete	1,219	1,013	582
Percent of total	76.0	70.4	54.0
Refused	340	335	380
Did not contact	16	76	111
Ineligible	29	14	4
Total	1,604	1,438	1,077

Appendix V: Study Objectives and Related Outputs

1. Describe trends in dairy cattle health and management practices
    - Part II: Changes in the U.S. Dairy Cattle Industry 1991–2007, March 2008
    - Part V: Changes in Dairy Cattle Health and Management in the United States, 1996–2007, July 2009

2. Evaluate management factors related to cow comfort and removal rates
    - Dairy Facilities and Cow Comfort on U.S. Dairy Operations, 2007, Interpretive Report, expected spring 2010

3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices
    - Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
    - Off-Site Heifer Raising on U.S. Dairy Operations, 2007, info sheet, November 2007
    - Colostrum Feeding and Management on U.S. dairy Operations, 1991–2007, info sheet, March 2008
    - Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, February 2009
    - Calf Health and Management Practices on U.S. Dairy Operations, 2007, Interpretive Report, February 2010
    - Calving Management on U.S. Dairy Operations, 2007, info sheet, January 2009
    - Passive Transfer Status of Heifer Calves on U.S. Dairies, 1991–2007, info sheet, March 2010

4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVD)
    - Bovine Viral Diarrhea (BVD) Detection in Bulk Tank Milk and BVD Management Practices in the United States, 1996–2007, info sheet, October 2008

5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens
    - Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
    - Milking Procedures on U.S. Dairy Operations, 2007, info sheet, October 2008

6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis*
    - Johne's Disease on U.S. Dairies, 1991–2007 info sheet, April 2008

7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices
    - Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
    - Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
    - **Biosecurity Practices on U.S. Dairy Operations, 1991–2007, Interpretive Report, May 2010**

8. Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns

- Antibiotic Use on U.S. Dairy Operations, 2002-07, info sheet, October 2008
- *Listeria* and *Salmonella* in Bulk Tank Milk on U.S. Dairy Operations, 2002–07, info sheet, June 2009
- *Salmonella* and *Campylobacter* on U.S. Dairy Operations, 2002–07, info sheet, July 2009
- Food Safety Pathogens Isolated from U.S. Dairy Operations, 2007, Interpretive Report, expected spring 2010
- Prevalence of *Coxiella burnetti* on U.S. Dairy Operations, 2007, info sheet, expected spring 2010

Additional informational sheets

- Dairy Cattle Identification Practices in the United States, 2007, info sheet, November 2007
- Reproduction Practices on U.S. Dairy Operations, 2007, info sheet, February 2009
- Bovine Leukosis Virus (BLV) on U.S. Dairy Operations, 2007, info sheet, October 2008
- Injection Practices on U.S. Dairy Operations, 2007, info sheet, February 2009
- Methicillin-Resistant *Staphylococcus aureus* (MRSA) Isolation from Bulk Tank Milk in the United States, 2007, info sheet, expected spring 2010

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United States
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Animal and
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Veterinary
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National
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System

January 2010

Dairy 2007

Heifer Calf Health and Management Practices on U.S. Dairy Operations, 2007

USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

N550.0110

Selected Highlights of Heifer Calf Health and Management Practices

The Dairy 2007 study marks the first time in 15 years that the National Animal Health Monitoring System has taken an in-depth look at dairy heifer calf health and management. Here are a few highlights from this report:

During 2006, almost 9 of 10 cows and heifers (86.0 percent) delivered a calf that was alive at 48 hours. Overall, 8.1 percent of calves were stillborn during 2006.

Approximately 6 of 10 operations (60.5 percent) had guidelines on when to intervene during calving for both heifers and cows, and more than 9 of 10 operations (91.9 percent) provided training in calving intervention for owners/employees of the operation.

The majority of operations (59.2 percent) hand-fed colostrum to calves from a bucket or bottle. On average, calves received hand-fed colostrum 3.3 hours following birth. About one-third of operations (36.3 percent) allowed calves to ingest colostrum during first nursing of the dam.

Almost one of five heifer calves (19.2 percent) had failure of passive transfer of immunity based on serum IgG testing. Calves allowed to nurse the dam were more likely to have failure of passive transfer than calves that did not nurse. Assessment of passive transfer level using serum total protein agreed with IgG classification of passive transfer level in 75.4 percent of calves.

The operation average age of heifers at weaning was 8.2 weeks, with large operations weaning calves at an older age (9.1 weeks) than medium and small operations (7.9 and 8.2 weeks, respectively). The median weight at 2 months of age (56 to 62 days) for Holstein heifer calves was 177 pounds.

About 1 of 10 operations (9.3 percent) raised any dairy heifers off the operation. More than two of three operations (69.5 percent)—housing 78.7 percent of heifer calves—did not allow preweaned calves to have contact with older cattle.

During 2006, 7.8 percent of preweaned heifers and 1.8 percent of weaned heifers died. Scours, diarrhea, or other digestive problems accounted for the majority of preweaned heifer deaths (56.5 percent). Respiratory disease was the single largest cause of weaned heifer deaths (46.5 percent).

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This study was a cooperative effort between two U.S. Department of Agriculture (USDA) Agencies: the National Agricultural Statistics Service (NASS) and the Animal and Plant Health Inspection Service (APHIS).

Recognition goes to the NASS enumerators, State and Federal veterinary medical officers (VMOs), and animal health technicians (AHTs) who visited the operations and collected the data for the Dairy 2007 study. Their hard work and dedication to USDA's National Animal Health Monitoring System (NAHMS) were invaluable. The roles of the producers, area veterinarians in charge (AVICs), NAHMS coordinators, VMOs, AHTs, and NASS enumerators were critical in providing quality data for Dairy 2007 reports. Thanks also goes to the personnel at the Centers for Epidemiology and Animal Health for their efforts in generating and distributing valuable reports from Dairy 2007 data.

Additional biological sampling and testing were afforded by the generous contributions of collaborators for the Dairy 2007 study, including

- USDA:APHIS, National Veterinary Services Laboratories;
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- USDA:ARS, Russell Research Center;
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- Cornell University Animal Health Diagnostic Laboratory;
- Quality Milk Production Services;
- Tetracore, Inc.;
- University of Pennsylvania, New Bolton Center;
- University of Wisconsin, Madison; and
- Wisconsin Veterinary Diagnostic Laboratory.

All participants are to be commended, particularly the producers whose voluntary efforts made the Dairy 2007 study possible.

Larry M. Granger
Director
Centers for Epidemiology and Animal Health

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Contacts for further information:
Questions or comments on data analysis: Dr. Jason Lombard
(970) 494-7000
Information on reprints or other reports: Ms. Kathy Snover
(970) 494-7000
E-mail: NAHMS@aphis.usda.gov

Feedback
Feedback, comments, and suggestions regarding the Dairy 2007 study reports are welcomed. Please forward correspondence via e-mail at: NAHMS@aphis.usda.gov, or you may submit feedback via online survey at: http://nahms.aphis.usda.gov
(Click on "FEEDBACK on NAHMS reports.")

Table of Contents

Introduction

Calf Management

Calf management is an important aspect of dairy operations. Calf health is important to the long-term success of operations because heifer calves typically have better genetics (e.g., they are more productive) than adult cows and represent the future dairy herd. Producers should consider resources allocated to calf management as investments in the future.

Maximizing calf health is not easy. Young calves face numerous challenges: the birthing process, acquiring an adequate amount of high-quality colostrum, avoiding infectious diseases, and the impact of other stressors such as weaning and dehorning. Because of these challenges, preweaned calves have the highest morbidity and mortality rates of any age dairy cattle. Studies have estimated the proportion of stillbirths in dairy calves to be between 7 and 8 percent (7.1 percent–Meyer et al., 2000; 8.1 percent – USDA, 2007). Of calves born alive, an additional 7.8 percent die prior to weaning (USDA, 2007), bringing the overall preweaning calf mortality on dairy operations to approximately 15 percent. It is important to realize that the costs of poor calf management go beyond just calf mortality losses. For example, failure of passive transfer of immunity in calves not only results in increased mortality early in life (Wells et al., 1996), but also has long-term effects on calves' lives. Failure of passive transfer in heifer calves is linked with decreased rate and efficiency of growth and decreased first and second lactation milk production (Faber, 2005). Management practices including calving management, colostrum administration, nutrition, biosecurity, and vaccination can impact the overall health and productivity of the dairy herd.

For these reasons, excellent calf health and management should be a high priority. The purpose of this report is to examine dairy calf health and calf management practices in the United States.

Study Development

The National Animal Health Monitoring System (NAHMS) is a nonregulatory division of the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service. NAHMS is designed to help meet the Nation's animal-health information needs and has collected data on dairy health and management practices through three previous studies.

The NAHMS 1991-92 National Dairy Heifer Evaluation Project (NDHEP) provided the dairy industry's first national information on the health and management of dairy cattle in the United States. Just months after the study's first results were released in 1993, cases of acute bovine viral diarrhea (BVD) surfaced in the United States following a 1993 outbreak in Canada. NDHEP information on producer vaccination and biosecurity practices helped officials address the risk of disease spread and target educational efforts on vaccination protocols. An outbreak of human illness was reported in 1993 in the Pacific Northwest, this time related to *Escherichia coli* 0157:H7. NDHEP data on the bacteria's prevalence in dairy cattle helped officials define public risks as well as research needs. This baseline picture of the industry also helped identify additional research and educational efforts in various production areas, such as feed management and weaning age.

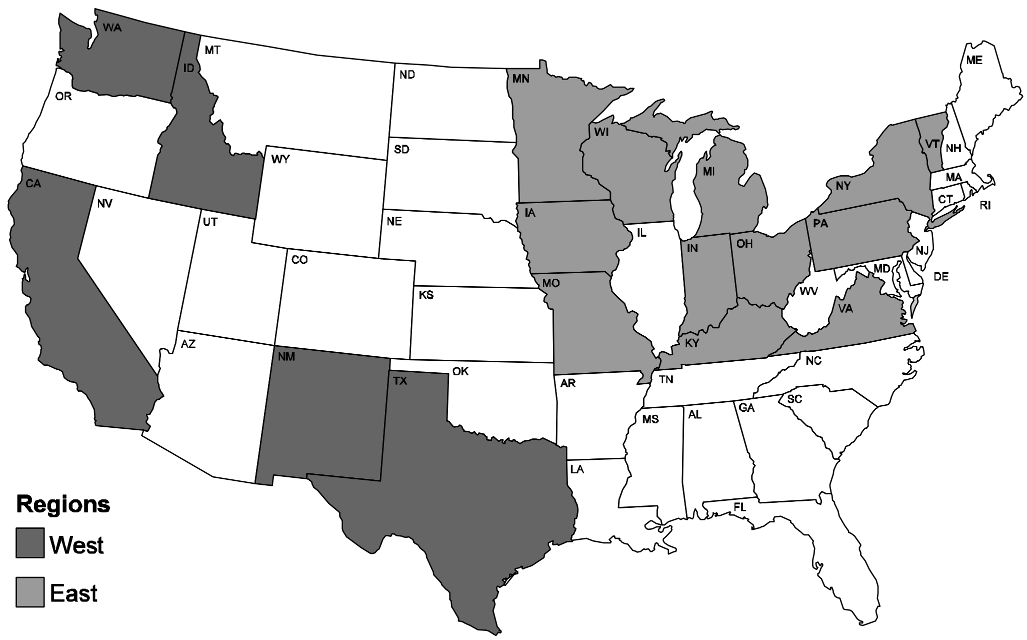
Information from the NAHMS Dairy '96 study helped the U.S. dairy industry identify educational needs and prioritize research efforts on such timely topics as antibiotic usage and Johne's disease, as well as digital dermatitis, bovine leukosis virus, and potential foodborne pathogens, including *E. coli*, *Salmonella*, and *Campylobacter.*

A major focus of the Dairy 2002 study was to describe management strategies that prevent and reduce Johne's disease and to determine management factors associated with *Mycoplasma* and *Listeria* in bulk-tank milk. Additionally, levels of participation in quality assurance programs, the incidence of digital dermatitis, a profile of animal waste handling systems used on U.S. dairy operations, and industry changes since the NDHEP in 1991 and Dairy '96 were examined.

The Dairy 2007 study was conducted in 17 of the Nation's major dairy States (see map on following page) and provides participants, stakeholders, and the industry as a whole with valuable information representing 79.5 percent of U.S. dairy operations and 82.5 percent of the U.S. dairy cows. Phase I data were collected from 2,194 dairy operations by National Agricultural Statistics Service enumerators January 1-31, 2007. For phase II of the Dairy 2007 study, data were collected from a subset of Phase 1 participants (582 operations with 30 or more dairy cows). Phase II data were collected by State and Federal veterinary medical officers (VMOs) and animal health technicians (AHTs) between February 26 and August 31, 2007.

One objective of the Dairy 2007 study was to describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices. This report provides all calf-related information collected during the Dairy 2007 study.

Dairy 2007 Participating States



Information on the methods used and number of respondents in the study can be found at the end of this report.

All Dairy 2007 study reports, as well as reports from previous NAHMS dairy studies, are available online at http://nahms.aphis.usda.gov.

For questions about this report or additional copies, please contact:

USDA-APHIS-VS-CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000

Terms Used In This Report

Amniotic sac: The fluid-filled sac surrounding the calf in the uterus, also referred to as the water bag.

Antibiotics: Substances produced by microorganisms that kill or inhibit the growth of other microorganisms. For the purpose of this report, antibiotics are synonymous with antimicrobials.

Antimicrobial: Any substance that kills or inhibits the growth of microorganisms.

Bovine viral diarrhea: an infectious disease of cattle caused by a pestivirus. Infection can result in embryonic death, abortion, stillbirths, and congenital defects such as cerebellar agenesis that results in ataxia or lack of coordination.

Colostrum: The mammary secretion harvested immediately after calving, which is rich in immunoglobulins (maternal antibodies) and other nutrients.

Cow: Female dairy bovine that has calved at least once.

Dam: The maternal parent.

Dry period: The period from the end of one lactation to the beginning of a new lactation.

Dystocia: Delayed, abnormal, or difficult calving which usually requires intervention to deliver the calf.

ELISA: Enzyme-linked immunosorbent assay.

Estrous: Pertaining to estrus or in reference to the entire reproductive cycle (i.e., estrous cycle).

Estrus: The period during the reproductive cycle when the female displays interest in mating and will stand to be mounted. Behavioral signs of estrus, in addition to standing to be mounted, include passage of clear mucus from the vulva and swelling of the vulva.

Forestomach: A collective term for the rumen, reticulum, and omasum of the ruminant stomach.

Heifer: Female dairy bovine that has not yet calved.

Helminth: A parasitic worm.

Herd size: Herd size is based on January 1, 2007, dairy cow inventory. Small herds are those with fewer than 100 head, medium herds are those with 100 to 499 head, and large herds are those with 500 or more head.

Hypocalcemia: Low calcium level in blood.

IgG: Immunoglobulin G, one of several proteins that function as antibodies, a component of the immune system which helps an animal to fight disease.

Immunoglobulins: Proteins that function as antibodies, a component of the immune system that helps an animal fight disease.

Ionophore: Feed additive that enhances feed efficiency in cattle by altering ruminal fermentation by facilitating the transport of ions across cell membranes. Ionphores are also used to control coccidiosis infections in calves. The Food and Drug Administration (FDA), which approves and regulates animal drugs, considers ionophores a type of antibiotic.

Milk fever: Common name for hypocalcemia or low blood calcium levels, common in cows around the time of calving.

Multiparous: Female dairy bovine that has given birth two or more times.

Nonsaleable milk: Milk that is not sold for human consumption, typically includes waste milk, transition milk, and colostrum.

Operation: The definition of operation for Phase I of the Dairy 2007 study was: premises with at least one dairy cow on January 1, 2007. For Phase II it was: premises with at least 30 dairy cows on January 1, 2007. This report contains data from both phases.

Operation average: The average value for all operations. A single value for each operation is summed over all operations reporting divided by the number of operations reporting. For example, the operation average number of calving personnel (see table a, p 16) was calculated by summing the number of hours following birth that calves usually got their first colostrum feeding over all operations divided by the number of operations.

Parturition: The process of giving birth.

Passive transfer: The process by which the cow passes immunoglobulins via colostrum (for protection against disease) to the calf.

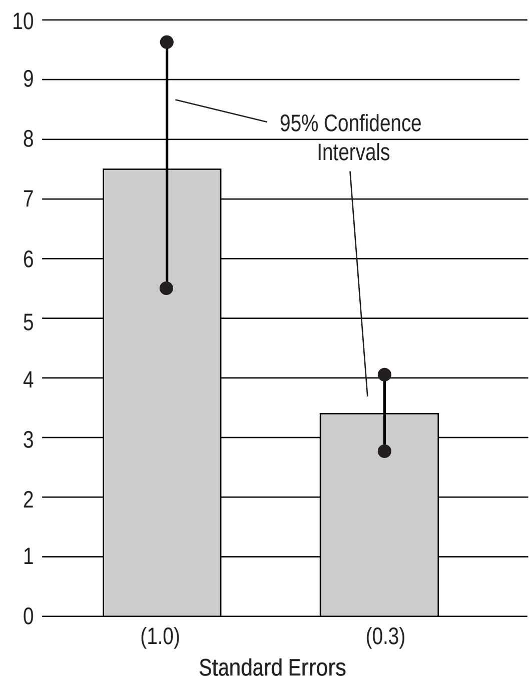
PCR: Polymerase chain reaction.

Placenta: A structure in the uterus that allows transport of nutrients and waste products between the dam and the fetus during pregnancy. The placenta is expelled following birth.

Population estimates: The estimates in this report make inference to all operations or dairy cattle in the target population (see Methodology, p 133). Data from the operations responding to the survey are weighted to reflect their probability of selection during sampling and to account for any survey nonresponse.

Precision of population estimates: Estimates in this report are provided with a measure of precision called the standard error. A 95-percent confidence interval can be created with bounds equal to the estimate plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean 95 out of 100 times. In the example to the right, an estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). The second estimate of 3.4 shows a standard error of 0.3 and results in limits of 2.8 and 4.0. Alternatively, the 90-percent confidence interval would be created by multiplying the standard error by 1.65 instead of 2.

Examples of a 95% Confidence Interval



Most estimates in this report are rounded to the nearest tenth. If rounded to 0, the standard error was reported (0.0). If there were no reports of the event, no standard error was reported (--). References to estimates being higher or lower than other estimates are based on the 95 percent- confidence intervals not overlapping.

Primiparous: Female dairy bovine that has only given birth once or is pregnant for the first time.

Regions:

- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

Sample profile: Information that describes characteristics of the operations from which Dairy 2007 data were collected.

Transition milk: The mammary secretion harvested in the period between colostrum and normal milk, often considered waste or nonsaleable milk.

Usual calving area: An area separate from housing for lactating cows designated specifically for calving. Tie stalls or stanchions were not considered usual calving areas for the purpose of this report.

Section I: Population Estimates

Note: Unless otherwise specified, estimates in the following tables represent only operations with 30 or more dairy cows.

A. Calving

1. Introduction

The goal of the calving event is to have a live, healthy calf and cow. Preparation for successful calving begins long before the date of parturition. About 60 days before calving, the dry period begins for lactating dairy cows. The length of the dry period and the nutrition provided during this time are important to the health of the cow and the calf. Dry periods shorter than 40 days can result in decreased quantities of colostrum as well as decreased milk production in the subsequent lactation. Dry periods shorter than 21 days may result in decreased quality of colostrum.

2. Maternity housing

During the dry period, nonlactating (dry) cows should be segregated from the lactating herd to allow the producer to formulate different diets to meet the specific needs of each group. Limiting potassium intake and providing anionic salts to dry cows help to prevent milk fever and can be implemented when dry cows are housed separately from lactating cows.

Dry cow or maternity housing was separate from lactating cow housing on 60.0 percent of operations, and the percentage of operations that used separate housing increased as herd size increased.

Percentage of operations in which maternity housing was separate from housing used for lactating cows, by herd size

Percent Operations*							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
51.5	(1.7)	80.8	(1.8)	90.4	(2.0)	60.0	(1.3)

*Operations with any dairy cows.

3. Calving area

Cows are generally moved from the far-off dry cow area to a close-up dry cow area when they are about 3 weeks from calving. Expected calving dates are determined based on service date and gestation length. The average gestation period for a cow is approximately 282 days; the gestation period for Ayrshires, Holsteins, and Jerseys is usually closer to 279 days, while Brown Swiss and Guernsey gestations are about 288 and 283 days, respectively (Brakel et al., 1952; Merck, 1998).

Ideally, cows should be moved from the close-up dry cow area into the calving pen as close to calving as possible. If the cows spend too long in the calving pen, the cleanliness of the area can be compromised. The calving area should be clean, dry, quiet, and provide 100-125 square feet of resting space per cow, enough to allow the cow to lie down comfortably and deliver a calf. It should have good lighting to facilitate observation and should be isolated from other areas of the dairy to prevent the cow from becoming distracted or stressed by commotion from other farm tasks. Individual calving pens that can be cleaned between uses are ideal for the prevention of disease. However, group calving pens, if managed well, can also be effective. Group pens require fewer workers for monitoring, which can be desirable on larger dairies. In addition, sick cattle or animals that have tested positive for Johne's disease should not be allowed in the calving area, since they can transmit diseases to calves (Davis and Drackley, 1998; Mee, 2008).

The majority of operations (70.0 percent) used a multiple-animal calving area/pen. A lower percentage of small operations (65.6 percent) used a multiple-animal calving area compared with medium operations (79.8 percent). Approximately one-fourth of operations used an individual calving area that was either cleaned between each calving or cleaned after two or more calvings (25.5 and 26.2 percent, respectively). A higher percentage of small operations (30.6 percent) used an individual-animal pen that was cleaned between each calving compared with medium and large operations (14.6 and 13.5 percent, respectively). Some operations listed more than one type of calving area.

a. Percentage of operations by areas used for calving, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Calving Area	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Multiple-animal area/pen	65.6	(3.5)	79.8	(3.5)	78.5	(4.3)	70.0	(2.6)
Individual-animal area/pen cleaned between each calving	30.6	(3.4)	14.6	(3.3)	13.5	(3.9)	25.5	(2.5)
Individual-animal area/pen cleaned after two or more calvings	25.4	(3.3)	27.4	(3.7)	30.3	(5.6)	26.2	(2.5)
Other	5.1	(1.7)	3.6	(1.4)	3.1	(1.7)	4.6	(1.2)

The usual calving area was defined as an area separate from housing for lactating cows designated specifically for calving. Tie stalls or stanchions were not considered usual calving areas for the purpose of this report. The percentage of operations with a usual calving area ranged from 62.5 percent of small operations to 98.2 percent of large operations.

b. Percentage of operations that had a usual calving area, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Percent	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
62.5	(3.8)	83.7	(3.3)	98.2	(1.2)	70.1	(2.7)

A higher percentage of operations in the West region than in the East region had a usual calving area (88.7 and 68.3 percent, respectively). This difference is likely due to the different types of housing used for lactating cows in the two regions. Operations in the West region are generally larger and most often house cows in loose housing systems such as freestalls or drylots, which necessitate the use of dedicated calving areas. Cows in the East region are often housed in smaller tie stall/stanchion barns and calve in their respective stalls. These types of facilities were not considered usual calving areas in this report.

c. Percentage of operations that had a usual calving area, by region

Percent Operations			
Region			
West		East	
Percent	Standard Error	Percent	Standard Error
88.7	(3.8)	68.3	(3.0)

Of operations with a usual calving area, 4 of 10 (39.9 percent) moved cows into the calving area within a day prior to calving; there were no differences by region. Cows were kept in the calving area prior to calving for 3.1 to 14.0 days on 26.6 percent of operations and for 14.1 or more days on 18.9 percent of operations.

d. For the 70.1 percent of operations with a usual calving area, percentage of operations by number of days cows remained in the usual calving area/pen *prior* to calving, and by region

	Percent Operations					
	Region					
	West		East		All Operations	
Number of Days	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1 or less	28.6	(4.9)	41.4	(3.6)	39.9	(3.2)
1.1 to 3.0	8.3	(2.9)	15.4	(2.6)	14.6	(2.3)
3.1 to 14.0	36.4	(5.6)	25.3	(3.1)	26.6	(2.8)
14.1 or more	26.7	(4.9)	17.9	(2.5)	18.9	(2.3)
Total	100.0		100.0		100.0	

Of operations with a usual calving area, only 12.9 percent removed cows from the calving area in the first hour after calving. A lower percentage of large operations (6.2 percent) allowed cows to remain in the usual calving area for 14.1 or more hours compared with small operations (25.0 percent).

e. For the 70.1 percent of operations with a usual calving area, percentage of operations by number of hours cows remained in the usual calving area/pen *after* calving, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Number of Hours	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Removed immediately	4.4	(1.8)	2.7	(1.3)	7.2	(3.0)	4.2	(1.2)
0.25 to 1.0	8.0	(2.3)	7.8	(2.1)	16.5	(3.8)	8.7	(1.6)
1.1 to 3.0	22.5	(4.0)	26.1	(4.0)	28.0	(5.4)	24.1	(2.8)
3.1 to 14.0	40.1	(4.6)	44.0	(4.4)	42.1	(5.5)	41.4	(3.2)
14.1 or more	25.0	(4.2)	19.4	(3.9)	6.2	(3.2)	21.6	(2.8)
Total	100.0		100.0		100.0		100.0	

There were no regional differences by length of time that cows remained in the usual calving area after calving.

f. For the 70.1 percent of operations with a usual calving area, percentage of operations by number of hours cows remained in the usual calving area/pen *after* calving, by region

	Percent Operations			
	Region			
	West		East	
Number of Hours	Percent	Std. Error	Percent	Std. Error
Removed immediately	6.7	(2.7)	3.9	(1.3)
0.25 to 1.0	7.3	(2.7)	8.9	(1.7)
1.1 to 3.0	22.6	(4.9)	24.3	(3.1)
3.1 to 14.0	44.6	(5.8)	41.0	(3.5)
14.1 or more	18.8	(4.9)	21.9	(3.2)
Total	100.0		100.0	

A higher percentage of small and medium operations (37.3 and 33.0 percent, respectively) allowed sick cows into calving areas than large operations (16.5 percent). Approximately one-half of operations (51.6 percent) allowed lame cows into the calving area. A lower percentage of large operations (28.6 percent) allowed lame cows into the calving area than medium and small operations (57.9 and 51.8 percent, respectively).

g. For the 70.1 percent of operations with a usual calving area, percentage of operations that allowed sick/lame cows in the usual calving area, by cattle class and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Cattle Class	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Sick cows	37.3	(4.6)	33.0	(4.5)	16.5	(4.4)	34.2	(3.2)
Lame cows	51.8	(4.6)	57.9	(4.4)	28.6	(4.5)	51.6	(3.1)
Other	5.4	(2.0)	5.8	(2.3)	4.1	(2.2)	5.4	(1.4)
Any of the above	56.4	(4.6)	62.3	(4.2)	30.7	(4.6)	55.8	(3.1)

Cows that test positive for Johne's disease present a risk of contaminating the usual calving area and transmitting disease to newborn calves. To prevent calving-area contamination and the potential for infecting calves, test-positive cows should not be allowed in the calving area or other calf areas. Of all operations, 28.3 percent had a usual calving area and tested for Johne's disease. A higher percentage of medium operations had a usual calving area and tested for Johne's disease compared with small operations.

h. Percentage of operations that had a usual calving area and tested for Johne's disease, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
23.4	(3.2)	39.6	(4.0)	37.1	(5.6)	28.3	(2.4)

There were no differences by herd size in the percentage of operations that allowed Johne's disease test-positive animals into the calving area; 15.5 percent of operations that had a usual calving area and tested for Johne's disease allowed test-positive cows into the calving area.

i. For the 28.3 percent of operations with a usual calving area and that tested for Johne's disease, percentage of operations that allowed Johne's test-positive cows in the usual calving area, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
12.0	(4.5)	18.0	(5.0)	30.2	(8.3)	15.5	(3.2)

The percentage of calves born in the usual calving area increased as herd size increased. Overall, 89.8 percent of calves were born in the usual calving area.

j. For the 70.1 percent of operations with a usual calving area, percentage of calves born in the usual calving area, by herd size

Percent Calves							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
79.9	(2.0)	89.0	(1.3)	93.6	(1.3)	89.8	(0.9)

Photo courtesy of Judy Rodriguez

A higher percentage of small operations than large operations reported that less than three-fourths of their calves were born in the usual calving area. A higher percentage of large operations (45.8 percent) reported that 91 to 99 percent of calves were born in the calving area compared with 16.6 percent of small operations.

k. For the 70.1 percent of operations with a usual calving area, percentage of calves born in the usual calving area/pen, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Percent Calves	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
0 to 50	19.3	(3.8)	8.4	(2.5)	3.7	(2.0)	14.7	(2.5)
51 to 75	18.3	(3.9)	6.5	(2.3)	3.6	(2.0)	13.5	(2.5)
76 to 90	28.6	(4.3)	29.0	(4.2)	24.0	(4.5)	28.3	(3.0)
91 to 99	16.6	(3.2)	38.4	(4.5)	45.8	(5.7)	25.6	(2.5)
100	17.2	(3.3)	17.7	(3.3)	22.9	(5.5)	17.9	(2.3)
Total	100.0		100.0		100.0		100.0	

4. Calving personnel

The operation average number of calving personnel (people with any work duties in the calving area, including employees and family members) was 2.4. As expected, the average number of calving personnel increased as herd size increased.

a. Operation average number of calving personnel by herd size

Operation Average Number of Calving Personnel							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Avg.	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
2.0	(0.1)	3.0	(0.1)	4.1	(0.3)	2.4	(0.1)

Overall, there was an average of 70.2 cows on the operation for every person with duties in the calving area. On small operations, the ratio of number of cows in the herd to the number of calving personnel was 29.4. On large operations, there was an average of 297.8 cows for each person with calving area duties.

b. Operation average number of cows for each person with duties in the calving area, by herd size

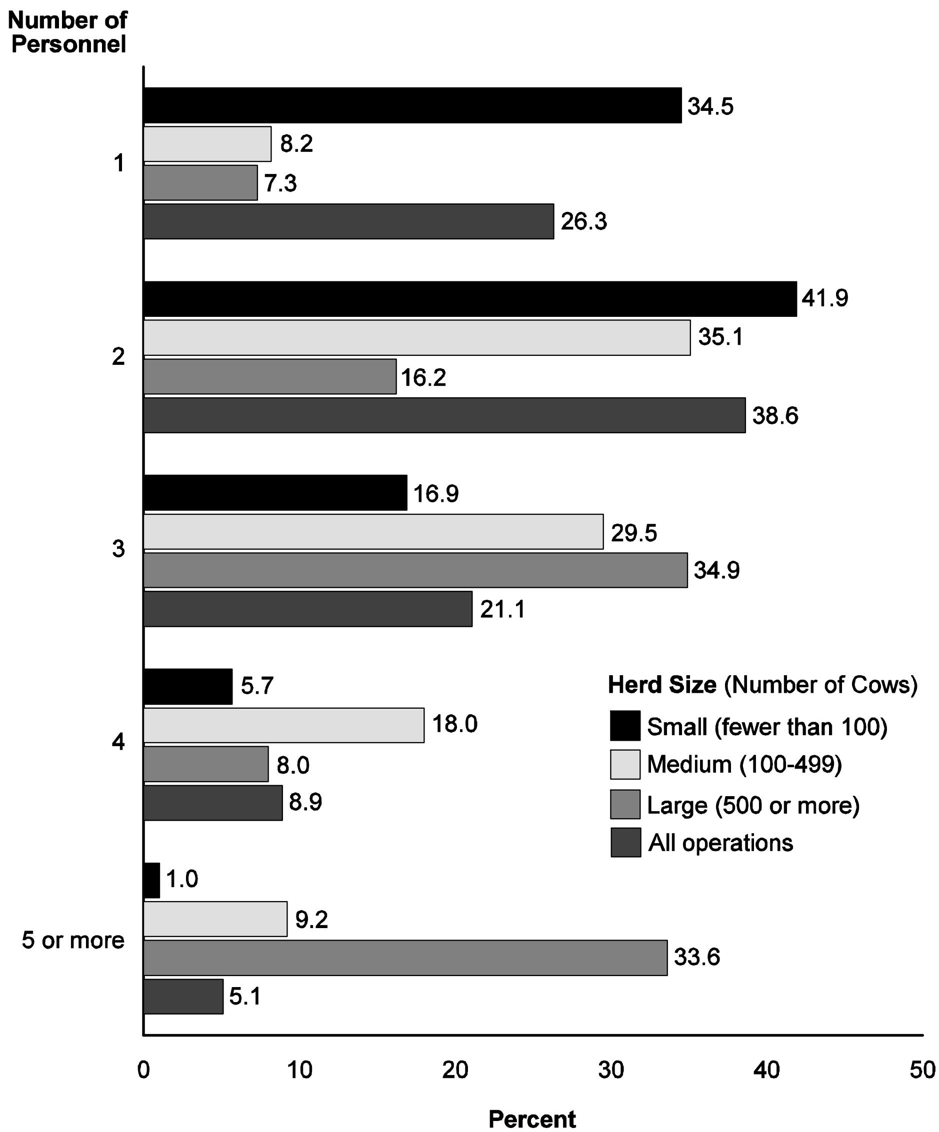
Operation Average Number of Cows per Person							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Avg.	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
29.4	(1.2)	64.0	(3.0)	297.8	(27.7)	70.2	(4.1)

The majority of small operations (76.4 percent) had one or two calving personnel compared with two or three for medium operations (64.6 percent) and three or more for large operations (76.5 percent).

c. Percentage of operations by number of calving personnel, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Number of Personnel	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1	34.5	(3.9)	8.2	(2.3)	7.3	(3.7)	26.3	(2.8)
2	41.9	(4.0)	35.1	(4.3)	16.2	(4.7)	38.6	(3.0)
3	16.9	(3.1)	29.5	(4.2)	34.9	(6.4)	21.1	(2.4)
4	5.7	(1.6)	18.0	(3.5)	8.0	(3.3)	8.9	(1.5)
5 or more	1.0	(0.7)	9.2	(2.4)	33.6	(5.5)	5.1	(0.9)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Number of Calving Personnel, and by Herd Size



The West region had a higher percentage of operations with five or more calving personnel (16.6 percent) than the East region (4.0 percent), which is probably a reflection of larger herds in the West region.

d. Percentage of operations by number of calving personnel, and by region

	Percent Operations			
	Region			
	West		East	
Number of Personnel	Percent	Std. Error	Percent	Std. Error
1	15.7	(4.8)	27.3	(3.1)
2	35.1	(5.9)	38.9	(3.2)
3	27.4	(5.1)	20.6	(2.6)
4	5.2	(2.5)	9.2	(1.6)
5 or more	16.6	(3.9)	4.0	(0.9)
Total	100.0		100.0	

5. Births

During 2006, almost 9 of 10 cows and heifers (86.0 percent) delivered a calf that was alive at 48 hours.

a. Calves* born during 2006 and alive at 48 hours, as a percentage of January 1, 2007, cow inventory, by region

Region					
West		East		All Operations	
Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
81.0	(1.1)	89.7	(0.5)	86.0	(0.6)

*Calves on operations with any cows

One-half of calves born in 2006 and alive at 48 hours (50.8 percent) were heifer calves.

b. Heifer calves* as a percentage of all calves born during 2006 and alive at 48 hours, by region

Percent Calves*					
Region					
West		East		All Operations	
Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
52.0	(0.6)	49.9	(0.3)	50.8	(0.3)

*Calves on operations with any cows

6. Stillbirths

Note: Stillbirths were reported on p 61 of NAHMS' "Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007–08" report. Stillbirth estimates in Part I represent operations with any cows and are slightly lower than those reported below (6.5 percent versus 8.1 percent of all calves), which represent operations with 30 or more cows.

All medium and large operations had at least one stillborn calf during the previous 12 months, and almost all small operations (94.7 percent) had at least one stillborn calf. Overall, 8.1 percent of calves were stillborn during the previous 12 months.

a. Percentage of operations with stillborn calves and percentage of calves that were stillborn (including calves that were born dead or died within 48 hours of birth) during the previous 12 months, by herd size

	Percent							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Population	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Operations	94.7	(1.8)	100.0	(0.0)	100.0	(0.0)	96.3	(1.3)
Calves*	8.9	(0.4)	8.6	(0.4)	7.2	(0.5)	8.1	(0.3)

*Number of calves stillborn x 100 / number of calves born during 2006.

All operations in the West region and 96.0 percent in the East region had at least one stillbirth. The West region had a lower percentage of stillborn calves than the East region.

b. Percentage of operations with stillborn calves and percentage of calves that were stillborn (including calves that were born dead or died within 48 hours of birth) during the previous 12 months, by region

	Percent			
	Region			
	West		East	
Population	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Operations	100.0	(0.0)	96.0	(1.4)
Calves*	6.6	(0.5)	8.9	(0.3)

*Number of calves stillborn x 100 / number of calves born during 2006.

The majority of stillborn calves were born dead (78.6 percent), while the remaining 21.4 percent were born alive but died within 48 hours of birth.

c. For the 8.1 percent of calves that were stillborn during the previous 12 months, percentage of stillborn calves by time of death and by herd size

	Percent Stillborn Calves							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Time of Death	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Born dead	73.8	(2.2)	77.7	(2.0)	83.1	(2.5)	78.6	(1.4)
Born alive, but died within 48 hr	26.2	(2.2)	22.3	(2.0)	16.9	(2.5)	21.4	(1.4)
Total	100.0		100.0		100.0		100.0	

B. Dystocia Management

Note: Unless otherwise specified, estimates in the following tables represent only operations with 30 or more dairy cows.

1. Introduction

Providing the proper assistance at calving, especially during dystocia or calving difficulty, can significantly reduce dairy calf morbidity and mortality. Dairy producers and personnel should be properly trained in correct calving practices, including

- The normal calving process and signs of an abnormal calving,
- How frequently the dam should be observed during calving,
- How to intervene during calving, and
- When to call for professional help.

Current guidelines suggest that the dam should be observed at least every 3 hours during calving (Mortimer, 2009). It is important to understand the stages of labor in order to know when to intervene during calving. Labor is classified into three stages.

Stage 1: Characterized by cervical dilation and uterine contractions, which are usually not evident as abdominal contractions. Cattle during this stage may show signs of restlessness due to the discomfort of the uterine contractions, and they often seek isolation. Stage 1 usually lasts for 2 to 6 hours but may be longer in heifers. Intervention is needed if stage 1 labor lasts longer than 8 hours. Common reasons that cows do not to progress from stage 1 to stage 2 include uterine inertia (hypocalcemia) and some types of abnormal deliveries (Mortimer, 2009).

Stage 2: Uterine contractions continue and abdominal contractions become evident (the dam is noticeably pushing). Stage 2 ends in the delivery of the fetus or fetuses and usually takes less than 2 hours for mature cows but up to 4 hours for heifers. During this stage, the posture, presentation, and position of the fetus are important. Posture refers to the orientation of the fetus' legs and head compared to the dam. Position refers to whether the fetus is right side up (normal) or upside down (abnormal). Presentation refers to which part of the calf is exiting the birth canal first; examples are breech (tail coming first), backward or posterior (back feet coming first) and normal or anterior (front feet coming first). Intervention is recommended if any of the following situations occur during stage 2 of labor:

- Delivery is abnormal (abnormal presentation, posture or position)
- Cow or calf experiences undue stress or weakness (for instance, the calf has a swollen tongue)
- Cow makes no progress despite 30 minutes of active labor
- Cow stops pushing for more than 15 to 20 minutes (breaks are normal but they should not last more than 5 to 10 minutes unless the cow is moved during Stage 2 labor)
- Amniotic sac has been visible for 2 hours or more, and the cow is not pushing (Mortimer, 2009)

Stage 3: Results in the expulsion of the fetal membranes (placenta) due to continued uterine contractions. The placenta is normally expelled within 8 to 12 hours after calving; longer than this constitutes a retained placenta, and treatment may be needed.

Many factors contribute to dystocia. The most common cause of dystocia in primiparous dams is a calf too large relative to the size of the dam's pelvic canal. Dystocia in multiparous dams is usually caused by abnormal presentation, posture, or position of the calf, and maternal causes such as uterine inertia (Arthur et al., 1989). Studies have shown that a higher percentage of heifers than cows experience dystocia. Dystocia rates over a 12-year period were reported based on 666,341 dairy calving records from the Mid States Dairy Record Processing Center. The estimated dystocia rate for heifers (primiparous) was 28.6 percent and for cows (multiparous) 10.7 percent (Meyer et al., 2001). In a study conducted on three Colorado dairies (Lombard et al., 2007), dystocia rates were 51.2 percent for heifers and 29.4 percent for cows.

Dystocia is an important problem for dairy operations because it has a negative impact on calf health. Calves experiencing a dystocia have a higher risk of being stillborn. In dairy cattle, stillborn is usually defined as death at or within 24 to 48 hours of delivery (Philipsson et al., 1979). The reported stillbirth rate for dairy calves based on 666,341 calving records was 7 percent (Meyer et al., 2000). A study of three Colorado dairies reported a stillbirth rate of 8.2 percent (Lombard et al., 2007). Slight dystocia increased the likelihood of stillbirth by a factor of 2.9 for heifers and 4.7 for cows. For severe dystocia, the likelihood of stillbirth increased by a factor of 6.8 for heifers and 11.4 for cows (Meyer et al., 2001). Calves experiencing severe dystocia that survive the immediate perinatal period have a higher risk of death or illness in the first 120 days of life (Lombard et al., 2007).

When managing dystocia it is important to act in a prompt and patient manner. Once it has been determined that intervention is warranted, several basic guidelines should be followed. Producers and personnel should clean the cow's perineal area with soap or antiseptic, use palpation sleeves and lubrication. Knowing when to call for professional help will also improve calving success. A professional is often a veterinarian but can be anyone who knows enough to better manage the dystocia. Producers should call for help when they do not know what the calving problem is or when they know what the problem is but do not make any progress after 30 minutes of trying to resolve it (Mortimer, 2009).

Calves that experience a dystocia but are alive at birth should be given special attention to improve their odds of survival. Calves experiencing a prolonged dystocia are likely to have low levels of oxygen in their blood (hypoxia), and their blood pH is frequently acidic (acidosis) instead of neutral. These impairments lead to a cascade of events, such as decreased ability to nurse, decreased absorption of IgG, and poor temperature regulation. The administration of oxygen to calves after dystocia may improve survival. In addition, careful attention to adequate colostrum intake and maintenance of body temperature are critical.

Selective breeding programs may be used to reduce the incidence of dystocia on dairy operations. However, dystocia is caused by multiple factors; genetics alone will not eliminate the problem. Despite this, a breeding program is still a valuable tool for reducing the impact of dystocia. To track the success of any dystocia management plan, dairies should keep records of calving-difficulty scores. Recording and monitoring calving-difficulty scores can assist in selecting sires and in the retention of replacements. A common scoring system is a 5-point system where 1=no assistance, 2=slight problem, 3=needed assistance, 4=considerable force, and 5=extreme difficulty/ surgical procedure. A simplified system can also be implemented that categorizes calvings as “no assistance,” “mild dystocia,” or “severe dystocia.” Tracking calvings that required assistance and comparing them with those that did not allows a dairy to monitor dystocia rates and the impact on calf performance.

2. Guidelines for calving intervention

Approximately 6 of 10 operations had guidelines on when to intervene during calving for heifers (60.7 percent), cows (60.5 percent), or both (60.5 percent). There were no differences in the percentage of operations with calving guidelines by herd size or by region.

a. Percentage of operations with general guidelines (e.g., standard operating procedures or established protocols) on when to intervene during calving for heifers, cows, or both, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Cattle Class	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Heifers	62.3	(3.8)	56.9	(4.6)	57.4	(6.5)	60.7	(2.9)
Cows	62.3	(3.8)	56.3	(4.6)	57.5	(6.5)	60.5	(2.9)
Both	62.3	(3.8)	56.3	(4.6)	57.4	(6.5)	60.5	(2.9)

b. Percentage of operations with general guidelines (e.g., standard operating procedures or established protocols) on when to intervene during calving for heifers, cows, or both, by region

	Percent Operations			
	Region			
	West		East	
Cattle Class	Percent	Std. Error	Percent	Std. Error
Heifers	54.9	(6.2)	61.2	(3.1)
Cows	54.9	(6.2)	61.1	(3.1)
Both	54.9	(6.2)	61.1	(3.1)

For operations with guidelines for both heifers and cows, about one-half (51.7 percent) used different guidelines for heifers and cows.

c. For the 60.5 percent of operations with guidelines for intervening during calving for both heifers and cows, percentage of operations that used different guidelines for heifers and for cows, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
49.2	(5.3)	57.0	(5.9)	59.7	(7.7)	51.7	(3.9)

3. Training personnel

More than 9 of 10 operations (91.9 percent) provided training in calving intervention for owners/employees. Most operations (90.4 percent) used on-the-job training. Approximately one of four operations (27.0 percent) provided training through discussion/lecture. Some operations used more than one method to train owners/employees in calving intervention.

Percentage of operations by calving-intervention training methods used for owners/employees of the operation

Training Method	Percent Operations	Standard Error
Video	2.4	(0.7)
Discussion/ lecture	27.0	(2.7)
On-the-job	90.4	(1.8)
Other	6.1	(1.5)
Any	91.9	(1.7)

4. Calving difficulty scoring

More than one-third of operations (38.5 percent) had a system for scoring calving difficulty. A higher percentage of large operations (57.9 percent) than small operations (35.2 percent) had a scoring system.

a. Percentage of operations that had a system for scoring calving difficulty, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
35.2	(3.8)	42.6	(4.3)	57.9	(6.1)	38.5	(2.9)

There was no regional difference in the percentage of operations that had a system for scoring calving difficulty.

b. Percentage of operations that had a system for scoring calving difficulty, by region

Percent Operations			
Region			
West		East	
Percent	Standard Error	Percent	Standard Error
35.4	(5.1)	38.8	(3.1)

Of operations with a system for scoring calving difficulty, almost all (91.6 percent) recorded the score for assisted births.

c. For the 38.5 percent of operations that had a system for scoring calving difficulty, percentage of operations that recorded the calving difficulty score for assisted births, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
88.5	(4.6)	97.8	(1.4)	93.7	(3.9)	91.6	(3.0)

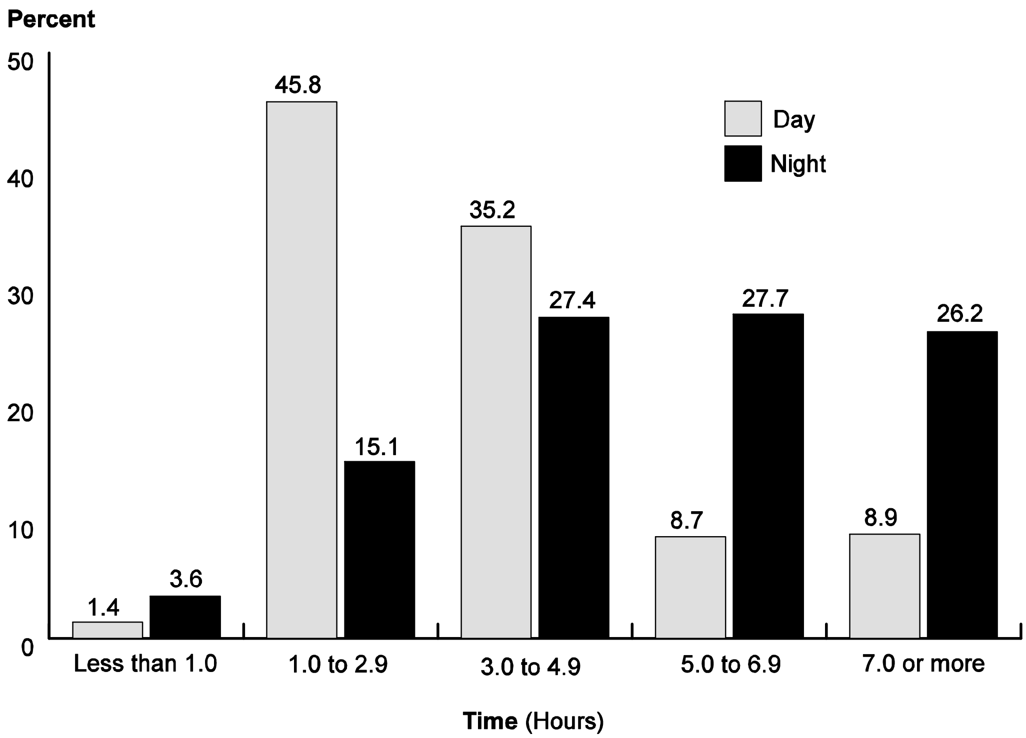
5. Observation close to calving

As expected, females close to calving were observed more frequently during the day than at night. About one-half of operations (47.2 percent) allowed fewer than 3 hours, on average, to pass between observations during the day, with 17.6 percent of operations allowing 5 hours or more between observation periods. During the night, 18.7 percent of operations allowed less than 3 hours to pass between observations, and 53.9 percent let 5 hours or more pass between observation periods.

a. Percentage of operations by average time between observation periods of cattle close to calving, and by time of day

	Percent Operations			
	Day		Night	
Time (Hours)	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 1.0	1.4	(0.6)	3.6	(1.3)
1.0 to 2.9	45.8	(3.0)	15.1	(2.1)
3.0 to 4.9	35.2	(2.9)	27.4	(2.8)
5.0 to 6.9	8.7	(1.8)	27.7	(2.7)
7.0 or more	8.9	(1.8)	26.2	(2.6)
Total	100.0		100.0	

Percentage of Operations by Average Time Between Observation Periods of Cattle Close to Calving, and by Time of Day

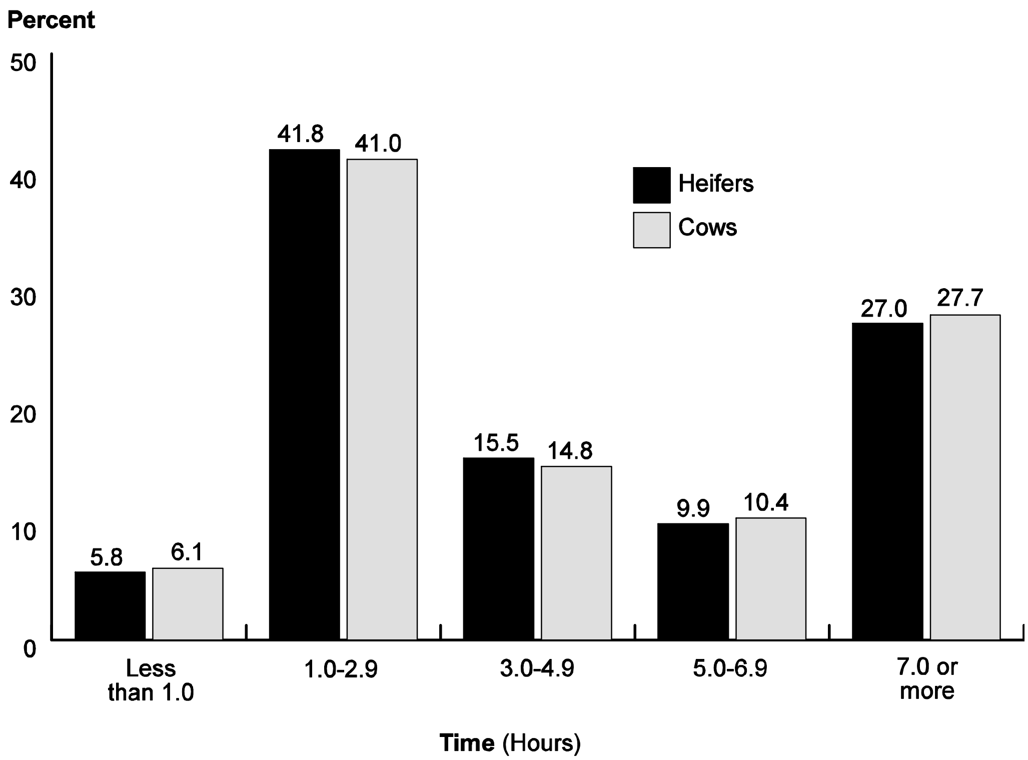


The majority of operations (63.1 percent for heifers and 61.9 percent for cows) would examine or assist an animal before 5 hours elapsed if she showed signs of stage 1 labor without subsequent straining. More than one-fourth of operations (27.0 percent for heifers and 27.7 percent for cows) would wait 7 hours or more to examine or assist an animal that exhibits signs of stage 1 labor without subsequent straining.

b. Percentage of operations by length of time producers would wait to examine or assist an animal when calving is imminent and the heifer or cow is restless/off feed but not observed to be straining

	Percent Operations			
	Heifers		Cows	
Time (Hours)	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 1.0	5.8	(1.2)	6.1	(1.3)
1.0 to 2.9	41.8	(2.9)	41.0	(2.8)
3.0 to 4.9	15.5	(2.0)	14.8	(1.9)
5.0 to 6.9	9.9	(1.9)	10.4	(2.1)
7.0 or more	27.0	(2.8)	27.7	(2.8)
Total	100.0		100.0	

Percentage of Operations by Length of Time Producers Would Wait to Examine or Assist an Animal When Calving is Imminent and the Heifer or Cow is Restless/Off Feed but not Observed to be Straining

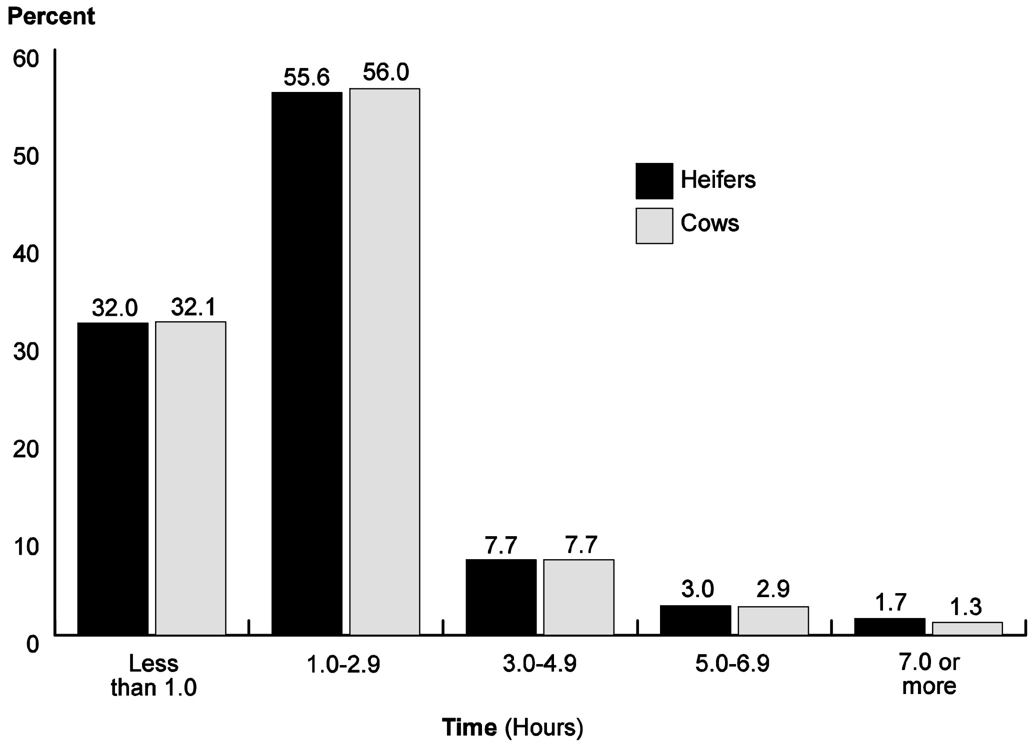


Almost 9 of 10 operations reported that they would wait less than 3 hours to assist heifers or cows that are observed to be straining but are not progressing in delivery (87.6 and 88.1 percent, respectively). Less than 2 percent of operations reported that they would wait 7 hours or more before attending to heifers or cows that are straining but not progressing in delivery.

c. Percentage of operations by length of time producers would wait to examine or assist a heifer or cow that has begun to strain but is not progressing in delivery of the calf

	Percent Operations			
	Heifers		Cows	
Time (Hours)	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 1.0	32.0	(2.9)	32.1	(2.9)
1.0 to 2.9	55.6	(3.0)	56.0	(3.0)
3.0 to 4.9	7.7	(1.5)	7.7	(1.5)
5.0 to 6.9	3.0	(1.2)	2.9	(1.3)
7.0 or more	1.7	(0.9)	1.3	(0.8)
Total	100.0		100.0	

Percentage of Operations by Length of Time Producers Would Wait to Examine or Assist a Heifer or Cow that has Begun to Strain but is not Progressing in Delivery of the Calf



About 95 percent of operations reported that they examine or assist heifers and cows within 3 hours of the water bag appearing at the vulva. Almost one-half of operations would assist heifers and cows within 1 hour of the water bag appearing at the vulva.

d. Percentage of operations by length of time producers would wait before examining or assisting a heifer or cow once the water bag appears at the vulva

	Percent Operations			
	Heifers		Cows	
Time (Hours)	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 1.0	48.4	(2.8)	49.2	(2.8)
1.0 to 2.9	46.2	(2.8)	46.4	(2.8)
3.0 to 4.9	4.1	(1.1)	3.5	(1.0)
5.0 to 6.9	0.6	(0.5)	0.0	(--)
7.0 or more	0.7	(0.5)	0.9	(0.5)
Total	100.0		100.0	

6. Intervention

The practices listed in the following table are generally recommended when a dystocia or difficult calving necessitates intervention. More than 50 percent of operations generally implemented recommended practices, with the exceptions of calling a veterinarian to assist (12.9 percent of operations) and tying or holding the tail out of the way (32.4 percent of operations). A higher percentage of small operations (14.6 percent) than large operations (3.6 percent) would generally call a veterinarian to assist. A higher percentage of large operations than small operations would restrain the cow in a head catch or similar equipment, which might reflect the loose housing systems (such as freestall or drylot) that are more common on large operations than on small operations. Other differences between large and small operations when assisting with delivery included: typically washing the perineum area with soap and water (74.8 and 48.8 percent, respectively), the use of obstetrical gloves (87.1 and 62.5 percent, respectively), and the use of a lubricant (82.2 and 50.4 percent, respectively).

a. Percentage of operations by practice generally implemented once a decision is made to intervene in calving, and by herd size

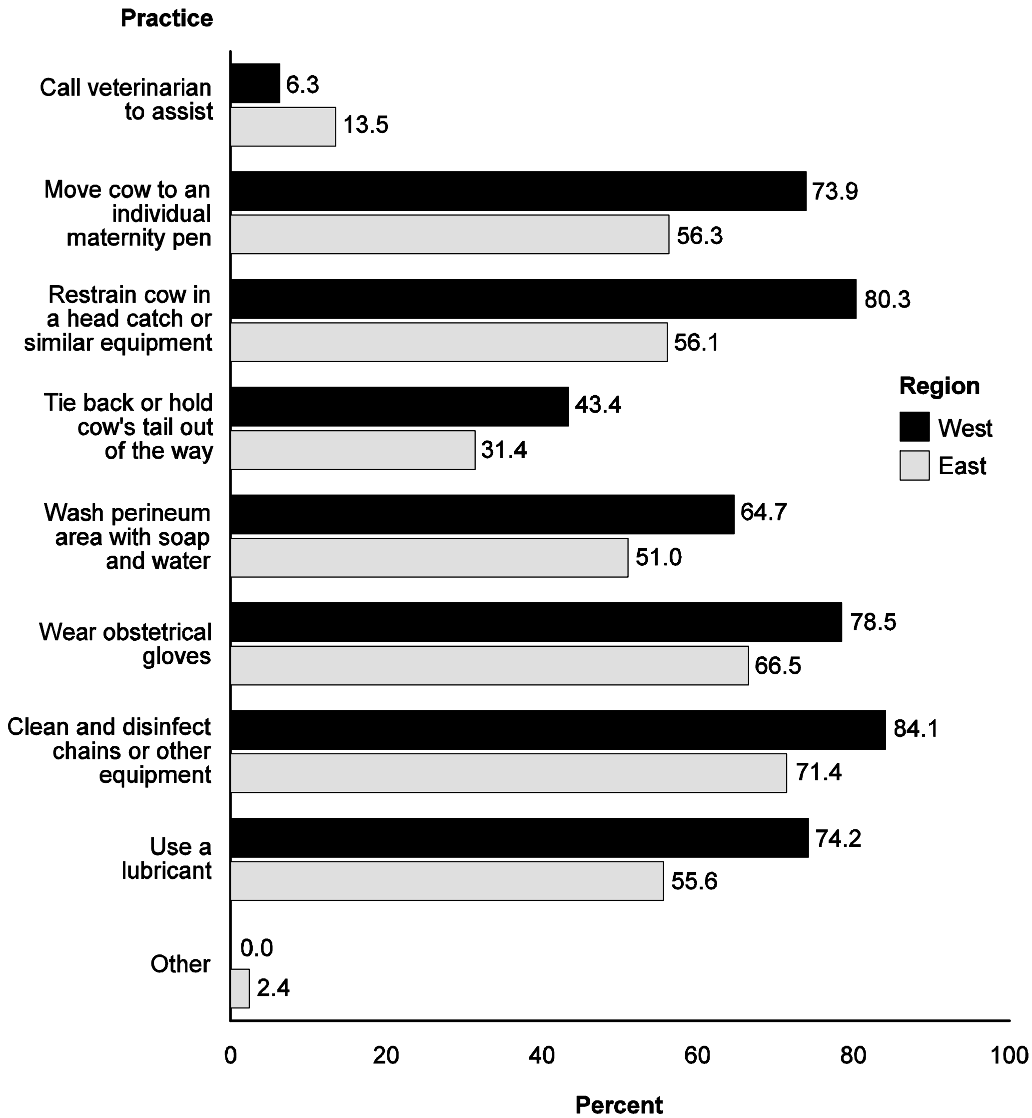
	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Practice	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Call veterinarian to assist	14.6	(3.1)	10.6	(2.9)	3.6	(2.1)	12.9	(2.3)
Move cow to an individual maternity pen	54.4	(4.0)	64.4	(4.1)	69.0	(5.5)	57.8	(2.9)
Restrain cow in a head catch or similar equipment	55.1	(4.0)	58.4	(4.3)	91.7	(2.4)	58.3	(2.9)
Tie back or hold cow's tail out of the way	30.3	(3.7)	36.0	(4.3)	41.2	(6.3)	32.4	(2.8)
Wash perineum area with soap and water	48.8	(4.1)	55.9	(4.5)	74.8	(5.4)	52.2	(3.0)
Wear obstetrical gloves	62.5	(4.0)	76.2	(3.5)	87.1	(4.3)	67.5	(2.9)
Clean and disinfect chains or other equipment prior to use in the vagina or uterus	70.4	(3.7)	75.2	(4.0)	85.7	(4.5)	72.6	(2.7)
Use a lubricant	50.4	(4.1)	69.5	(4.1)	82.2	(5.1)	57.2	(3.0)
Other	3.0	(1.4)	0.3	(0.3)	0.3	(0.3)	2.2	(0.9)

The use of three recommended practices for calving interventions differed by region: a higher percentage of operations in the West region than in the East region would generally move the cow to an individual maternity pen (73.9 and 56.3 percent, respectively), restrain the cow in a head catch or similar equipment (80.3 and 56.1 percent, respectively), or use a lubricant (74.2 and 55.6 percent, respectively).

b. Percentage of operations by practice generally implemented once a decision is made to intervene in calving, by region

	Percent Operations			
	Region			
	West		East	
Practice	Percent	Std. Error	Percent	Std. Error
Call veterinarian to assist	6.3	(2.4)	13.5	(2.5)
Move cow to an individual maternity pen	73.9	(5.1)	56.3	(3.2)
Restrain cow in a head catch or similar equipment	80.3	(3.7)	56.1	(3.2)
Tie back or hold cow's tail out of the way	43.4	(5.6)	31.4	(3.0)
Wash perineum area with soap and water	64.7	(5.8)	51.0	(3.3)
Wear obstetrical gloves	78.5	(5.0)	66.5	(3.1)
Clean and disinfect chains or other equipment prior to use in the vagina or uterus	84.1	(4.3)	71.4	(2.9)
Use a lubricant	74.2	(5.2)	55.6	(3.2)
Other	0.0	(--)	2.4	(1.0)

Percentage of Operations by Practice Generally Implemented Once a Decision is Made to Intervene in Calving, by Region



Although the dam provides the best lubricant, additional lubricant during dystocia can be helpful in delivering a healthy calf and in protecting the dam from trauma. With the exception of water used alone, all lubricants listed below may be helpful. The best choice is a commercial obstetrical lubricant mixed with water and used generously.

More than 50 percent of operations that generally used a lubricant during calving intervention used a commercial lubricant (57.5 percent), soap (56.2 percent), or water with other lubricant (51.8 percent). Less than 10 percent of operations used mineral oil, shortening, or water only as a lubricant.

c. For the 57.2 percent of operations that generally used a lubricant during calving intervention, percentage of operations by type of lubricant used

Lubricant	Percent Operations	Standard Error
Mineral oil	8.4	(1.8)
Soap	56.2	(3.6)
Water with other lubricant	51.8	(3.8)
Water only	2.0	(1.1)
Commercial obstetrical lubricant (e.g., J-Lube)	57.5	(3.8)
Shortening (e.g., Crisco)	2.4	(1.1)
Other	1.0	(0.5)

Instruments used to assist with a difficult delivery should be easy to sanitize, especially those used inside the vagina and uterus. Most operations (71.1 percent) used stainless-steel OB chains for pulling calves; these chains are easy to sanitize and are recommended for use. Stainless-steel OB chains were used on a higher percentage of medium and large operations than on small operations. Alternatively, twine was used on a higher percentage of small operations than medium or large operations. Almost 50 percent of operations (49.6 percent) used twine to pull calves, while 22.1 percent used rope.

d. Percentage of operations by type of equipment used for pulling calves (direct contact with calf), and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Equipment Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Stainless-steel OB chains	65.5	(3.8)	81.5	(3.7)	90.6	(3.5)	71.1	(2.8)
Twine	56.5	(4.0)	37.7	(4.4)	21.5	(5.4)	49.6	(3.0)
Rope	23.2	(3.5)	19.4	(3.5)	21.4	(5.3)	22.1	(2.6)
Other	3.1	(1.3)	1.7	(0.7)	8.1	(3.5)	3.1	(0.9)
Any	99.4	(0.6)	100.0	(0.0)	100.0	(0.0)	99.6	(0.4)

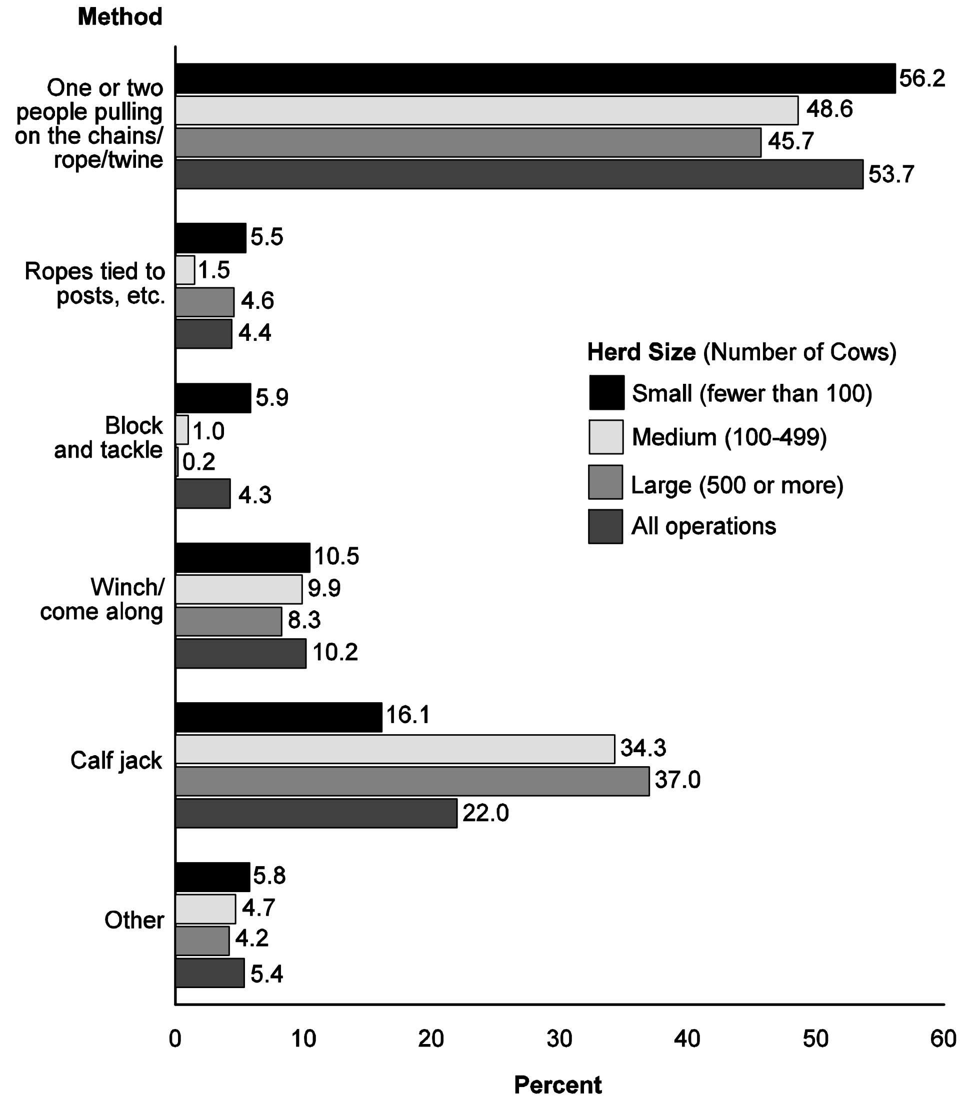
Pressure exerted on the calf during an assisted delivery can cause injury or death to the cow and calf. Studies have reported that two strong people can exert a force of 400 to 600 pounds while delivering a calf, whereas a calf jack can exert 2,000 pounds of force. If two people cannot deliver a calf manually, then an alternative delivery methods, such as a C-section for live calves or a fetotomy for dead calves, are usually recommended.

More than one-half of operations (53.7 percent) reported that one or two people pulling on the chains, rope, or twine was the method most commonly used to apply traction to deliver the calf. About one of five operations (22.0 percent) used a calf jack to apply traction. A block and tackle was used by a higher percentage of small operations than large operations (5.9 and 0.2 percent, respectively). A higher percentage of medium and large operations used a calf jack (34.3 and 37.0 percent, respectively) compared with small operations (16.1 percent).

e. Percentage of operations by method most commonly used to apply traction to deliver the calf, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
One or two people pulling on the chains/rope/twine	56.2	(4.0)	48.6	(4.4)	45.7	(6.3)	53.7	(3.0)
Ropes tied to posts, etc.	5.5	(2.1)	1.5	(0.8)	4.6	(2.4)	4.4	(1.4)
Block and tackle	5.9	(1.8)	1.0	(0.9)	0.2	(0.2)	4.3	(1.3)
Winch/come-along	10.5	(2.7)	9.9	(2.6)	8.3	(3.3)	10.2	(2.0)
Calf jack	16.1	(2.8)	34.3	(4.1)	37.0	(5.9)	22.0	(2.2)
Other	5.8	(1.8)	4.7	(1.7)	4.2	(3.7)	5.4	(1.3)
Total	100.0		100.0		100.0		100.0	

Percentage of Operations by Method Most Commonly Used to Apply Traction to Deliver the Calf, and by Herd Size



To reduce the possibility of injury to the dam during calving intervention, traction should be applied when the dam is straining. More than three of four operations (77.3 percent) generally applied traction in conjunction with the dam straining, while 22.7 percent generally applied traction continuously.

f. Percentage of operations by best description of how traction is generally applied during calving intervention, and by region

	Percent Operations					
	Region					
	West		East		All Operations	
Traction Application	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
In conjunction with dam straining	88.2	(3.5)	76.2	(2.7)	77.3	(2.5)
Continuously	11.8	(3.5)	23.8	(2.7)	22.7	(2.5)
Total	100.0		100.0		100.0	

7. Veterinary assistance

Although only 12.9 percent of operations would generally seek veterinary assistance immediately after making the decision to intervene during calving, (see table a., p 35), almost all operations had sought veterinary assistance for difficult deliveries, regardless of herd size or region.

a. Percentage of operations that seek veterinary assistance for difficult deliveries, and by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
95.5	(1.5)	95.0	(1.5)	86.8	(4.4)	94.8	(1.1)

b. Percentage of operations that seek veterinary assistance for difficult deliveries, by region

Percent Operations			
Region			
West		East	
Percent	Standard Error	Percent	Standard Error
86.6	(3.9)	95.6	(1.2)

For the 94.8 percent of operations that seek veterinary assistance for difficult deliveries, 93.5 percent would seek assistance to help correct the calf's position for delivery, and 85.6 percent would seek veterinary assistance after applying traction for a specific amount of time with no evidence of progress.

c. For the 94.8 percent of operations that seek veterinary assistance for difficult deliveries, percentage of operations that would seek assistance for the following situations, by region

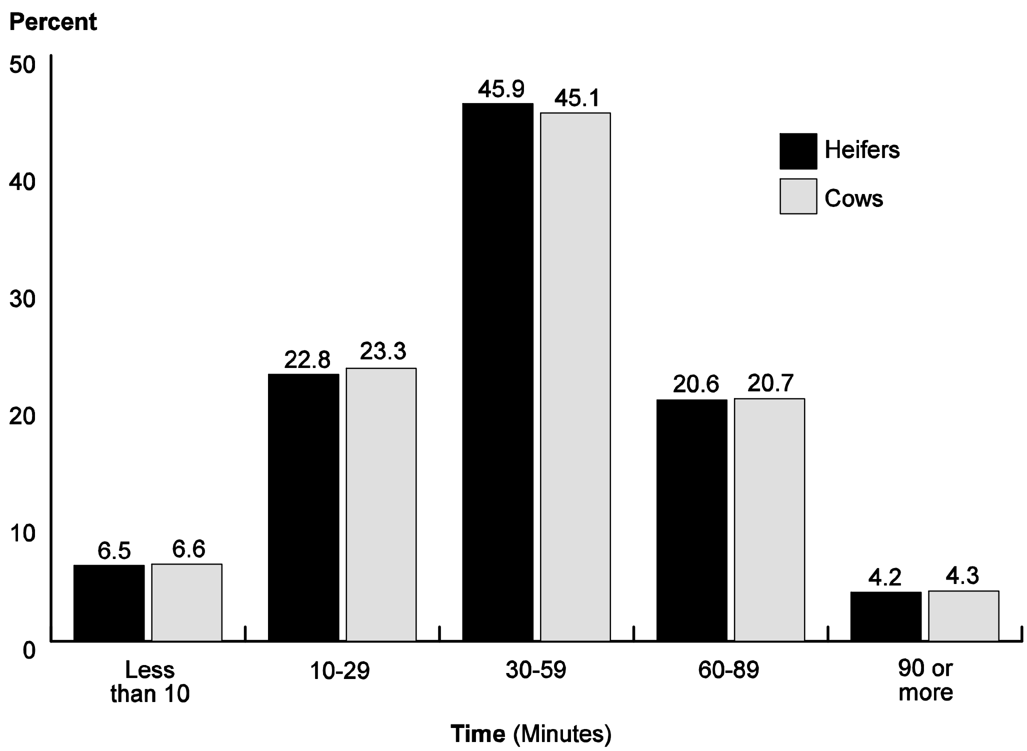
	Percent Operations					
	Region					
	West		East		All Operations	
Situation	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Unable to correctly position calf for delivery	87.5	(4.5)	94.0	(1.5)	93.5	(1.4)
Applied traction for a specific amount of time without progress	81.3	(4.7)	86.0	(2.4)	85.6	(2.2)

The percentages of operations by length of time elapsed before calling for assistance were about the same for heifers and cows. About 30 percent of operations would call for veterinary assistance within 30 minutes of intervening in a calving. The highest single percentages of operations would seek assistance within 30 to 59 minutes of intervening for both heifers and cows. About one-fourth of operations (24.8 percent for heifers and 25.0 percent for cows) would work to relieve the dystocia for 1 hour or more before calling for veterinary assistance.

d. For the 94.8 percent of operations that seek veterinary assistance for difficult deliveries, percentage of operations by length of time from beginning intervention during calving until calling for veterinary assistance, for heifers and for cows

	Percent Operations			
	Heifers		Cows	
Time (Minutes)	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 10	6.5	(1.5)	6.6	(1.5)
10 to 29	22.8	(2.7)	23.3	(2.7)
30 to 59	45.9	(3.2)	45.1	(3.2)
60 to 89	20.6	(2.5)	20.7	(2.5)
90 or more	4.2	(1.1)	4.3	(1.1)
Total	100.0		100.0	

For the 94.8 Percent of Operations that Ever Seek Veterinary Assistance for Difficult Deliveries, Percentage of Operations by Length of Time from Beginning Intervention During Calving Until Calling for Veterinary Assistance, for Heifers and for Cows



A higher percentage of cows (79.4 percent) than heifers (69.0 percent) calved unassisted during the previous 12 months. A higher percentage of heifers than cows experienced severe dystocia (6.8 percent of heifers and 3.5 percent of cows) or mild dystocia (11.8 percent of heifers and 7.3 percent of cows).

e. Percentage of heifers and cows that calved during the previous 12 months, by calving difficulty

Calving Difficulty	Percent Heifers[1]	Std. Error	Percent Cows[2]	Std. Error
Severe dystocia (surgical or mechanical extraction)	6.8	(0.7)	3.5	(0.3)
Mild dystocia	11.8	(0.8)	7.3	(0.5)
No dystocia, but assistance provided anyway	12.4	(1.0)	9.8	(0.9)
No assistance	69.0	(1.4)	79.4	(1.3)
Total	100.0		100.0	

[1]As a percentage of dairy cow replacements entering the milking herd in 2006.
[2]As a percentage of cows on the operation at the time of VS Initial Visit interview.

8. Assistance for compromised calves

Calves that experience a dystocia are more likely to be stillborn. Calves that experience a dystocia but are born alive can be given assistance, such as supplemental oxygen, which increases their chances of survival. Depending on the environmental conditions, all the procedures listed in the following table—with the exception of hanging calves upside down—are considered beneficial to the health of the calves when administered correctly. Hanging calves upside down, which was once promoted to assist in removing fluid from the calves' lungs, might actually be harmful for two reasons: most of the liquid comes from the abomasum and not the lungs, making the calves more susceptible to dehydration; and hanging the calves upside down increases pressure on the chest, making it more difficult for the calves to breathe. Calves that experience dystocia are likely to have low levels of oxygen in their blood (hypoxia), and their blood pH is frequently acidic (acidosis) instead of neutral. These impairments lead to other problems, such as decreased ability to nurse and decreased absorption of IgG, and can negatively impact temperature regulation. In many cases, the administration of oxygen to calves after dystocia may have the single largest impact on calf survival.

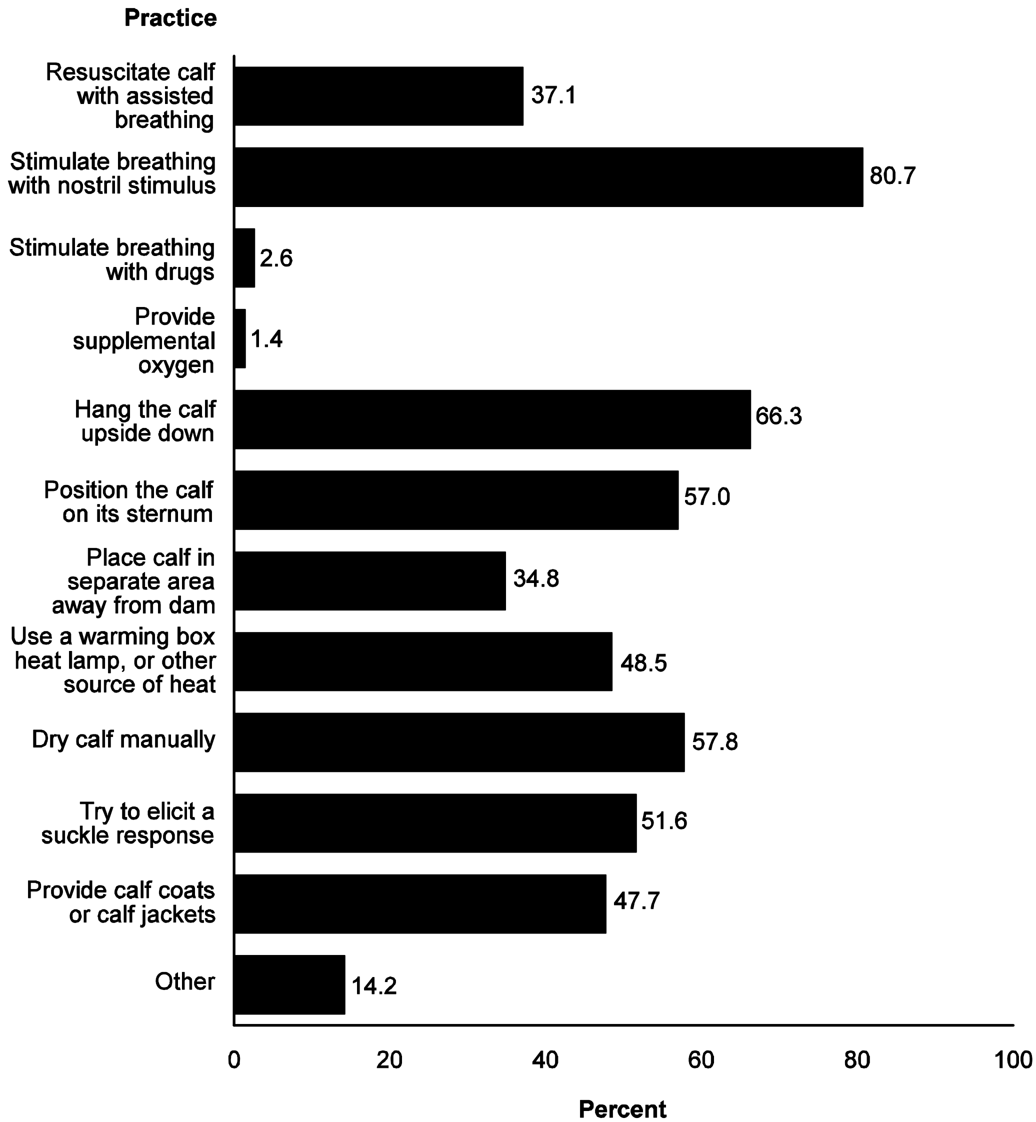
On 80.7 percent of operations, calves that experienced a difficult birth would receive nostril stimulation to initiate breathing. Hanging calves upside down would be performed on 66.3 percent of operations. Three practices which are simple to perform and do not require special equipment or materials were performed by at least one-half of operations: positioning the calf on its sternum, drying the calf manually with towels or a hair dryer, and trying to elicit a suckle response. Few operations (1.4 percent) would provide supplemental oxygen. "Other" practices included allowing the dam to lick/ stimulate the calf and feeding colostrum (14.2 percent of operations).

The use of some practices varied by size of operation. Almost two-thirds of large operations (62.5 percent) resuscitated calves via assisted breathing, compared with slightly more than one-third of small and medium operations (35.0 and 36.6 percent, respectively). A higher percentage of small and medium operations (61.5 and 55.6 percent, respectively) than large operations (27.4 percent) dried calves manually with towels, hair dryer, etc. Additionally, a higher percentage of small and medium operations (45.8 and 58.5 percent, respectively) provided calf coats or calf jackets compared with large operations (26.6 percent).

a. Percentage of operations by practice generally done within 1 hour after delivery for a calf that experienced a difficult birth, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Practice	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Resuscitate calf with assisted breathing	35.0	(3.9)	36.6	(4.3)	62.5	(5.9)	37.1	(2.9)
Stimulate breathing with nostril stimulus	77.3	(3.4)	88.3	(2.7)	87.7	(4.2)	80.7	(2.5)
Stimulate breathing with drugs (Dopram, etc.)	0.6	(0.5)	6.7	(2.4)	7.9	(3.4)	2.6	(0.7)
Provide supplemental oxygen	0.0	(--)	5.2	(2.2)	2.3	(2.1)	1.4	(0.6)
Hang the calf upside down	66.3	(3.8)	66.2	(4.3)	67.0	(6.0)	66.3	(2.8)
Position the calf on its sternum	54.3	(4.0)	63.4	(4.4)	61.2	(6.2)	57.0	(3.0)
Place the calf in separate area away from the dam	32.6	(3.8)	39.1	(4.5)	41.5	(6.0)	34.8	(2.9)
Use a warming box, heat lamp, or other source of heat during cold weather	45.7	(4.1)	59.3	(4.4)	36.6	(5.0)	48.5	(3.0)
Dry calf manually with towels, hair dryer, etc.	61.5	(3.8)	55.6	(4.5)	27.4	(5.3)	57.8	(2.8)
Try to elicit a suckle response	53.9	(4.0)	48.6	(4.4)	39.2	(6.4)	51.6	(3.0)
Provide calf coats or calf jackets after calf is dry	45.8	(4.1)	58.5	(4.3)	26.6	(4.9)	47.7	(3.0)
Other	16.9	(3.2)	7.7	(2.8)	10.7	(4.1)	14.2	(2.4)

Percentage of Operations by Practice Generally Done Within 1 Hour After Delivery for a Calf that Experienced a Difficult Birth



A higher percentage of operations in the West region (54.3 percent) generally resuscitated calves that experienced a difficult birth with assisted breathing compared with operations in the East region (35.5 percent). Alternatively, a higher percentage of operations in the East region dried calves manually with towels, hair dryer, etc. (60.1 percent) or provided calf coats or jackets after the calves were dry (50.5 percent), compared with 34.5 and 18.7 percent of operations in the West region, respectively.

b. Percentage of operations by practice generally done within 1 hour after delivery for a calf that experienced a difficult birth, by region

	Percent Operations			
	Region			
	West		East	
Practice	Percent	Std. Error	Percent	Std. Error
Resuscitate calf with assisted breathing	54.3	(5.4)	35.5	(3.1)
Stimulate breathing with nostril stimulus	84.1	(4.1)	80.4	(2.7)
Stimulate breathing with drugs (Dopram, etc.)	2.5	(1.4)	2.6	(0.8)
Provide supplemental oxygen	3.3	(2.0)	1.3	(0.6)
Hang the calf upside down	67.0	(5.9)	66.3	(3.1)
Position the calf on its sternum	60.2	(6.0)	56.7	(3.2)
Place the calf in separate area away from the dam	34.6	(5.9)	34.8	(3.1)
Use a warming box, heat lamp, or other source of heat during cold weather	38.7	(5.5)	49.4	(3.3)
Dry calf manually with towels, hair dryer, etc.	34.5	(5.5)	60.1	(3.0)
Try to elicit a suckle response	37.6	(5.7)	53.0	(3.2)
Provide calf coats or calf jackets after calf is dry	18.7	(4.4)	50.5	(3.3)
Other	6.5	(2.7)	15.0	(2.6)

C. Colostrum Management and Passive Transfer Status

Note: Unless otherwise specified, estimates in the following tables represent only operations with 30 or more dairy cows.

1. Colostrum management

Providing high quality colostrum as soon as possible after birth maximizes dairy calf health. Colostrum is produced in the 5 weeks prior to calving and differs from milk in that it contains higher levels of protein (especially immunoglobulins), fat, and fat soluble vitamins like vitamin A (Davis and Drackley, 1998). Colostrum is harvested during the first milking after calving. Milk produced in the interim (e.g., second and third milking) between the harvest of colostrum and normal (saleable) milk is commonly referred to as transition milk.

a. Comparison of colostrum, transition milk, and saleable milk by content parameter

		Transition Milk		
Parameter	Colostrum	Second Milking	Third Milking	Saleable Milk
Specific gravity	1.056	1.040	1.035	1.032
IgG (g/100 mL)	4.1	2.5	1.5	0.06
Fat (percent)	6.7	5.4	3.9	3.6
Total protein (percent)	14.9	8.4	5.1	3.2
Lactose (percent)	2.5	3.9	4.4	4.9
Vitamin A (µg/g)	4.9	1.8	1.1	0.3

Source: adapted from Foley and Otterby (1978), Davis and Drackley (1998), and Kehoe et al. (2007).

Colostrum is critically important to calves because calves are born with little or no previous exposure to infectious pathogens. All mammals need maternal immunoglobulins to be protected from disease following birth, and most animals receive the immunoglobulins *in utero* across the placenta. In contrast, calves are born with no immunoglobulins, so they rely on the ingestion of colostrum. The process by which the cow passes immunoglobulins to the calf via colostrum is called passive transfer of immunity. Successful passive transfer in calves is important to dairy producers for a number of reasons. Studies have shown that failure of passive transfer in heifers increases calf morbidity and mortality, reduces calf growth rate and efficiency, and decreases first and second lactation milk production (Fahey and McKelvey, 1965; Faber et al., 2005; Wells et al., 1996).

There are four key principals to colostrum management on the dairy farm: **quality**, **quantity**, **quickness**, and **cleanliness** (Stewart et al., 2005).

Colostrum **quality** refers to the concentration of immunoglobulins in the colostrum, and the goal is to have greater than 50 g IgG/L. Colostrum quality is highly variable; values for Holstein cattle have been reported between 9.4 and 185.7 g IgG/L (Burton et al., 1989; Levieux and Oliver, 1999; Tyler et al., 1999; Morin et al., 2001; Swan et al., 2007). Colostrum quality can be affected by cattle breed, parity (primiparous versus multiparous), length of the dry period, vaccination history of the dam, and timing of colostrum collection after calving. To obtain high quality colostrum, the cow should be milked as soon as possible after calving, preferably within 1 to 2 hours, and no later than 6 hours (Godden, 2008). The amount of IgG in colostrum decreases when first milking is delayed. By 6 hours after calving, the immunoglobulin concentration in colostrum can drop by 17 percent when compared with the levels 2 hours after calving (Moore et al., 2005). Producers can also improve the quality of colostrum by ensuring good dry cow nutrition and comfort, avoiding long or short dry periods, and by having a regular vaccination program for dry cows and heifers.

Common methods for assessing colostrum quality on the farm include visual inspection and the use of a colostrometer. The colostrometer (hydrometer) provides an estimate of IgG levels based on the specific gravity of the colostrum. Although the colostrometer has poor sensitivity for predicting colostrum quality (Pritchett et al., 1994), it is still the most common method used on dairies because it is economical and simple. Colostrum should be at room temperature when using a colostrometer, and only high quality (green) colostrum should be fed to newborn calves. Fair and poor quality colostrum can be fed to calves 24 hours of age and older for nutritional purposes rather than for acquiring immunity. Another method for determining colostrum quality is to directly measure the IgG concentration, either with an available field test kit (Chigerwe et al., 2005) or by sending a sample to a laboratory. Visual inspection is not an accurate method for ascertaining the IgG content of colostrum, but it is important in determining whether colostrum contains blood or is mastitic and, therefore, should not be fed to calves.

It is important to feed an adequate **quantity** of colosturm to calves, once it is determined that the colostrum is of high quality. The Bovine Alliance on Management and Nutrition's "Guide to Colostrum and Colostrum Management for Dairy Calves" suggests that 4 quarts of high quality colostrum should be fed by esophageal feeder within 1 hour of birth (BAMN, 2001). This recommendation applies for the average 90-pound Holstein calf. A larger calf will need a larger volume of colostrum, and a small calf, such as a Jersey or Guernsey, may only need 3 quarts. Colostrum can be hand-fed with either a bottle or an esophageal tube. Passive transfer can be achieved with either method, as long as an adequate volume (4 quarts) of colostrum is fed (Molla, 1978; Adams et al., 1985; Besser et al., 1991). Leaving the calf with the cow for nursing is not recommended because 61 percent (Besser et al., 1991) or 42 percent (Brignole and Stott, 1980) of these calves may not receive adequate passive transfer of immunity. Also, calves allowed to nurse have an increased risk of exposure to pathogens because they may ingest manure from the environment while searching for and suckling teats.

Quickness is another important factor in colostrum management. At birth, a calf's gastrointestinal system is designed to temporarily allow the absorption of large molecules, allowing the IgG in colostrum to be absorbed into the bloodstream. The ability of the calf to absorb the immunoglobulins decreases with time and is typically gone within 24 hours after birth (Stott et al., 1979). A study showed that in a small group of calves allowed to nurse the dam, calf serum IgG levels decreased by 2 mg/mL for every 30-minute delay in the ingestion of colostrum (Rajala and Castren, 1995). Therefore, it is recommended that the calf receive colostrum as soon as possible following birth, preferably within 1 hour and no later than 6 hours.

Cleanliness is also important to a successful colostrum management program. Bacteria in colostrum such as *E coli*, *Salmonella, Mycoplasma,* and *Mycobacterium avium* subspecies *paratuberculosis*, can cause diseases in calves. The cleanliness of colostrum can be assessed by submitting a sample for bacteriological culture. The results of the culture are reported as total plate count (TPC), which reflects the total number of aerobic bacteria in the sample, and total coliform count, which indicates the level of contamination of the sample by gram-negative aerobic bacteria typically found in the intestinal tract of animals, such as *E. coli*. Each live bacterium in the colostrum sample represents a colony forming unit (cfu). The goal for colostrum cleanliness is to have a TPC less than 100,000 cfu/mL, and total coliform count less than 10,000 cfu/mL (McGuirk and Collins, 2004). Bacterial contamination of colostrum may be a common problem on dairies; TPC and total coliform counts exceeded 100,000 cfu/mL and 10,000 cfu/mL, respectively, in 85 percent of colostrum samples from 40 different farms (McGuirk and Collins, 2004).

Proper collection, handling, and storage will reduce the number of bacteria in colostrum. Prior to colostrum collection, the udder should be cleaned and prepared in the same manner used for collecting saleable milk. In addition, equipment used for milking, storing colostrum, and feeding calves should be sanitized regularly. Studies have shown that storing colostrum at warm ambient temperatures results in a rapid increase of bacterial growth (Stewart et al., 2005). To minimize bacterial growth, colostrum should be fed within 1 hour of collection; if it is not to be fed within 1 hour of collection, it can be refrigerated in 2-quart plastic containers for up to 24 hours. For storage longer than 24 hours, colostrum can be frozen in plastic freezer bags for up to 1 year, as long as it is not repeatedly thawed and refrozen. Freezing will not reduce the IgG levels or nutrient content in colostrum (Foley and Otterby, 1978; Klobasa et al., 1998). However, one study reported that calves fed previously frozen colostrum were at a slightly higher risk for failure of passive transfer than calves fed refrigerated colostrum (Besser et al., 1991).

Unpasteurized colostrum should not be pooled, as this practice can increase calves' exposure to pathogens. For example, if a single cow in the herd has Johne's disease, pooling colostrum could potentially expose multiple calves to the disease. It has also been suggested that pooling colostrum decreases the rate of successful passive transfer of immunity (Weaver et al., 2000), probably because the immunoglobulins in the pooled colostrum are diluted by samples with high volume but low immunoglobulin levels.

More than one-half of operations (55.9 percent) removed newborn heifer calves immediately after calving, prior to nursing. These operations accounted for 65.6 percent of all heifer calves. One of five operations (22.2 percent) —accounting for 21.3 percent of newborn calves—removed calves after they nursed their dams but prior to 12 hours of age. Fewer than 1 of 10 operations (7.3 percent)—representing 2.6 percent of calves—allowed calves to stay with their dams for more than 24 hours.

b. Percentage of operations (and percentage of heifers born on these operations during 2006 and alive at 48 hours) by time following birth that calves were normally separated from their dams

Time	Percent Operations[1]	Standard Error	Percent Heifer Calves[2]	Standard Error
Immediately (no nursing)	55.9	(1.4)	65.6	(1.5)
After nursing but less than 12 hours	22.2	(1.2)	21.3	(1.3)
12 to 24 hours	14.6	(1.0)	10.5	(0.9)
More than 24 hours	7.3	(0.8)	2.6	(0.3)
Total	100.0		100.0	

[1]Operations with any dairy cows.
[2]Born during 2006 and alive at 48 hours.

On average, calves received hand-fed colostrum 3.3 hours following birth.

c. For the 55.9 percent of operations that immediately removed calves from their dams and hand-fed colostrum, operation average number of hours after birth that calves got their first colostrum feeding, and by herd size

Operation Average Hours*							
Herd Size (Number of Cows)							
Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Hours	Std. Error	Hours	Std. Error	Hours	Std. Error	Hours	Std. Error
3.4	(0.1)	3.3	(0.1)	2.8	(0.2)	3.3	(0.1)

*Operations with any dairy cows.

The majority of operations (59.2 percent) hand-fed colostrum to calves from a bucket or bottle. These operations accounted for 59.6 percent of heifer calves. About one-third of operations (36.3 percent) allowed calves to ingest colostrum during first nursing of the dam. A total of 4.3 percent of operations accounting for 13.7 percent of calves used an esophageal feeder to administer colostrum.

d. Percentage of operations (and percentage of heifers born on these operations during 2006 and alive at 48 hours) by method normally used for calves' first feeding of colostrum

Colostrum Delivery Method	Percent Operations[1]	Std. Error	Percent Heifer Calves[2]	Std. Error
During first nursing of dam	36.3	(1.4)	26.5	(1.3)
Hand-fed from bucket or bottle	59.2	(1.4)	59.6	(1.6)
Hand-fed using esophageal feeder	4.3	(0.5)	13.7	(1.2)
Did not get colostrum	0.2	(0.1)	0.2	(0.1)
Total	100.0		100.0	

[1]Operations with any dairy cows.
[2]Born during 2006 and alive at 48 hours.

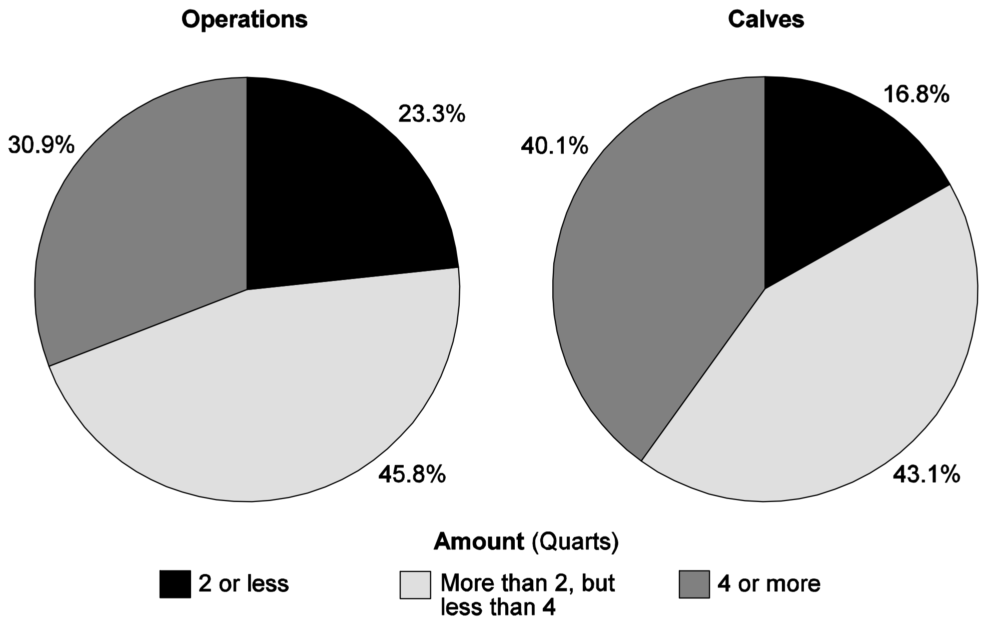
Of operations that normally hand-fed colostrum, 45.8 percent—representing 43.1 percent of heifer calves—fed calves more than 2 but less than 4 quarts of colostrum during the first 24 hours of life. About 4 of 10 calves (40.1 percent) received 4 quarts or more, while 16.8 percent received 2 quarts or less during the first 24 hours.

e. For the 63.5 percent of operations that normally hand-fed colostrum, percentage of operations (and percentage of heifers born on these operations during 2006 and alive at 48 hours) by amount of colostrum normally fed during the first 24 hours

Amount (Quarts)	Percent Operations[1]	Std. Error	Percent Heifer Calves[2]	Std. Error
2 or less	23.3	(1.6)	16.8	(1.4)
More than 2 but less than 4	45.8	(1.9)	43.1	(2.1)
4 or more	30.9	(1.7)	40.1	(2.0)
Total	100.0		100.0	

[1]Operations with any dairy cows.
[2]Born during 2006 and alive at 48 hours.

For the 63.5 Percent of Operations that Normally Hand-Fed Colostrum, Percentage of Operations (and Percentage of Heifer Calves Born and Alive at 48 Hours on These Operations During 2006) by Amount of Colostrum Normally Fed During the First 24 Hours



About one of eight operations that hand-fed colostrum (13.0 percent) estimated the immunoglobulin levels of the colostrum or evaluated its quality before feeding. The percentage of operations that evaluated colostrum more than doubled as herd size increased, ranging from 7.6 percent of small operations to 45.2 percent of large operations.

f. For the 63.5 percent of operations that normally hand-fed colostrum, percentage of operations that estimated the immunoglobulin levels of the colostrum or evaluated its quality, by herd size

Percent Operations*

Herd Size (Number of Cows)

Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
7.6	(1.3)	19.8	(2.3)	45.2	(3.2)	13.0	(1.1)

*Operations with any dairy cows.

The most commonly used methods of evaluating colostrum were a colostrometer and visual appearance (43.7 and 41.6 percent of operations, respectively).

g. For the 13.0 percent of operations that estimated immunoglobulin levels in colostrum or evaluated its quality, percentage of operations by primary method used for measuring immunoglobulin

Primary Method	Percent Operations*	Standard Error
Colostrometer	43.7	(4.2)
Visual appearance	41.6	(4.3)
Volume of first milking colostrum (lb)	9.7	(2.8)
Other	5.0	(2.7)
Total	100.0	

*Operations with any dairy cows.

The majority of small operations (64.8 percent) did not store colostrum. In comparison, only 11.8 percent of large operations did not store colostrum. For large operations that stored colostrum, 50.5 percent used a refrigerator as the primary method of storage and 34.7 percent used a freezer.

h. For the 63.5 percent of operations that normally hand-fed colostrum, percentage of operations by primary method of storing colostrum, and by herd size

	Percent Operations[1]							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Primary Method[2]	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Stored without refrigeration	4.4	(1.0)	2.8	(0.9)	3.0	(0.9)	3.9	(0.7)
Stored in refrigerator	6.0	(1.1)	15.2	(1.9)	50.5	(3.5)	11.1	(0.9)
Stored in freezer	24.8	(2.1)	36.2	(2.8)	34.7	(3.0)	28.2	(1.6)
Not stored	64.8	(2.3)	45.8	(3.0)	11.8	(2.8)	56.8	(1.8)
Total	100.0		100.0		100.0		100.0	

[1]Operations with any dairy cows.
[2]No operations reported “other” as a primary method for storing colostrum.

About one of five operations (21.0 percent) pooled colostrum. As herd size increased so did the percentage of operations that pooled colostrum, ranging from 16.0 percent of small operations to 56.9 percent of large operations.

i. For the 63.5 percent of operations that normally hand-fed colostrum, percentage of operations that pooled colostrum from more than one cow, by herd size

Percent Operations*							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
16.0	(1.7)	26.0	(2.4)	56.9	(3.1)	21.0	(1.3)

*Operations with any dairy cows.

A Johne's disease control program may include testing individual animals in order to identify those shedding *Mycobacterium avium* subspecies *paratuberculosis* and, therefore, presenting a risk to noninfected animals on the operation. More than one-third of operations (35.3 percent) tested for Johne's disease. A higher percentage of medium operations than small operations tested for Johne's disease (47.6 and 30.7 percent, respectively).

j. Percentage of operations that tested for Johne's disease, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
30.7	(3.4)	47.6	(4.1)	37.5	(5.7)	35.3	(2.6)

Colostrum from Johne's test-positive cows could transmit the disease to calves. Studies suggest that colostrum is approximately three times as likely as milk to contain *Mycobacterium avium* subspecies *paratuberculosis* (Streeter, 1995). Operations should use colostrum from test-negative cows, pasteurize colostrum prior to feeding, or feed a commercial colostrum replacer. About 1 of 20 operations that tested for Johne's disease (4.9 percent) fed colostrum from test-positive cows to calves. There were no differences by herd size.

k. For the 35.3 percent of operations that tested for Johne's disease, percentage of operations in which calves were fed colostrum from cows that tested positive for Johne's disease, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
6.0	(2.9)	3.8	(2.8)	0.6	(0.4)	4.9	(2.0)

2. Pasteurizing colostrum

Pasteurizing colostrum significantly reduces or eliminates pathogens and reduces the potential for transmitting disease to calves. Colostrum should not be pasteurized at the same times and temperatures used to pasteurize milk (high temperature short time—161 ºF (71 ºC) for 15 seconds, or Holder Method—145 ºF (63 ºC) for 30 minutes). At these times and temperatures colostrum will thicken and its immunoglobulin levels will decrease significantly (Meylan et al., 1996; Godden et al., 2003; Stabel et al., 2004). For colostrum, batch pasteurization at 140 ºF (60 ºC) for 60 minutes decreased bacterial counts without decreasing immunoglobulin levels (Godden et al., 2006). Calves fed colostrum pasteurized in this manner had improved immunoglobulin absorption, possibly due to decreased bacterial interference with passive transfer (Johnson et al., 2007).

It is important to note that pasteurization will not increase the amount of maternal antibodies in the colostrum. Although pasteurization is commonly used for milk and works well for colostrum, there are several technical issues inherent in pasteurizing colostrum.

If colostrum is pasteurized, the following management practices are recommended:

1. Use a batch pasteurizer
2. Treat small batches (15-gallon maxium)
3. Ensure precise temperature control (do not allow temperature to rise above 140^0F)
4. Agitate constantly during heat-up, pasteurization, and cool-down phases
5. Rapidly heat and cool colostrum
6. Maintain and clean equipment regularly

7. Monitor serum IgG or protein levels and culture colostrum samples to verify that the system is working (Godden et al., 2007).

These intensive managing and monitoring requirements might be one reason that relatively few dairies pasteurize colostrum.

Less than 1 percent of operations that hand-fed colostrum (0.8 percent) pasteurized the colostrum before feeding it to calves. A higher percentage of large operations (6.4 percent) pasteurized colostrum compared with medium and small operations (0.9 and 0.2 percent, respectively).

For the 63.5 percent of operations that normally hand-fed colostrum, percentage of operations that pasteurized colostrum, by herd size

Percent Operations*							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
0.2	(0.2)	0.9	(0.4)	6.4	(1.6)	0.8	(0.2)

*Operations with any dairy cows.

3. Measuring passive transfer of immunity

Measuring serum IgG levels or serum total protein in calves within the first week of life is a relatively simple method for evaluating passive transfer of immunity and the effectiveness of the colostrum management program. Although there are several types of immunoglobulins (IgG, IgA, IgM), IgG is the predominant immunoglobulin passed to calves via colostrum (Butler, 1983). Passive transfer of immunity is considered successful if calves' serum IgG levels are 10 mg/mL (1,000 mg/dL) or greater at 24 to 48 hours of age. Serum IgG can be measured at a laboratory using radial immunodiffusion assay (RID) (Fahey and McKelvey, 1965), and test results are generally available in 24 hours.

Serum total protein in calves can be measured as an estimate of the serum IgG level. Total protein is relatively simple and inexpensive to measure.

A serum total protein greater than or equal to 5.0 to 5.2 g/dL is correlated with successful passive transfer of immunity in healthy calves that are not dehydrated (Tyler et al., 1996). In sick calves, which are often dehydrated, a serum total protein greater than or equal to 5.5 g/dL should be used to assess passive transfer of immunity (Tyler et al., 1999). However, measuring serum total protein may not always be an accurate predictor of passive transfer on an individual-calf basis; its best application is to monitor the overall success of passive transfer in a group of calves. The goal is to have at least 90 percent of calves with serum total protein values greater than 5.2 g/dL and 50 percent above 5.5 g/dL.

Morbidity and mortality in calves is sometimes used as a measure of passive transfer success. The goal is to have morbidity affecting less than 25 percent of calves and a death rate less than 5 percent (Godden, 2007). If morbidity and mortality levels exceed these guidelines, colostrum management as well as general preweaned calf management practices should be reviewed.

Overall, 2.1 percent of operations routinely measured passive transfer via serum proteins. A higher percentage of large operations (14.5 percent) routinely evaluated passive transfer compared with medium and small operations (2.4 and 1.1 percent, respectively).

Percentage of operations that routinely monitored serum proteins (as a measure of passive transfer) in heifers within the first 3 days of life, by herd size

Percent Operations*							
Herd Size (Number of Cows)							
Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1.1	(0.4)	2.4	(0.6)	14.5	(1.7)	2.1	(0.3)

*Operations with any dairy cows.

4. Calf IgG passive transfer status

The following tables on colostrum management, IgG, and total protein reflect a particular population of calves: healthy heifer calves that had received colostrum, were tested for passive transfer status, and resided on dairies with *30 or more dairy cows*. **As a result, the following estimates in these tables differ from the previous tables in this report that estimated colostrum management practices for** *all* **heifer calves on dairy operations with at least** *any* **dairy cows.**

As part of the Dairy 2007 study, blood samples were collected to evaluate the passive transfer status of heifer calves on U.S. dairy operations.

Healthy heifer calves that received colostrum and were 1 to 7 days old were tested for serum IgG by RID assay and total protein. For each calf tested, information was recorded about the calf's age, the quantity of colostrum the calf received at first feeding, and the method by which colostrum had been administered. A total of 1,816 samples from 394 operations in 17 States were used in the analysis.

The majority of tested calves (61.5 percent) received colostrum from a bottle. One of 10 calves received colostrum from an esophageal tube feeder or via nursing the dam. The multiple/ other category includes calves fed by a bucket or pail, and calves that received colostrum in more than one way.

a. Percentage of tested heifer calves by method used for first feeding of colostrum

Colostrum Delivery Method	Percent Calves	Standard Error
Hand-fed from bottle	61.5	(3.1)
Hand-fed using esophageal tube feeder	10.3	(1.7)
Nursed dam	10.7	(1.8)
Multiple/other*	17.5	(2.7)
Total	100.0	

*Includes calves fed by buckt/pail and calves fed by more than one method, e.g., nursed dam and bottle-fed.

About one-fourth of calves (25.2 percent) were allowed to nurse from their dams. Some of these calves also received colostrum by another method. No differences were observed between the West and East regions in the percentage of heifer calves that nursed colostrum from their dams.

b. Percentage of tested heifer calves that nursed colostrum from their dams, by region

Percent Calves					
Region					
West		East		All Operations	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
41.7	(9.4)	22.0	(2.8)	25.2	(2.9)

About one-half of hand-fed calves (48.5 percent) received between 2.0 and 2.9 quarts of colostrum at the first feeding, and 31.3 percent received 4.0 quarts or more.

c. For the 74.8 percent of calves not allowed to nurse their dams, percentage of tested heifer calves by amount of colostrum fed at the first feeding

Amount (Quarts)	Percent Calves	Standard Error
Less than 2.0	6.8	(1.5)
2.0 to 2.9	48.5	(3.6)
3.0 to 3.9	13.4	(2.2)
4.0 or more	31.3	(3.4)
Total	100.0	

Passive transfer status was considered excellent if serum IgG level measured by RID was 15.0 mg/mL or greater. Passive transfer was considered adequate if IgG was 10.0 to 14.9 mg/mL, and IgG less than 10.0 mg/mL was considered failure of passive transfer. The conventional phrase "failure of passive transfer" might more accurately be termed poor passive transfer, since these calves likely had some transfer of IgG. However, the conventional terminology is used in this report.

Two-thirds of calves (66.7 percent) had excellent passive transfer based on IgG levels, and about one-fifth (19.2 percent) had failure of passive transfer.

d. Percentage of tested heifer calves by IgG level and passive transfer status

IgG Level (mg/mL)	**Passive Transfer Status**	**Percent Calves**	**Standard Error**
More than 20.0	Excellent	52.4	(2.4)
15.0 to 20.0		14.3	(1.2)
10.0 to 14.9	Adequate	14.1	(1.4)
6.2 to 9.9	Failure	8.0	(0.9)
Less than 6.2		11.2	(1.2)
Total		100.0	

The percentages of tested calves with failure of passive transfer based on IgG levels were similar across herd sizes.

e. Percentage of tested heifer calves by IgG passive transfer status, and by herd size

	Percent Calves							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
IgG Passive Transfer Status	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Excellent (15.0 mg/mL or more)	65.5	(3.5)	67.8	(2.7)	68.5	(5.6)	66.7	(2.2)
Adequate (10.0-14.9 mg/mL)	15.1	(2.5)	15.0	(1.7)	9.4	(1.7)	14.1	(1.4)
Failure (Less than 10.0 mg/mL)	19.4	(2.5)	17.2	(2.2)	22.1	(4.7)	19.2	(1.7)
Total	100.0		100.0		100.0		100.0	

A higher percentage of calves in the East region than in the West region had adequate passive transfer. The percentages of calves in the excellent and failure categories were similar between the regions.

f. Percentage of tested heifer calves by IgG passive transfer status, and by region

	Percent Calves			
	Region			
	West		**East**	
IgG Passive Transfer Status	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Excellent (15.0 mg/mL or more)	70.0	(5.8)	66.1	(2.4)
Adequate (10.0-14.9 mg/mL)	8.8	(1.7)	15.1	(1.7)
Failure (Less than 10.0 mg/mL)	21.2	(4.8)	18.8	(1.8)
Total	100.0		100.0	

Season of birth did not influence the passive transfer status of calves.

g. Percentage of tested heifer calves by IgG passive transfer status, and by season of birth

	Percent Calves					
	Season of Birth					
	Winter		Spring		Summer	
IgG Passive Transfer Status	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Excellent (15.0 mg/mL or more)	67.6	(6.4)	67.7	(3.4)	65.7	(3.2)
Adequate (10.0-14.9 mg/mL)	13.6	(3.4)	13.7	(2.0)	14.6	(2.3)
Failure (Less than 10.0 mg/mL)	18.8	(5.0)	18.6	(2.5)	19.7	(2.5)
Total	100.0		100.0		100.0	

For calves fed by bottle or tube, about 7 of 10 tested had excellent passive transfer of immunity (68.2 percent and 72.4 percent, respectively). In comparison, about 5 of 10 calves (54.1 percent) that received their first feeding of colostrum by nursing their dams had excellent passive transfer of immunity.

h. Percentage of tested heifer calves by IgG passive transfer status, and by method of first feeding of colostrum

	Percent Calves							
	Colostrum Delivery Method							
	Hand-fed from Bottle		Hand-fed Using Esophageal Tube		Nursed Dam		Multiple Methods/Other	
IgG Passive Transfer Status	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Excellent (15.0 mg/mL or more)	68.2	(2.7)	72.4	(5.9)	54.1	(6.1)	64.1	(5.5)
Adequate (10.0-14.9 mg/mL)	16.0	(1.9)	6.3	(2.0)	17.8	(6.1)	10.7	(2.3)
Failure (Less than 10.0 mg/mL)	15.8	(1.8)	21.3	(6.1)	28.1	(5.0)	25.2	(4.6)
Total	100.0		100.0		100.0		100.0	

Calves allowed to nurse their dams were more likely to have failure of passive transfer than calves that did not —p value <0.05 (25.8 and 16.9 percent, respectively).

i. Percentage of tested heifer calves by IgG passive transfer status, and by whether calves nursed colostrum from their dams

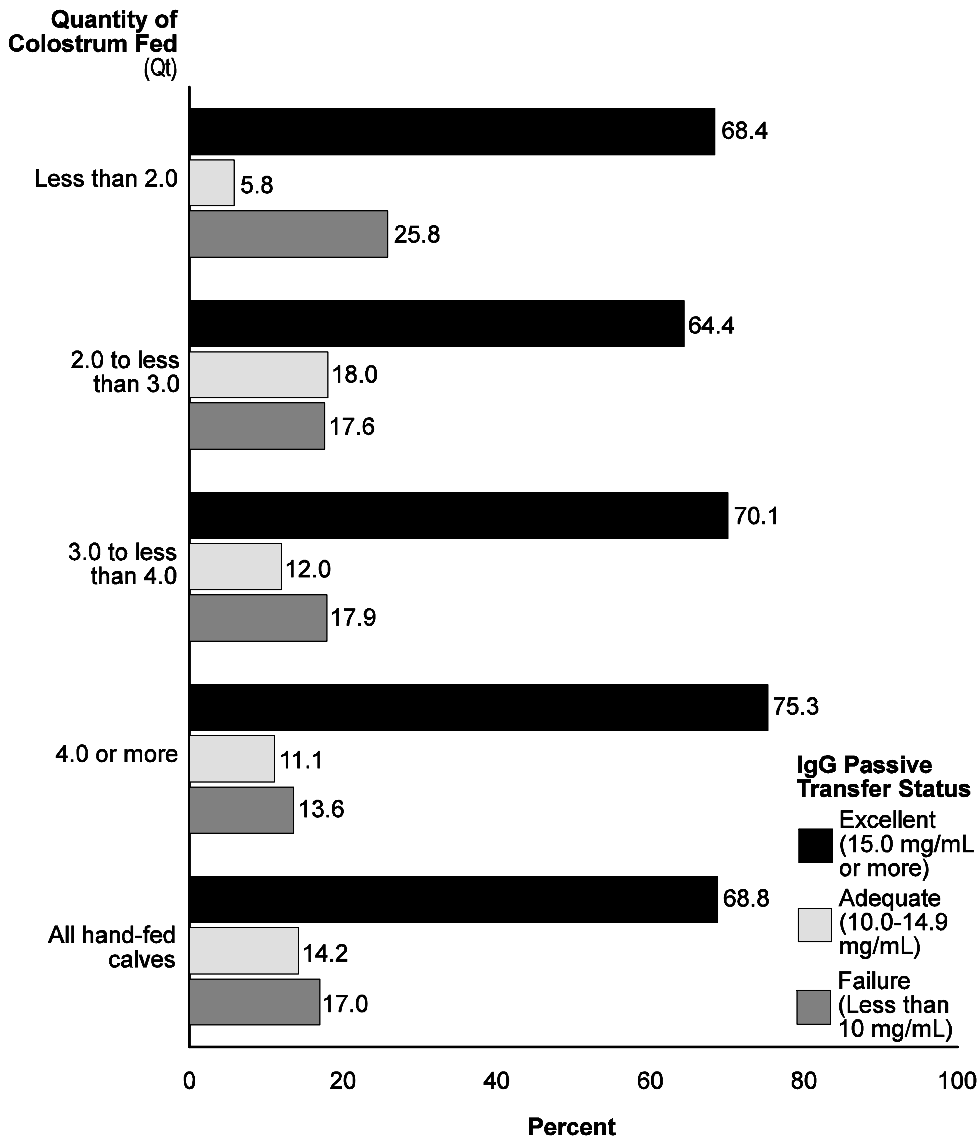
	Percent Calves			
	Nursed Dam			
	Yes		No	
IgG Passive Transfer Status	Percent	Std. Error	Percent	Std. Error
Excellent (15.0 mg/mL or more)	60.2	(4.2)	69.0	(2.5)
Adequate (10.0-14.9 mg/mL)	14.0	(3.0)	14.1	(1.6)
Failure (Less than 10.0 mg/mL)	25.8	(3.3)	16.9	(1.9)
Total	100.0		100.0	

For the 74.8 percent of calves not allowed to nurse their dams (table see table b., p62), failure of passive transfer occurred in 25.8 percent of calves that received less than 2.0 quarts of colostrum at first feeding and in 13.6 percent of calves that received 4.0 quarts or more. However, when considering the standard errors, these estimates were not substantially different.

j. For the 74.8 percent of calves not allowed to nurse their dams, percentage of tested heifer calves by IgG passive transfer status, and by quantity of colostrum administered at first feeding

	Percent Calves									
	Quantity of Colostrum Fed at First Feeding (Quarts)									
	Less than 2.0		**2.0 to 2.9**		**3.0 to 3.9**		**4.0 or more**		**All Hand-fed Calves**	
IgG Passive Transfer Status	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Excellent (15.0 mg/mL or more)	68.4	(8.2)	64.4	(3.7)	70.1	(6.5)	75.3	(3.8)	68.8	(2.5)
Adequate (10.0-14.9 mg/mL)	5.8	(3.2)	18.0	(2.6)	12.0	(3.0)	11.1	(2.6)	14.2	(1.6)
Failure (Less than 10.0 mg/mL)	25.8	(7.8)	17.6	(2.7)	17.9	(5.5)	13.6	(2.8)	17.0	(1.9)
Total	100.0		100.0		100.0		100.0		100.0	

For the 74.8 Percent of Calves not Allowed to Nurse their Dams, Percentage of Tested Heifer Calves by IgG Passive Transfer Status, and by Quantity of Colostrum Administered at First Feeding



5. Calf serum total protein passive transfer status

Serum samples collected from heifer calves for IgG testing were also tested for total protein. Serum total protein in calves is often used as an estimate of the serum IgG level. Previous studies have reported correlation between serum IgG levels and serum total protein for predicting passive transfer level and have suggested that a serum total protein greater than or equal to 5.0 to 5.2 g/dL correlates with an IgG level of 10 mg/mL or greater in healthy calves that are not dehydrated (Tyler et al., 1996).

In the following tables, passive transfer status was considered excellent if serum total protein level was 5.5 g/dL or greater. Passive transfer was considered adequate if total protein was 5.0 to 5.4 g/dL, and total protein less than 5.0 g/dL was defined as failure of passive transfer.

The percentages of tested calves by serum total protein passive transfer status were similar across herd sizes, between regions, and among seasons of birth. Over one-half of all calves had excellent passive transfer based on total protein levels (58.5 percent), and 21.3 percent had failure of passive transfer. As expected, these results are very similar to the IgG passive transfer results.

a. Percentage of tested heifer calves by serum total protein passive transfer status, and by herd size

	Percent Calves							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Serum Total Protein Passive Transfer Status	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Excellent (5.5 g/dL or more)	56.7	(3.6)	60.6	(2.8)	59.8	(6.1)	58.5	(2.3)
Adequate (5.0 to 5.4 g/dL)	20.8	(2.7)	20.3	(1.7)	18.4	(2.5)	20.2	(1.6)
Failure (Less than 5.0 g/dL)	22.5	(2.8)	19.1	(2.4)	21.8	(5.5)	21.3	(1.9)
Total	100.0		100.0		100.0		100.0	

b. Percentage of tested heifer calves by serum total protein passive transfer status, and by region

	Percent Calves			
	Region			
	West		East	
Serum Total Protein Passive Transfer Status	Percent	Std. Error	Percent	Std. Error
Excellent (5.5 g/dL or more)	63.5	(6.3)	57.5	(2.4)
Adequate (5.0 to 5.4 g/dL)	16.2	(2.6)	21.0	(1.8)
Failure (Less than 5.0 g/dL)	20.3	(5.6)	21.5	(2.0)
Total	100.0		100.0	

c. Percentage of tested heifer calves by serum total protein passive transfer status, and by season of birth

	Percent Calves					
	Season of Birth					
	Winter		Spring		Summer	
Serum Total Protein Passive Transfer Status	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Excellent (5.5 g/dL or more)	58.1	(7.9)	59.9	(3.5)	57.4	(3.2)
Adequate (5.0 to 5.4 g/dL)	20.8	(4.8)	21.7	(2.6)	19.0	(2.1)
Failure (Less than 5.0 g/dL)	21.1	(5.3)	18.4	(2.7)	23.6	(2.9)
Total	100.0		100.0		100.0	

About 8 of 10 calves fed by bottle had excellent or adequate passive transfer (81.4 percent). Excellent or adequate passive transfer status was seen in 73.7 percent of calves that received their first feeding of colostrum by nursing their dams and in 72.6 percent of calves that were fed by esophageal tube (see also IgG results in table h., p 65).

d. Percentage of tested heifer calves by serum total protein passive transfer status, and by method of first feeding of colostrum

	Percent Calves							
	Colostrum Delivery Method							
	Hand-fed from Bottle		Hand-fed Using Esophageal Tube		Nursed Dam		Multiple Methods/Other	
Serum Total Protein Passive Transfer Status	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Excellent (5.5 g/dL or more)	60.7	(2.9)	58.9	(6.0)	49.5	(5.0)	53.4	(5.9)
Adequate (5.0 to 5.4 g/dL)	20.7	(2.1)	13.7	(2.5)	24.2	(5.2)	21.3	(3.4)
Failure (Less than 5.0 g/dL)	18.6	(2.2)	27.4	(6.0)	26.3	(4.9)	25.3	(5.2)
Total	100.0		100.0		100.0		100.0	

The percentage of calves with failure of passive transfer based on serum total protein levels was similar between those that nursed and those that did not (25.2 and 20.0 percent, respectively) (see also IgG results in table i., p 66).

e. Percentage of tested heifer calves by serum total protein passive transfer status, and by whether calves nursed colostrum from their dams

	Percent Calves			
	Nursed Dam			
	Yes		No	
Serum Total Protein Passive Transfer Status	Percent	Std. Error	Percent	Std. Error
Excellent (5.5 g/dL or more)	51.8	(4.3)	60.7	(2.7)
Adequate (5.0 to 5.4 g/dL)	23.0	(3.1)	19.3	(1.8)
Failure (Less than 5.0 g/dL)	25.2	(3.7)	20.0	(2.1)
Total	100.0		100.0	

For the 74.8 percent of calves not allowed to nurse their dams (table b., p 62), failure of passive transfer based on serum total protein levels occurred in 25.3 percent of calves that received less than 2.0 quarts of colostrum and in 15.1 percent of calves that received 4.0 quarts or more (see also IgG results in table j., p67). However, as was the case with the IgG estimates, these estimates were not significantly different.

f. For the 74.8 percent of calves not allowed to nurse their dams, percentage of tested heifer calves by serum total protein passive transfer status, and by quantity of colostrum administered at first feeding

	Percent Calves									
	Quantity of Colostrum Fed at First Feeding (Quarts)									
	Less than 2.0		2.0 to 2.9		3.0 to 3.9		4.0 or more		All Hand-fed Calves	
Serum Total Protein Passive Transfer Status	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Excellent (5.5 g/dL or more)	64.8	(8.3)	55.6	(4.0)	60.9	(6.5)	67.3	(4.3)	60.6	(2.7)
Adequate (5.0 to 5.4 g/dL)	9.9	(4.7)	21.6	(2.6)	20.5	(4.8)	17.6	(3.1)	19.4	(1.8)
Failure (Less than 5.0 g/dL)	25.3	(7.1)	22.8	(3.4)	18.6	(5.4)	15.1	(3.2)	20.0	(2.1)
Total	100.0		100.0		100.0		100.0		100.0	

6. Comparison of IgG and total protein status

Total protein and IgG passive transfer status agreed in 75.4 percent of samples taken from heifer calves (excellent 55.1, adequate 6.4, and failure 13.9 percent). The highest percentage of results with disagreement occurred for calves with excellent passive transfer based on IgG, but only adequate passive transfer based on total protein (9.4 percent of calves).

Percentage of tested calves by IgG and serum total protein passive transfer status

	Percent Calves							
	IgG Passive Transfer Status							
	Excellent (15.0 mg/mL or more)		**Adequate** (10.0-14.9 mg/mL)		**Failure** (Less than 10.0 mg/mL)		**Total**	
Serum Total Protein Passive Transfer Status	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Excellent (5.5 g/dL or more)	55.1	(2.3)	2.5	(0.6)	0.9	(0.3)	58.5	(2.3)
Adequate (5.0-5.4 g/dL)	9.4	(1.1)	6.4	(0.9)	4.4	(0.8)	20.2	(1.6)
Failure (Less than 5.0 g/dL)	2.2	(0.5)	5.2	(1.0)	13.9	(1.5)	21.3	(1.9)
Total	66.7	(2.2)	14.1	(1.4)	19.2	(1.7)	100.0	

D. Nutrition

Note: Estimates in the following tables represent operations with any dairy cows.

1. Introduction

Calves undergo remarkable physiological changes from birth to weaning. At birth, the abomasum makes up almost 50 percent of the total weight of a calf's stomach (Warner and Flatt, 1965). The abomasum is often referred to as the true stomach because it digests proteins in a fashion similar to the stomach of a nonruminant (Davis and Drackley, 1998). During the first few weeks of life, calves receive most of their energy by digesting milk or milk replacer in the abomasum and the small intestine. Young calves have a unique feature called the esophageal groove that helps deliver milk directly to the abomasum. The esophageal groove is a tube created by the contraction of certain muscles in the esophagus. These muscles lie in a fold of tissue that extends from the base of the esophagus (cardia) to the reticulo-omasal orifice (Orskov et al., 1970; Orskov, 1972). Because of the esophageal groove, 97 percent of the milk or milk replacer bypasses the reticulorumen and enters the abomasum, where it can be digested to provide nutrients for the calf (Tuolloc and Guilloteau, 1989).

2. Liquid diets (milk/milk replacer)

Selecting a suitable liquid feeding plan is important to the health of dairy calves. Producers must select an appropriate liquid diet that will support the calves until they are weaned. Liquid diets commonly fed to dairy calves include commercial milk replacer, saleable milk, and nonsaleable milk.

Until the 1950s, most dairy calves were fed whole milk (Otterby and Linn,1981). Although pasteurized saleable milk is an excellent source of nutrition for calves, it has traditionally been the most expensive liquid diet option (Davis and Drackley, 1998). Commercial milk replacers were developed in the 1950s as an economical alternative to feeding saleable milk. Other advantages of milk replacers include easy storage, diet consistency from day to day, and disease control (Davis and Drackley, 1998). The table below shows a comparison between whole milk and a 20:20 (percent fat: percent protein) milk replacer. Whole milk has higher amounts of protein and fat per gallon compared with most milk replacers. Despite this, if calves are fed large amounts of high quality milk replacer their growth can equal that of calves fed whole milk. When comparing milk replacer to whole milk, it is important to compare them based on equal calf nutrient intake. In other words, since milk contains more energy per gallon, feeding 2 quarts of milk replacer is not equal to feeding 2 quarts of whole milk.

a. Comparison of whole milk and milk replacer

Parameter	Whole Milk	20:20 Milk Replacer (1 lb/gal water)
Total solids (percent)	12.5	11.4
Fat* (percent)	28.8	20.7
Protein* (percent)	27.1	20.7
lb protein/gal	0.285	0.190
lb fat/gal	0.317	0.190

*Dry matter basis: since milk replacer is about 96 to 98 percent dry matter, a product that contains 20 percent fat on the label actually contains 20.7 percent fat on a dry matter basis. Source: adapted from Corbett (2007) and Jones et al. (2007).

Many commercial milk replacers are available, most of which contain 18 to 28 percent protein and 10 to 22 percent fat. A number of different protein sources are used in milk replacers. Milk-derived proteins such as dried skim milk, casein, and dried whey are most common; soy protein, egg, and animal plasma are also used. The most common source of fat is tallow or lard. Other important ingredients include carbohydrates, trace minerals, and vitamins A, B, D, and E. Some milk replacers are medicated with lasalocid or decoquinate (anticoccidials) or contain subtherapeutic levels of antibiotics intended to prevent calf scours. The use of subtherapeutic antibiotics is coming under scrutiny due to concerns about antimicrobial resistance. A recent study showed that calves fed a medicated milk replacer had decreased overall morbidity and increased weight gain compared with calves fed a nonmedicated milk replacer. However, the most important factor in reducing calf morbidity and mortality was successful passive transfer provided through colostrum. The study concluded that removal of antibiotics from milk replacers may have a significant negative impact on calf health in the absence of adequate passive transfer (Berge et al., 2005).

Nonsaleable milk is another liquid-diet option for calves. Nonsaleable milk typically includes surplus colostrum, transition milk, abnormal (mastitic) milk, and milk from cows treated with medications that call for a withdrawal period. Disease transmission via pathogens in milk is one concern about feeding raw, nonsaleable milk to calves; Selim and Cullor (1997) showed that unpasteurized, nonsaleable milk had more bacteria than milk replacer or saleable (bulk-tank) milk. To reduce bacterial contamination, nonsaleable milk can be pasteurized. Pasteurization destroys or significantly decreases the number of pathogens that can affect calf health, without affecting milk quality (Stabel et al., 2004). However, pasteurization is a labor-intensive process that requires frequent monitoring of equipment and the feeding system.

Feeding pasteurized nonsaleable milk to calves may offer economic advantages over feeding saleable milk or milk replacers. A study by Godden et al. (2005) showed that calves fed pasteurized nonsaleable milk gained more weight, had higher weights at weaning, lower morbidity in summer, and lower morbidity and mortality in winter than calves fed an equal volume of milk replacer. However, these findings were expected since calves fed pasteurized nonsaleable milk received more dry matter protein and energy than those fed milk replacer. In addition, feeding waste milk resulted in a savings of $0.69 per calf per day when compared with feeding milk replacer.

Despite the possible economical advantages to feeding pasteurized nonsaleable milk, some concern exists about antibiotic residues and the lack of consistency of the diet from day to day. In a study in which calves were fed surplus colostrum, diet variability from day to day did not impact weight gain or increase the occurrence of scours (Foley and Otterby, 1978); however, most operations fed a blend of colostrum, transition milk, waste milk, and milk replacer. More studies are needed to investigate the effects of antibiotic residues in nonsaleable milk. In one trial, Wray et al. (1990) found an increase in streptomycin resistance of intestinal bacteria in calves fed waste milk containing antibiotics; however, no increase in antibiotic resistance was observed when the trail was repeated. Langford et al. (2003) reported an increase in resistance of intestinal bacteria when milk was artificially spiked with varying amounts of penicillin (6.25, 12.5, 25 and 50 microliters of 10,000 IU/mL Penicillin G per kilogram of milk).

Regardless of the type of liquid diet fed, adequate nutrition must be provided to prevent disease and promote growth. The 2001 Nutrient Requirements of Dairy Cattle (National Research Council, Nutrient Requirements of the Young Calf, chapter 10 and the computer calf model) can be used as a guide for determining a specific feeding plan for milk or milk replacer. Daily feeding quantities should be based on the weather conditions, the health of the calf, the calf's weight, and the desired growth rate for the calf. It is important to note that feeding strategies must be adjusted when the temperature is outside the thermoneutral range (60 to 68 ºF). At higher or lower temperatures, more whole milk or milk replacer must be fed. Otherwise, calves will use energy reserves to maintain body temperature, instead of using the energy for growth and the maintenance of a healthy immune system. For example, at 25 ºF, calves require 32 percent more energy than they do when the temperature is in the thermoneutral zone (Scibilia et al., 1987). Management practices recommended for cold weather (less than 60 ºF) include: milk/milk replacer and water should be warmed to about 105 ºF prior to feeding; and the amount of nutrition provided should be increased by either increasing the solids content of the milk replacer to 15 to 18 percent, adding additional fat to the diet, or feeding a third meal consisting of 25 to 50 percent more milk or milk replacer (BAMN, 2003; Corbett, 2007).

To summarize, selecting a liquid feeding program on a particular operation depends upon performance goals for calves, the number of calves, economics, disease concerns, individual preferences, and the availability of resources (i.e., supply of nonsaleable milk). Appropriate management decisions in this area can improve calf health and growth efficiency.

A higher percentage of large operations (26.4 percent) fed nonmedicated milk replacer than medium and small operations (14.2 and 11.4 percent, respectively). Alternatively, small and medium operations (55.2 and 68.2 percent, respectively) were more likely to feed medicated milk replacer than large operations (43.6 percent). Overall, medicated milk replacer (including antibiotics and anticoccidials) was fed on more than one-half of all operations (57.5 percent). A higher percentage of large operations (28.7 percent) fed pasteurized waste milk compared with medium and small operations (3.0 and 1.0 percent, respectively). Small operations (32.2 percent) were more likely to feed unpasteurized whole (saleable) milk than medium and large operations (17.4 and 12.1 percent, respectively). Similar percentages of operations fed unpasteurized waste milk and unpasteurized whole (saleable) milk (30.6 and 28.0 percent, respectively).

b. Percentage of operations by type of liquid diet fed to heifers calves at any time prior to weaning during 2006, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Liquid Diet	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Nonmedicated milk replacer	11.4	(1.2)	14.2	(1.7)	26.4	(2.4)	12.7	(0.9)
Medicated milk replacer	55.2	(1.8)	68.2	(2.1)	43.6	(3.1)	57.5	(1.4)
Unpasteurized waste milk	32.2	(1.7)	25.7	(2.0)	27.6	(2.8)	30.6	(1.3)
Pasteurized waste milk	1.0	(0.3)	3.0	(0.9)	28.7	(2.7)	2.8	(0.3)
Unpasteurized whole (saleable) milk	32.2	(1.7)	17.4	(1.7)	12.1	(1.9)	28.0	(1.3)
Pasteurized whole (saleable) milk	1.3	(0.4)	1.6	(0.8)	2.0	(0.7)	1.4	(0.3)
Other	2.6	(0.6)	3.5	(0.9)	4.9	(1.8)	2.9	(0.5)

The percentages of heifers by type of liquid diets fed were similar to the percentages of operations by type of liquid diets fed. About one-half of all heifers (49.9 percent) received medicated milk replacer at some point prior to weaning. Although only 2.8 percent of operations fed pasteurized waste milk, 15.0 percent of heifers received pasteurized waste milk, suggesting that this practice was more common on larger operations.

c. Percentage of heifers by type of liquid diet fed any time prior to weaning during 2006, and by herd size

	Percent Heifers							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Liquid Diet	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Nonmedicated milk replacer	10.4	(1.1)	13.7	(1.7)	27.9	(2.6)	19.1	(1.3)
Medicated milk replacer	57.9	(1.8)	63.0	(2.2)	36.4	(3.0)	49.9	(1.5)
Unpasteurized waste milk	23.2	(1.5)	20.3	(1.8)	19.9	(2.5)	20.9	(1.3)
Pasteurized waste milk	1.2	(0.3)	2.6	(0.6)	31.5	(2.6)	15.0	(1.2)
Unpasteurized whole (saleable) milk	25.5	(1.6)	13.3	(1.5)	6.9	(1.3)	13.8	(0.8)
Pasteurized whole (saleable) milk	0.9	(0.3)	0.6	(0.3)	1.4	(0.6)	1.0	(0.3)
Other	1.6	(0.4)	3.1	(0.9)	3.7	(1.3)	3.0	(0.6)

The most common medications in milk replacer at the operation level were oxytetracycline in combination with neomycin (49.5 percent of operations). Oxytetracycline and decoquinate were fed on nearly one of five operations (21.9 and 18.8 percent, respectively).

d. For operations that fed a medicated milk replacer to heifers during 2006, percentage of operations by type of medication used

Medication	Percent Operations	Standard Error
Chlortetracycline (CTC)	12.1	(1.1)
Oxytetracycline (OTC)	21.9	(1.5)
Oxytetracycline in combination with Neomycin (Oxy NEO)	49.5	(1.9)
Decoquinate	18.8	(1.4)
Lasalocid	7.2	(0.9)
Other	5.4	(0.9)

Calf-feeding equipment should be cleaned between calves to prevent the spread of disease from one calf to another. Approximately one of four operations (24.4 percent) cleaned calf-feeding equipment between calves. A higher percentage of large and medium operations (39.1 and 30.9 percent, respectively) cleaned equipment between calves compared with small operations (21.4 percent). The majority of operations (58.5 percent) cleaned equipment daily, and there was no difference by herd size in the percentage of operations that cleaned daily. Small and medium operations were more likely to clean equipment weekly (7.0 and 5.2 percent, respectively) than large operations (1.3 percent). "Other" frequency accounted for 7.5 percent of operations, and a high percentage of these operations cleaned equipment twice daily, but not between calves.

e. Percentage of operations by frequency milk feeding equipment* was cleaned and disinfected, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Frequency	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Between calves	21.4	(1.5)	30.9	(2.2)	39.1	(2.7)	24.4	(1.2)
Daily	59.8	(1.8)	55.9	(2.3)	51.8	(2.8)	58.5	(1.4)
Weekly	7.0	(1.0)	5.2	(0.9)	1.3	(0.9)	6.4	(0.8)
Monthly	3.8	(0.7)	1.4	(0.6)	2.2	(1.0)	3.2	(0.5)
Other	8.0	(1.0)	6.6	(1.1)	5.6	(1.3)	7.5	(0.8)
Total	100.0		100.0		100.0		100.0	

*Bottles, buckets, nipples.

3. Water and calf starter

Calves should be offered free-choice water from birth for several reasons. A study showed that calves not offered water consume milk to satisfy their thirst. In this situation, the esophageal groove did not close, and milk was delivered to the forestomach (Orskov, 1972). In addition, research has shown that calves given free-choice water from birth to 4 weeks of age ate more dry feed, had improved daily weight gain, and had no increase in incidence of scours compared with calves deprived of water (Kertz et al., 1984). Detailed recommendations for providing water, starter, and hay to calves can be found in "A Guide to Dairy Calf Feeding and Management" (BAMN, 2003).

Rumen maturation in calves is triggered by the introduction of calf starter. Specifically, the microbial fermentation of carbohydrates and proteins in the dry feed produces volatile fatty acids (VFAs): acetic, propionic, and butyric acids. Butyric and propionic acids are the principal VFAs involved in accelerating forestomach (rumen, reticulum, and omasum) development; they directly affect proliferation and differentiation of gastrointestinal epithelial cells, and they provide energy for the growing stomach tissue (McGilliard et al., 1965; Velazquez et al., 1996). Thus, to ensure normal rumen development and achieve the economic benefits of an early weaning age for calves, high quality calf starter should be introduced by the time calves are 4 days old.

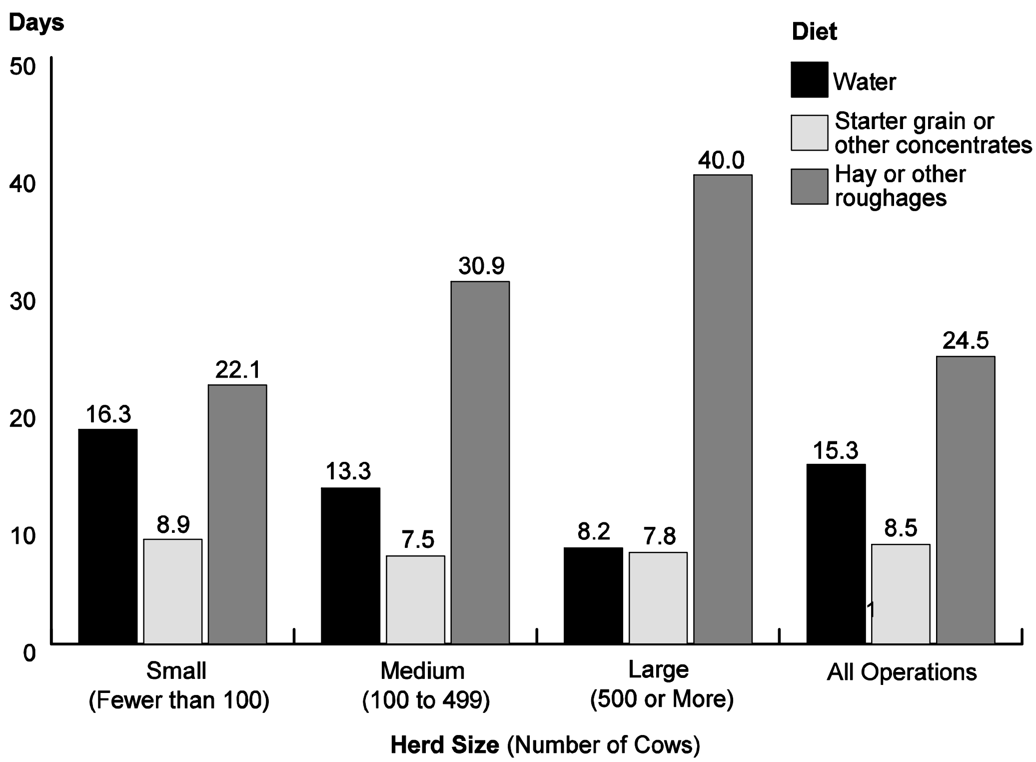
Producers should begin by offering small amounts of calf starter, replacing it daily. Hay should not be fed to calves prior to weaning because—compared with calves fed a high quality, properly balanced starter—it may delay rumen development. Calves fed primarily grain (starter) have better development of rumen tissue, longer papillae, and heavier rumen weight than calves fed primarily hay (Stobo et al. [1966]; Davis and Drackley [1998]). The best time to start hay is after weaning, when calves are about 8 to 10 weeks old and consistently consuming a minimum of 5 pounds of starter daily.

Across all operations, water was offered to calves at 15.3 days of age on average. Large operations offered water earlier (8.2 days) than medium and small operations (13.3 and 16.3 days, respectively). Starter was routinely offered at an average of 8.5 days of age. The average age of heifers receiving hay or other roughage increased as operation size increased, ranging from 22.1 days of age on small operations to 40.0 days on large operations.

Operation average age (days) of preweaned heifers when heifers were routinely offered the following diets, by herd size

	Operation Average Age (Days)							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Diet	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
Water	16.3	(0.7)	13.3	(0.8)	8.2	(0.9)	15.3	(0.6)
Starter grain or other concentrate	8.9	(0.3)	7.5	(0.4)	7.8	(0.7)	8.5	(0.3)
Hay or other roughage	22.1	(0.7)	30.9	(1.1)	40.0	(1.9)	24.5	(0.6)

Operation Average Age (Days) of Preweaned Heifers When Heifers were Routinely Offered the Following Diets, by Herd Size



E. Growth from Birth to Weaning

Estimates in the following tables represent only operations with 30 or more dairy cows.

1. Introduction

Dairy heifer growth represents the culmination of many feeding, health, and management practices. Growth is fundamentally important in determining the age at which heifers can be bred and become productive. Heifers that calve with less than optimal body weight produce less milk during first lactation and are, therefore, less profitable to the dairy producer.

Heifer growth was measured as part of the Dairy 2007 study. Measurements of heart girth and wither height were taken from heifers between birth and weaning using a Coburn calf tape. Calf weight was estimated based on the girth measurement. Each heifer was measured only once, and her age was recorded at the time of measurement.

A total of 5,381 heifer calves from 418 operations were evaluated for growth parameters, of which 4,667 were Holsteins (386 operations). The remaining calves were comprised of Jersey, Brown Swiss, Guernsey, and crossbreed dairy cattle whose numbers were too small to report growth curves.

The following tables allow producers to compare their Holstein heifers with other heifers in the United States. A recommended goal for producers is to have their heifers fall somewhere near the 75^{th} percentile. For more information, and for instructions on measuring heifers, producers can refer to the Penn State publication “Monitoring Dairy Heifer Growth” (Heinrichs and Lammers, 1998).

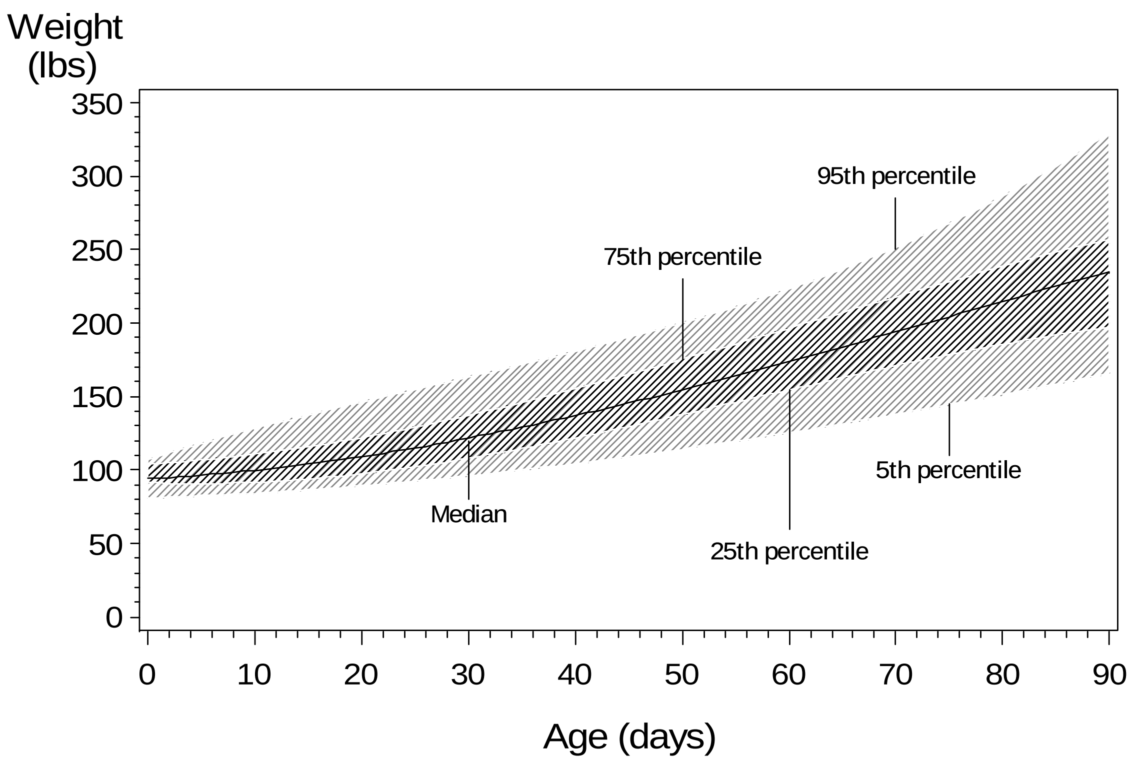
2. Holstein growth parameters

At one month of age (28 to 34 days), the median weight of a Holstein heifer calf was 126 pounds; at 2 months of age (56 to 62 days) the median weight was 177 pounds; and by 3 months of age (84 to 90 days) the median was 236 pounds. For comparison, data collected during the NAHMS' NDHEP study conducted in 1991-92 indicated that the median weights for Holstein heifer calves at 1, 2, and 3 months of age were 119, 161, and 211 pounds, respectively (Heinrichs and Lammers, 1998).

a. Percentile and weight (pounds) of Holstein heifers, by age (days)

	Weight (Pounds)		
Age (Days)	**25th Percentile**	**Median**	**75th Percentile**
Less than 7	91	97	105
7 to 13	91	101	115
14 to 20	97	105	115
21 to 27	97	115	126
28 to 34	115	126	138
35 to 41	120	138	151
42 to 48	126	151	164
49 to 55	138	151	177
56 to 62	157	177	204
63 to 69	171	191	220
70 to 76	171	191	212
77 to 83	184	204	236
84 to 90	204	236	260

Percentile and Weight (pounds) of Holstein Heifers, by Age (Days)

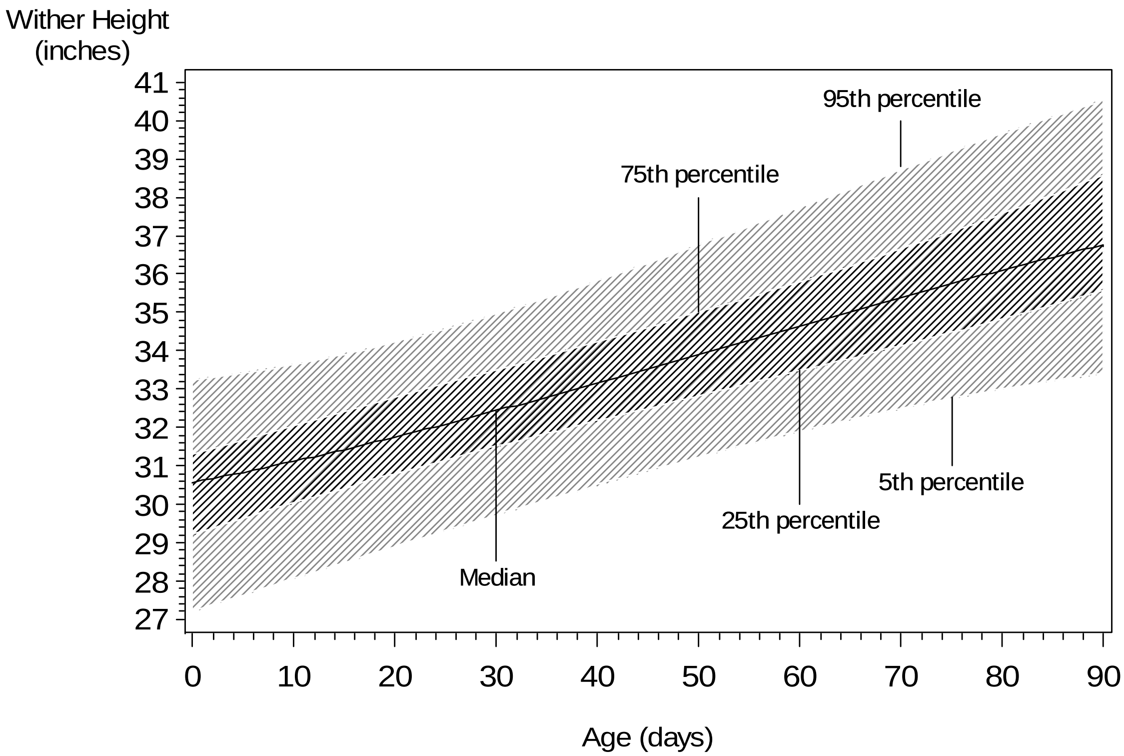


The median wither height for Holstein heifer calves was 32.5 inches at 1 month of age (28 to 34 days), 35.0 inches at 2 months (56 to 62 days), and 37.0 inches at 3 months (84 to 90 days). For comparison, data collected during the NAHMS' NDHEP study conducted in 1991-92 indicated that the median wither heights for Holstein heifer calves at 1, 2, and 3 months of age were 31.0, 33.0, and 35.0 inches, respectively (Heinrichs and Lammers, 1998).

b. Percentile and wither height (inches) of Holstein heifers, by age (days)

	Wither Height (Inches)		
Age (Days)	**25th Percentile**	**Median**	**75th Percentile**
Less than 7	30.0	31.0	32.0
7 to 13	30.0	31.0	32.3
14 to 20	30.5	31.5	33.0
21 to 27	31.0	32.0	33.0
28 to 34	31.5	32.5	33.0
35 to 41	32.0	34.0	35.0
42 to 48	32.5	34.0	35.0
49 to 55	33.0	34.0	35.0
56 to 62	34.0	35.0	36.5
63 to 69	34.0	35.0	37.0
70 to 76	34.0	35.0	36.0
77 to 83	35.0	36.0	37.0
84 to 90	35.0	37.0	38.0

Percentile and Wither Height (Inches) of Holstein Heifers, by Age (Days)



F. General Management

Note: Unless otherwise specified, estimates in the following tables represent operations with any dairy cows.

1. Housing

Housing design plays an important role in maximizing calf health, especially with the diverse climates across the United States. Housing for preweaned calves should provide a dry area with shelter that does not allow contact with other calves or, especially, older animals. Providing a deep layer of dry bedding is important to keep the calves warm during cold weather. For preweaned calves, hutches or individual animal pens are usually recommended. Individual hutches have several advantages. Hutches keep calves separated, thereby reducing the spread of disease, and they offer calves a choice of several different thermal zones: the back of the hutch, the front of the hutch, and the outdoor pen (Brunswold et al., 1985). The primary disadvantage of hutches is the difficulty that dairy personnel face in caring for calves during a snowstorm or other adverse weather event, particularly on operations with a large number of calves. Some operations house preweaned calves in individual pens inside a barn. This design is easier on caretakers and can be an effective system as long as the barn is adequately ventilated. After weaning, heifers are usually placed in group housing with other animals of similar age.

The majority of operations (74.9 percent) housed preweaned heifers in individual animal pens or hutches at some point during 2006. Approximately one-half of operations housed weaned heifers on pasture and/or in inside and outside multiple-animal areas (49.2, 55.6, and 44.6 percent of operations, respectively).

a. Percentage of operations by type of housing used for any length of time during 2006, and by cattle class

	Percent Operations			
	Cattle Class			
	Preweaned Heifers		Weaned Heifers	
Housing Type	Percent	Std. Error	Percent	Std. Error
Tie stall/ stanchion	12.1	(1.0)	12.2	(1.0)
Freestall	5.6	(0.7)	20.9	(1.2)
Individual pen/hutch	74.9	(1.3)	15.6	(1.1)
Drylot/multiple-animal outside area	5.2	(0.7)	44.6	(1.4)
Multiple-animal inside area	23.6	(1.3)	55.6	(1.5)
Pasture	6.3	(0.7)	49.2	(1.5)
Other	1.5	(0.3)	1.8	(0.4)

The most common primary housing types were individual-animal pens/hutches for preweaned heifers and multiple-animal inside areas for weaned heifers.

b. Percentage of operations by primary housing facility/outside area used during 2006, and by cattle class

	Percent Operations			
	Cattle Class			
	Preweaned Heifers		Weaned Heifers	
Housing Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Tie stall/stanchion	8.9	(0.8)	5.9	(0.7)
Freestall	2.7	(0.5)	12.1	(0.9)
Individual pen/hutch	67.9	(1.3)	5.3	(0.7)
Drylot/multiple-animal outside area	0.6	(0.2)	22.9	(1.1)
Multiple-animal inside area	14.2	(1.1)	34.6	(1.4)
Pasture	0.6	(0.2)	10.8	(0.9)
Not housed on operation	4.7	(0.5)	7.7	(0.7)
Other	0.4	(0.2)	0.7	(0.2)
Total	100.0		100.0	

2. Off-site heifer raising

Heifer rearing represents about 20 percent of the total operating expenses on dairy operations, making it the second largest expense behind feeding costs (Heinrichs, 1993). To raise heifers, dairies invest money and resources in feed, labor, and housing without receiving a return on their investments until the heifers calve, usually around 24 months of age. As dairy operations become larger (increased number of cows), the use of off-site calf ranches is increasingly common (Wolf, 2003). Calf ranches that raise a large number of heifers likely realize economies of scale that may allow them to produce heifers at a cost lower than an individual dairy farm.

Calves are transported to calf ranches at a predetermined age, such as prior to or after weaning. Typically, producers and calf ranches enter into a contract that specifies expectations of care, growing performance, and payment responsibilities. Various types of contracts are used, such as contracts in which producers pay calf ranches by the day or by pound of gain, or contracts in which producers sell heifers to the ranch upon delivery and retain the option to buy them back prior to freshening.

On operations with limited facilities, labor, or other components of a dairy operation, contracting with an off-site calf ranch has many advantages. Calf-ranch personnel are usually dedicated to working only with calves, which can result in increased attention to the feeding and health of calves and also decreased exposure to adult-cow diseases. In addition, if calves are not commingled with older animals or animals from other operations, their exposure to disease agents such as *Mycobacterium avium* subspecies *paratuberculosis* (the causative agent of Johne's disease) is reduced. Moving heifers off-site frees-up labor and space previously dedicated to heifer housing and feed-storage facilities. This extra labor and space can be used for the milking herd. Raising heifers off-site also reduces the amount of manure produced at single sites and/or may allow producers to maintain larger milking herds on the same acreage. Using off-site calf ranches may enable producers to reduce expenses, especially if the heifer-raising aspect of the operation is costly or inefficient, which might be indicated by consistent, higher-than-normal calf illness or death loss, or by heifers that calve later than 24 months of age and/or calve at suboptimal weights.

There can be drawbacks to using off-site calf ranches. For example, many calf ranches commingle heifers from different operations, presenting an increased risk of disease introduction. Wolf (2003) found that only 6 of 57 calf ranches permanently separated heifers according to farm of origin during the rearing period. Other drawbacks of using calf ranches include less control over management practices used in raising heifers, transportation costs of moving heifers to the off-site facility, and issues related to entering into and meeting contract obligations.

In Dairy 2007, about 1 of 10 operations (9.3 percent) raised some dairy heifers off the operation. The percentages of operations that raised heifers off-site increased as herd size increased for all heifer classes. Less than 5 percent of small operations raised any heifers off-site, compared with 15.5 percent of medium operations and 46.0 percent of large operations. Almost one-third of large operations (35.3 percent) raised preweaned calves off-site, compared with 7.1 percent of medium operations and 1.7 percent of small operations. Similar herd-size differences in the percentages of operations that raised heifers off-site were observed among all three heifer classes.

a. Percentage of operations that had any heifers raised off-site, by heifer class and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Heifer Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Preweaned	1.7	(0.5)	7.1	(1.2)	35.3	(2.9)	4.6	(0.5)
Weaned	4.3	(0.7)	14.6	(1.6)	44.2	(2.9)	8.6	(0.7)
Bred	4.1	(0.7)	11.5	(1.5)	22.5	(2.3)	6.7	(0.6)
Any of the above	4.7	(0.7)	15.5	(1.7)	46.0	(2.9)	9.3	(0.7)

For operations that raised any heifers off the operation, preweaned, weaned, and bred heifers were sent off-site at an operation average age of 4.9, 189.8, and 413.8 days, respectively. The average age at which any calves left to be raised off-site was 110.3 days.

b. For the 9.3 percent of operations that had any heifers raised off-site, operation average age of heifers when leaving operation, by heifer class

Operation Average Age (Days)							
Heifer Class							
Preweaned		**Weaned**		**Bred**		**All Operations**	
Avg.	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
4.9	(0.7)	189.8	(15.7)	413.8	(25.3)	110.3	(11.2)

Producers were asked to identify the primary class of heifers sent off-site. Almost one-half of operations that sent any heifers off-site to be raised sent preweaned or weaned calves (50.1 and 44.1 percent of operations, respectively). Only 5.8 percent of operations sent bred heifers off-site to be raised. Medium operations sent similar percentages of preweaned and weaned calves off-site (45.6 and 49.7 percent, respectively), and large operations most frequently sent preweaned heifers off-site (77.2 percent).

c. For the 9.3 percent of operations that had any heifers raised off-site, percentage of operations by primary heifer class raised off-site and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Heifer Class	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Preweaned	35.9	(7.7)	45.6	(5.8)	77.2	(3.3)	50.1	(3.8)
Weaned	54.3	(7.9)	49.7	(5.9)	21.1	(3.2)	44.1	(3.8)
Bred	9.8	(4.0)	4.7	(2.4)	1.7	(0.6)	5.8	(1.7)
Total	100.0		100.0		100.0		100.0	

About 8 of 10 operations that sent heifers off-site to be raised (81.1 percent) retained ownership of the heifers sent. A total of 9.4 percent of operations sold the heifers sent off-site and repurchased the same animals, and 9.5 percent of operations sold the animals sent and replaced them with different animals.

d. For the 9.3 percent of operations that had any heifers raised off-site, percentage of operations by ownership of the majority of heifers and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Ownership	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Ownership retained	72.3	(7.5)	83.8	(4.1)	89.6	(2.1)	81.1	(3.3)
Same animals sold and then repurchased	11.1	(6.1)	10.0	(3.2)	6.0	(1.6)	9.4	(2.6)
Animals sold outright, replaced with different animals	16.6	(5.6)	6.2	(2.8)	4.4	(1.4)	9.5	(2.4)
Total	100.0		100.0		100.0		100.0	

For operations that sent heifers off-site to be raised, the highest percentage of small and medium operations transported heifers fewer than 20 miles to the rearing facility, while the highest percentage of large operations transported heifers between 5 and 50 miles. A total of 10.6 percent of operations transported heifers 50 miles or more.

e. For the 9.3 percent of operations that had any heifers raised off-site, percentage of operations by number of miles heifers were transported to the off-site rearing facility, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Miles	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Fewer than 5.0	43.5	(8.4)	26.0	(5.4)	10.1	(2.8)	27.6	(3.7)
5.0 to 19.9	35.3	(8.7)	47.5	(6.1)	37.7	(4.4)	40.8	(3.9)
20.0 to 49.9	12.8	(5.2)	18.8	(4.7)	34.5	(4.7)	21.0	(3.0)
50 or more	8.4	(4.3)	7.7	(2.7)	17.7	(2.7)	10.6	(2.0)
Total	100.0		100.0		100.0		100.0	

Relatively few operations (4.1 percent) transported heifers out of State for rearing.

f. For the 9.3 percent of operations that had any heifers raised off-site, percentage of operations in which heifers were ever transported out of State for off-site rearing, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1.9	(1.8)	2.6	(1.5)	9.1	(1.8)	4.1	(1.0)

Producers were asked to choose the description that best described their primary off-site rearing facility. Ideally, heifer-raising facilities would only house animals from one operation. More than one-fourth of operations (27.7 percent) sent heifers to a single rearing facility in which heifers did not have contact with cattle from other operations, but the majority (51.3 percent) sent heifers to a single rearing facility in which heifers had contact with cattle from other operations.

g. For the 9.3 percent of operations that had any heifers raised off-site, percentage of operations by primary off-site rearing facility

Off-site Rearing Facility	Percent Operations	Standard Error
Heifers sent to a single rearing facility and did not have contact with cattle from other operations	27.7	(3.3)
Heifers sent to multiple rearing facilities and did not have contact with cattle from other operations	8.5	(2.1)
Heifers sent to a single rearing facility and had contact (commingled) with cattle from other operations	51.3	(4.0)
Heifers sent to multiple rearing facilities and had contact (commingled) with cattle from other operations	12.5	(3.0)
Total	100.0	

On average, weaned and bred heifers returned to the operation from the rearing facility at 7.0 and 21.6 months of age, respectively. The operation average age of any heifers returning was 17.3 months.

h. For the 9.3 percent of operations that had any heifers raised off-site, operation average age that heifers returned to the operation, by heifer class

Operation Average Age (Months)							
Heifer Class[1]							
Weaned		Bred		Other[2]		All Operations	
Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error
7.0	(0.6)	21.6	(0.3)	28.6	(1.0)	17.3	(0.6)

[1]No operations reported preweaned heifers returning from an off-site rearing facility.
[2]Heifers that had calved.

Producers were asked to identify the primary class of heifer replacements usually arriving or returning to the operation. About two of three operations that sent any heifers off-site (67.6 percent) brought bred heifers back to the operation from the rearing facility. About one of three operations (30.3 percent) brought back weaned heifers, while just 2.1 percent brought back "other" heifers (primarily heifers that had calved). A higher percentage of large operations (53.4 percent) brought back weaned heifers compared with medium and small operations (27.3 and 15.1, respectively). A higher percentage of small and medium operations (79.1 and 72.2 percent, respectively) brought back bred heifers compared with large operations (46.6 percent).

i. For the 9.3 percent of operations that had any heifers raised off-site, percentage of operations by primary class of heifers arriving or returning to the operation, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Heifer Class[1]	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Weaned	15.1	(6.0)	27.3	(5.1)	53.4	(4.7)	30.3	(3.4)
Bred	79.1	(6.7)	72.2	(5.2)	46.6	(4.7)	67.6	(3.5)
Other[2]	5.8	(3.4)	0.5	(0.5)	0.0	(0.0)	2.1	(1.2)
Total	100.0		100.0		100.0		100.0	

[1]No operations reported preweaned heifers returning from an off-site rearing facility.
[2]Heifers that had calved.

3. Weaning age

Weaning is a stressful time for calves. To reduce this stress, calves should only be weaned when they are healthy and should not be moved to different housing for 1 week after weaning. Deciding when to wean calves should be based on starter intake rather than age. When a calf has eaten 2 pounds of calf starter per day for three consecutive days, it is ready to be weaned (Corbett, 2007).

If careful attention is paid to proper nutrition, calves can often be weaned at a relatively young age (5 to 7 weeks). Early weaning can cut costs because feeding calf starter is less expensive and less labor-intensive than feeding milk or milk replacer.

The operation average age at weaning was 8.2 weeks, with large operations weaning calves at an older age (9.1 weeks) than medium and small operations (7.9 and 8.2 weeks, respectively).

a. Operation average age of heifers at weaning, by herd size

Operation Average Age (Weeks)							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Avg.	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**	**Avg.**	**Std. Error**
8.2	(0.1)	7.9	(0.1)	9.1	(0.2)	8.2	(0.1)

About one-third of operations (33.2 percent) weaned heifers at 8 weeks of age, while 20.5 percent weaned heifers at 6 weeks. Less than 5 percent of operations (4.8 percent) weaned heifers at 4 weeks of age.

b. Percentage of operations by average weaning age of heifers

Operation Average Weaning Age (Weeks)	Percent Operations	Standard Error
4	4.8	(0.6)
5	5.6	(0.6)
6	20.5	(1.2)
7	10.3	(0.8)
8	33.2	(1.4)
9	4.5	(0.6)
10	5.9	(0.6)
11	1.1	(0.3)
12	8.9	(0.9)
13 or more	5.2	(0.7)
Total	100.0	

4. Preventive practices

Various preventive practices, such as deworming, are utilized to improve heifer growth and health. Common helminths (worms) that affect cattle are *Cooperia, Bunostomum, Strongyloides, Nematodirus, Toxocara, Oesophagostomum*, *Trichuris,* and the stomach worms *Ostertagia, Haemonchus,* and *Trichostrongylus*. Younger animals are more likely to have high worm burdens than adult animals, since they have not yet acquired immunity to these parasites (Yazwinski and Gibbs, 1975; Merck, 1998). Heavy worm burdens cause diminished growth, poor health, and decreased milk production in dairy cattle (Block and Gadbois, 1986; Bradley et al., 1986; Block et al., 1987). The goal of a deworming protocol is to decrease existing worm burdens and to prevent future infections by reducing parasite load in the pasture. Choosing an appropriate deworming protocol depends upon the seasonal pattern of helminth disease and pasture access of the herd. Deworming products can be rotated to reduce the chance of developing anthelmintic resistance.

Coccidia are another important group of parasites in dairy cattle. The species of Coccidia most likely to cause diarrhea and immunosuppression are *Eimeria bovis* and *Eimeria zuernii*. Coccidia are present in the environment of both pastured and confinement-raised animals. A combination of stressed animals and eating off the ground tend to be the cause of most disease outbreaks. For calves, outbreaks can occur after weaning, dehorning, castration, or during cold weather. There are two classes of medications used to prevent coccidiosis in calves. Coccidoistats, such as Deccox (decoquinate) are one option. Ionophores are another method and have the added benefit of acting as growth promotants. In addition to being coccidiocidal, ionophores alter the rumen bacterial population, thereby changing the production of certain volatile fatty acids and facilitating more efficient use of feed. Common ionophores are lasalocid (Bovatec) and monensin (Rumensin). Ionophores have come under some scrutiny due to concerns about antimicrobial resistance. The USDA Food and Feed Safety Research Unit, Southern Plains Agricultural Research Center, reported in 2003 that the use of ionophores does not appear to contribute to antibiotic resistance to important human drugs (Callaway et al., 2003). The use of anticoccidial drugs in milk replacers and calf starter is recommended because these drugs increase growth rate and reduce health problems in calves (Anderson et al., 1988; Eicher-Pruiett et al., 1992; Heinrichs, 1993; Quigley et al., 1997).

Certain vitamins and minerals are often supplemented to prevent nutritional deficiencies in dairy cattle. Selenium, an essential trace mineral, is deficient in the soil and plants in some parts of the United States (Allaway, 1969). Selenium deficiency causes white muscle disease in calves; affected calves can have weakness, stiffness, and muscle tremors. Selenium deficiency also decreases overall growth and health in cattle, and increases the occurrence of mastitis and retained placentas in cows (Harrison et al., 1984; Smith et al., 1984; Kincaid, 1995). Selenium supplements can be added to feed in organic or inorganic forms. Sodium selenate and sodium selenite are the two inorganic forms of selenium; selenized yeast is an example of an organic source of selenium. Selenium can also be administered by injection. Vitamins A, D, and E are also essential to the health of dairy cattle. Chapters 6 and 7 of the “2001 Nutrient Requirements of Dairy Cattle” (National Research Council) give detailed recommendations for supplementing vitamins and minerals.

Anionic salts such as magnesium chloride and magnesium sulfate ($MgCl_2$, $MgSO_4$), ammonium chloride and ammonium sulfate (NH_4Cl, $(NH_4)_2SO_4$), and calcium chloride and calcium sulfate ($CaCl_2$, $CaSO_4$) are sometimes fed to dairy cows during the dry period to prevent hypocalcemia (milk fever). Although anionic salts are beneficial to cows, they are not recommended for heifers because parturient hypocalcemia is uncommon in heifers. Also, anionic salts are unpalatable, and feeding them to heifers can result in decreased dry matter intake, decreased energy balance, and lower body weight gains (Moore et al., 2000).

Probiotics are defined by the World Health Organization as “live microorganisms which when administered in adequate amounts confer a health benefit on the host” (FAO/WHO, 2001). *Lactobacillus acidophilus*, *Enterococcus faecium,* and *Bifidobacterium subtillus* are common microorganisms that have been used as probiotics in dairy calves. Studies have shown that probiotics in some situations are effective for growth promotion and disease prevention in calves (Abe et al., 1995; Donovan et al., 2002; Khuntia and Chaudhary, 2002; Timmerman et al., 2005).

Preventive practices were used for heifers on almost all operations: 94.6 percent of operations administered at least one preventive practice to heifers, and 94.6 percent of heifers were on these operations. Nearly 7 of 10 operations (69.4 percent) dewormed heifers, and similar percentages of operations provided vitamins A-D-E or selenium in feed (74.4 and 69.3 percent, respectively).

Percentage of operations (and percentage of heifers on these operations) by preventive practices normally used for heifers

Preventive Practice	Percent Operations	Standard Error	Percent Heifers*	Standard Error
Dewormers	69.4	(1.3)	55.2	(1.5)
Coccidiostats in feed	46.5	(1.4)	56.5	(1.6)
Vitamins A-D-E injection	10.4	(0.7)	17.4	(1.3)
Vitamins A-D-E in feed	74.4	(1.2)	71.9	(1.5)
Selenium injection	13.2	(0.9)	17.2	(1.2)
Selenium in feed	69.3	(1.3)	65.4	(1.6)
Ionophores in feed (e.g., Rumensin®, Bovatec®)	45.2	(1.4)	58.1	(1.6)
Probiotics	20.0	(1.1)	27.7	(1.6)
Anionic salts in feed	20.9	(1.1)	28.1	(1.5)
Other	4.6	(0.7)	2.5	(0.4)
Any preventive	94.6	(0.7)	94.6	(0.9)

*As a percentage of January 1, 2007, heifer inventory.

5. Injection practices

Almost all operations gave injections to heifers (96.9 percent). More than 9 of 10 operations (94.0 percent) gave intramuscular (IM) injections to heifers , and approximately 5 of 10 operations (51.6 percent) administered intravenous (IV) injections to heifers.

a. Percentage of operations that administered injections to heifers during the previous 12 months, by injection route

Percent Operations*							
Injection Route							
Intramuscular		Subcutaneous		Intravenous		Any	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
94.0	(1.4)	62.2	(3.0)	51.6	(3.0)	96.9	(1.1)

*Operations with 30 or more dairy cows.

To restrain heifers while administering IM injections, operations primarily used lock-up (30.4 percent of operations), tie stall/stanchion (28.8 percent), or chute/head gate (22.6 percent) facilities. These same types of facilities also were primarily used for subcutaneous (SQ) and IV injections for heifers. Less than 11 percent of operations gave any injections to heifers loose in freestalls, in a palpation rail, or in the parlor.

b. For the 96.9 percent of operations that administered IM, SQ and/or IV injections to heifers, percentage of operations by type of cattle-handling facility primarily used, and by injection route

	Percent Operations*					
	Injection Route					
	Intramuscular		Subcutaneous		Intravenous	
Cattle-handling Facility Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Tie stall/stanchion	28.8	(2.9)	24.2	(3.4)	36.3	(4.1)
Lock-up	30.4	(2.5)	36.4	(3.3)	31.6	(3.6)
Chute/head gate	22.6	(2.5)	23.4	(2.8)	20.1	(3.0)
Loose in freestall	10.2	(2.0)	7.5	(2.1)	5.7	(1.7)
Palpation rail	0.3	(0.1)	0.5	(0.2)	0.2	(0.2)
Parlor	5.5	(1.2)	4.3	(1.3)	2.4	(1.2)
Other	2.2	(1.1)	3.7	(1.7)	3.7	(1.6)
Total	100.0		100.0		100.0	

*Operations with 30 or more dairy cows.

6. Vaccination practices

More than 60 percent of operations vaccinated heifers against bovine viral diarrhea (BVD), infectious bovine rhinotracheitis (IBR), parainfluenza Type 3 (PI3), bovine respiratory syncytial virus (BRSV), or leptospirosis. With the exception of IBR, PI3, BRSV, *Haemophilus somnus*, and *Mycobacterium* avium subspecies *paratuberculosis*, a higher percentage of large operations than medium or small operations vaccinated against the listed diseases. Less than half of operations (41.6 percent) normally vaccinated heifers against brucellosis. For heifers, a lower percentage of small operations vaccinated against each of the listed diseases than medium or large operations.

a. Percentage of operations that normally vaccinated heifers against the following diseases, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Disease	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Bovine viral diarrhea (BVD)	69.0	(1.7)	84.5	(1.7)	94.1	(1.4)	73.7	(1.3)
Infectious bovine rhinotracheitis (IBR)	65.7	(1.7)	81.7	(1.8)	88.4	(1.8)	70.4	(1.3)
Parainfluenza Type 3 (PI3)	57.1	(1.8)	70.2	(2.1)	76.2	(2.4)	61.0	(1.4)
Bovine respiratory syncytial virus (BRSV)	60.6	(1.8)	75.4	(2.0)	80.8	(2.2)	64.9	(1.4)
Haemophilus somnus	31.1	(1.7)	42.4	(2.3)	43.0	(2.6)	34.2	(1.3)
Leptospirosis	63.2	(1.7)	78.1	(1.9)	86.7	(1.9)	67.7	(1.3)
Salmonella	15.5	(1.3)	34.4	(2.2)	52.5	(3.0)	21.5	(1.1)
E. coli mastitis	17.6	(1.4)	36.6	(2.2)	61.8	(3.0)	24.1	(1.1)
Clostridia	28.3	(1.6)	48.8	(2.2)	63.4	(2.9)	34.6	(1.3)
Brucellosis	37.4	(1.7)	49.5	(2.2)	66.7	(2.5)	41.6	(1.3)
Mycobacterium avium subspecies *paratuberculosis* (Johne’s disease)	3.4	(0.7)	8.7	(1.3)	10.6	(2.1)	5.0	(0.6)
Neospora	3.8	(0.7)	11.3	(1.6)	20.5	(2.4)	6.3	(0.6)
Other	6.9	(0.9)	6.3	(1.0)	7.8	(1.4)	6.8	(0.7)
Any disease	79.3	(1.5)	92.0	(1.3)	97.1	(0.8)	83.0	(1.1)

Operations in the West region were more likely to vaccinate heifers for the majority of the listed diseases than operations in the East region. About twice the percentage of operations in the West than in the East region vaccinated against *Salmonella*, *E. coli* mastitis, clostridia, brucellosis, and *Neospora*. No regional differences in vaccination were seen for PI3, BRSV, *Haemophilus somnus*, and Johne's disease.

b. Percentage of operations that normally vaccinated heifers against the following diseases, by region

	Percent Operations			
	Region			
	West		East	
Disease	Percent	Std. Error	Percent	Std. Error
Bovine viral diarrhea (BVD)	85.6	(2.3)	72.8	(1.4)
Infectious bovine rhinotracheitis (IBR)	78.4	(2.7)	69.8	(1.4)
Parainfluenza Type 3 (PI3)	67.0	(3.0)	60.5	(1.5)
Bovine respiratory syncytial virus (BRSV)	72.3	(2.9)	64.4	(1.5)
Haemophilus somnus	36.6	(3.0)	34.1	(1.4)
Leptospirosis	78.8	(2.4)	66.9	(1.4)
Salmonella	41.5	(2.9)	20.0	(1.1)
E. coli mastitis	48.3	(2.9)	22.1	(1.2)
Clostridia	65.3	(3.0)	32.2	(1.3)
Brucellosis	87.0	(1.8)	38.0	(1.4)
Mycobacterium avium subspecies *paratuberculosis* (Johne's disease)	8.3	(1.7)	4.7	(0.6)
Neospora	17.9	(2.5)	5.4	(0.6)
Other	7.5	(1.8)	6.8	(0.7)
Any disease	97.8	(0.7)	81.2	(1.2)

7. Bovine viral diarrhea (BVD)

BVD infection in a dairy herd can result in large economic and production losses, primarily because of reproductive problems, decreased overall herd health, and decreased milk production (Houe, 1999; Heuer et al., 2007). BVD causes two types of infections in cattle: persistent infection and transient infection. Persistently infected animals become infected while *in utero*. These animals never clear the infection, so they shed large amounts of the virus continually throughout life. They are the primary source for transmitting transient infections to other members of the herd. Transiently infected animals are those animals infected with BVD following birth. These animals may be subclinical or they may have mild or severe symptoms such as diarrhea or decreased milk production, but they will eventually clear the virus and recover if the infection is not severe enough to be fatal. A persistently infected calf is produced if the dam is persistently infected or becomes transiently infected during pregnancy. In this way, the next generation of persistently infected animals is created and the cycle of BVD continues in the herd. Other possible outcomes when a cow is transiently infected during pregnancy include abortions and congenital (birth) defects.

Culling persistently infected cattle is a critical step in eliminating BVD from a dairy herd. According to the 2006 Academy of Veterinary Consultants position statement on the disposition of persistently infected cattle, “the marketing or movement of PIs in any manner that potentially exposes at-risk cattle is strongly discouraged.” Therefore, the persistent-infection status of cattle that are culled should be disclosed.

Some BVD persistently infected animals appear ill, but many show no obvious symptoms. There are several testing options for identifying persistently infected animals. One method of determining if a dam and her calf are persistently infected with BVD is to test the calf. Since a persistently infected cow will always produce a persistently infected calf, the dam is negative if the calf tests negative. However, a persistently infected calf does not necessarily mean that the dam is persistently infected. Ear notch testing is a popular method for identifying animals persistently infected with BVD, and ear notch tests are accurate for cattle of any age (Fulton et al., 2006). Ear notches can be tested with either IHC (immunohistochemistry) or antigen-capture ELISA; either method is acceptable. Alternatively, serum samples can be tested using virus isolation, antigen capture ELISA, or PCR. Serum samples have the disadvantage of not being able to distinguish persistent infection from transient infection with a single sample. Animals that test positive on the first serum sample will need to be retested in about 3 weeks to distinguish persistent infection from transient infection. Also, some serum tests are inaccurate in young animals, so they are best reserved for animals older than 2 to 3 months of age. PCR on whole blood is one blood test that can be used with accuracy in young calves (Larson et al., 2005).

Few operations (4.0 percent) routinely tested heifer replacements for persistent infection with BVD. The percentage of operations that tested and the percentage of heifers represented by these operations increased as herd size increased. More than 1 of 10 heifers (11.2 percent) were on operations that routinely tested for BVD.

a. Percentage of operations (and percentage of heifers on these operations) that routinely tested heifer replacements to determine if animals were persistently infected with BVD, by herd size

	Percent							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Population	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Operations	1.9	(0.5)	6.7	(1.1)	21.2	(2.4)	4.0	(0.4)
Heifers	2.2	(0.5)	7.2	(1.2)	18.6	(2.2)	11.2	(1.1)

Of operations that tested heifers for persistent infection with BVD, the majority (66.8 percent) used individual ear notch tests, while 21.1 percent tested individual serum samples.

b. For the 4.0 percent of operations that routinely tested heifer replacements to determine if animals were persistently infected with BVD, percentage of operations by testing method used

Testing Method	Percent Operations	Standard Error
Individual ear notch	66.8	(5.7)
Pooled ear notch	11.4	(4.0)
Individual serum sample	21.1	(5.4)
Pooled serum sample	6.0	(3.0)
Other	6.5	(2.4)

Vaccination is an important management tool for controlling BVD and should be implemented along with a plan to test and remove persistently infected animals. There are two types of vaccines: modified live and killed. Killed vaccines contain inactivated virus mixed with substances that stimulate an immune response; modified live vaccines contain virus that has been modified so that it is unlikely to cause disease. The most notable advantage of modified live vaccines is that they provide quicker, stronger, and longer lasting immunity than killed vaccines. The biggest advantage of killed vaccines is their overall safety, especially for pregnant animals. The vaccination schedule should be designed to reduce reproductive losses and calf morbidity and mortality. If using a modified live vaccine, heifers should be vaccinated twice, at 3- to 4-week intervals about 60 days prior to breeding. Cows can then be boostered annually, 2 weeks before breeding. For killed vaccines, the second dose in the primary series for heifers should be given 2 weeks before breeding, and annual boosters for cows can still be given 2 weeks before breeding (Kelling, 2004). Although vaccination of the dam provides some degree of fetal protection, no vaccine has been shown to completely protect the fetus from persistent infection if the dam is exposed to BVD during pregnancy (Cortese et al., 1998; Kovacs et al., 2003; Ficken et al., 2006).

A higher percentage of operations administered modified live BVD vaccines than killed vaccines to heifers (62.2 percent and 43.1 percent, respectively).

c. For the 73.7 percent of operations that gave BVD vaccinations to heifers, percentage of operations by type of BVD vaccine given

Type of Vaccine	Percent Operations	Standard Error
Killed	43.1	(1.6)
Modified live	62.2	(1.5)

G. Surgical Procedures

Note: Estimates in the following tables represent only operations with 30 or more dairy cows.

1. Dehorning

Horns are removed from dairy cattle to reduce the risk of injury to people and other cattle. In young calves, horns start as buds located in the skin of the polls. The horn bud attaches to the skull adjacent to the frontal sinus when the calf is about 2 months of age. In adult cattle, a portion of the frontal sinus chamber extends into the horn. The cells that lie at the connection between the skin and the horn are called the corium; these cells produce the horn material.

Disbudding refers to the removal of the corium while the horn is still a bud, usually when the calf is 12 weeks of age or less. Disbudding is preferred over dehorning because it is less likely to cause a setback in calf growth (Loxton et al., 1982; Laden et al., 1985), and is less likely to cause complications such as bleeding or sinus infection. Caustic paste (chemical cauterization), hot irons (heat cauterization), and dehorning spoons or tubes (scooping techniques) are all used for disbudding calves. Chemical cauterization can be accomplished by applying a paste that contains sodium hydroxide or calcium hydroxide to the horn buds. Caustic paste works best if calves are less than 3 weeks of age and individually housed. Caution must be exercised to ensure that the caustic paste does not get into the calf's eyes or on its skin. Rather than destroying the corium with heat or chemicals, scooping techniques remove it.

Dehorning is the term used to describe removal of the horns at an older age, when the horns have already started to develop. Chemical or heat cauterization is not effective at this stage, so the horn must be physically removed. Typical techniques for dehorning include the Barnes scoop dehorner and the use of wire or saws. If any part of the corium is left behind during dehorning or disbudding, the horn tissue will grow back. For simplicity, the term dehorning will be used to refer to both disbudding and dehorning for the remainder of this discussion.

Dehorning causes behavioral and physiological signs of pain in calves. Studies have shown that dehorning results in behavioral signs of discomfort, such as head shaking, head rubbing, tail flicking, and ear flicking. In addition, dehorning causes increased blood levels of cortisol, a stress hormone, for 6 to 8 hours after the procedure (Morisse et al., 1995; McMeekan et al., 1997; McMeekan et al., 1998; Graf and Senn, 1999; Groendahl-Nielsen et al., 1999; Faulkner and Weary, 2000; Doherty et al., 2007). In the United States, there are no regulations concerning dehorning procedures. The American Veterinary Medical Association's Animal Welfare Division states "Both dehorning and castration should be done at the earliest age practicable. Disbudding is the preferred method of dehorning calves. Local anesthetic should be considered for other dehorning procedures." In the European Union, it is illegal to disbud or dehorn calves over 14 days of age without using a local anesthetic.

Local anesthesia has been advocated to reduce the pain of dehorning. Each horn can be desensitized by an injection of local anesthetic near the cornual nerve. Lidocaine, a frequently used local anesthetic, provides local anesthesia for about 2 hours. Most studies on the benefits of lidocaine suggest that it is effective in reducing the behavioral and physiological signs of pain for the duration of effect of the anesthetic. Sylvester et al. (2004) showed that 6-month-old calves that received lidocaine had a decrease in behavioral signs of pain for 2 hours after dehorning. After 2 hours, the signs of pain were comparable to calves that did not receive lidocaine. In addition, several studies have shown that local anesthesia temporarily reduced or prevented the rise in plasma cortisol levels after dehorning in a variety of age groups. However, the effect only lasted as long as the anesthesia; when the local anesthetic wore off, cortisol levels increased (Petrie et al., 1996; McMeekan et al., 1998; Sutherland et al., 2002). It should be noted that lidocaine does not appear to be effective for pain relief when caustic paste is used for disbudding, perhaps because the pH of the paste interferes with the lidocaine (Vickers et al., 2005).

The use of local anesthesia with ketoprofen, a nonsteroidal anti-inflammatory drug (NSAID) nearly eliminated the postdehorning rise in cortisol in 3- to 4-month-old calves when used prior to scoop dehorning (McMeekan et al. (1998). However, ketoprofen is not approved by the FDA for use in food animals in the United States. Flunixin meglumine is the only NSAID approved for use in cattle in the United States, and it is approved only for the treatment of mastitis, endotoxemia, or respiratory disease. Future research to determine if flunixin meglumine would also be effective as an analgesic for dehorning would be useful.

The use of xylazine, a sedative and mild analgesic, has also been investigated for dehorning calves (Ley et al., 1990); however, xylazine is not approved by the FDA for use in food animals in the United States. When a sedative, a local anesthetic, and ketoprofen were combined, behavioral signs of pain were greatly reduced for calves dehorned with a hot iron. In fact, calves did not even require restraint for the dehorning procedure when this protocol was used (Faulkner and Weary, 2000). However, a multiple-injection protocol such as this may not be practical for many operations. For operations wanting a simpler approach, Vikers et al. (2005) reported that the pain from the use of caustic paste was adequately controlled with xylazine alone.

Considering the challenges of using pharmaceuticals (cost and availability of approved drugs) to reduce pain during dehorning, selective breeding for polled stock may be an attractive alternative for the dairy industry.

Overall, 94.0 percent of operations routinely dehorned heifer calves while they were on the operation during the previous 12 months. A lower percentage of large operations (64.3 percent) dehorned heifer calves than small or medium operations (97.3 and 92.6 percent, respectively). More than 95 percent of operations in the East region (95.6 percent) routinely dehorned heifer calves, compared with 77.6 percent of operations in the West region. Herd-size and regional differences are likely related to large operations moving calves to heifer-raising facilities when calves are still too young for disbudding/dehorning.

a. Percentage of operations that routinely dehorned heifer calves while on the operation during the previous 12 months, and by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
97.3	(1.6)	92.6	(2.8)	64.3	(6.3)	94.0	(1.4)

b. Percentage of operations that routinely dehorned heifer calves while on the operation during the previous 12 months, by region

Percent Operations			
Region			
West		East	
Percent	Standard Error	Percent	Standard Error
77.6	(4.6)	95.6	(1.4)

For operations that routinely dehorned heifer calves during the previous 12 months, more than two-thirds (69.1 percent) used a hot iron; 28.2 percent used a tube, spoon, or gouge; and 16.3 percent used saws, wire, or Barnes dehorners. For operations that used a hot iron to dehorn calves, 13.8 percent used analgesics/ anesthetics when dehorning calves.

c. For the 94.0 percent of operations that routinely dehorned heifer calves during the previous 12 months, percentage of operations by dehorning method, and corresponding percentage of operations using that method in tandem with analgesics/anesthetics

Method	Percent Operations	Std. Error	Percent Operations that Used Analgesics/ Anesthetics	Std. Error
Hot iron	69.1	(2.8)	13.8	(2.6)
Caustic paste	9.2	(1.8)	14.2	(5.8)
Tube, spoon, or gouge	28.2	(2.9)	21.5	(5.1)
Saws, wire, or Barnes	16.3	(2.3)	21.5	(6.7)
Other	1.7	(0.9)	17.1	(16.5)

Photo courtesy of Dairy Herd Management/Bovine Veterinarian

The majority of heifer calves (67.5 percent) were dehorned using a hot iron at an average age of 7.6 weeks. Caustic paste was used on 12.2 percent of calves at an average age of 2.7 weeks. A similar percentage was observed for the tube-spoon-or gouge method, but average age increased to 16.9 weeks. Saws, wire, or Barnes dehorning was performed on 7.1 percent of heifer calves at an average age of 23.5 weeks.

d. For the 94.0 percent of operations that routinely dehorned heifer calves during the previous 12 months, percentage of calves dehorned and operation average age at dehorning, by method used to dehorn calves

Method	Percent Heifers*	Std. Error	Operation Average Age (Weeks)	Std. Error
Hot iron	67.5	(3.1)	7.6	(0.4)
Caustic paste	12.2	(2.6)	2.7	(0.3)
Tube, spoon, or gouge	13.0	(1.7)	16.9	(1.2)
Saws, wire, or Barnes	7.1	(1.1)	23.5	(2.6)
Other	0.2	(0.1)	32.7	(6.9)
Total	100.0			

*Dairy heifer calves weaned during the previous 12 months.

Of the dehorning equipment used on operations, tubes, spoons, gouges, saws, wire, and Barnes dehorners commonly cause bleeding. More than 4 of 10 operations (42.0 percent) used dehorning equipment that causes bleeding. A higher percentage of small and medium operations (42.9 and 43.5 percent, respectively) used dehorning equipment that causes bleeding compared with large operations (18.9 percent).

e. For the 94.0 percent of operations that routinely dehorned heifer calves while on the operation during the previous 12 months, percentage of operations that dehorned heifer calves with equipment that can cause bleeding, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
42.9	(4.0)	43.5	(4.6)	18.9	(5.7)	42.0	(3.1)

Disinfecting dehorning equipment that causes bleeding reduces the possibility of transmitting diseases such as bovine leukosis virus. Of the operations that used dehorning equipment that causes bleeding, 46.4 percent disinfected dehorning equipment for each calf.

f. For operations that routinely dehorned heifer calves with equipment that can cause bleeding, percentage of operations that chemically disinfected surgical dehorning equipment for each calf

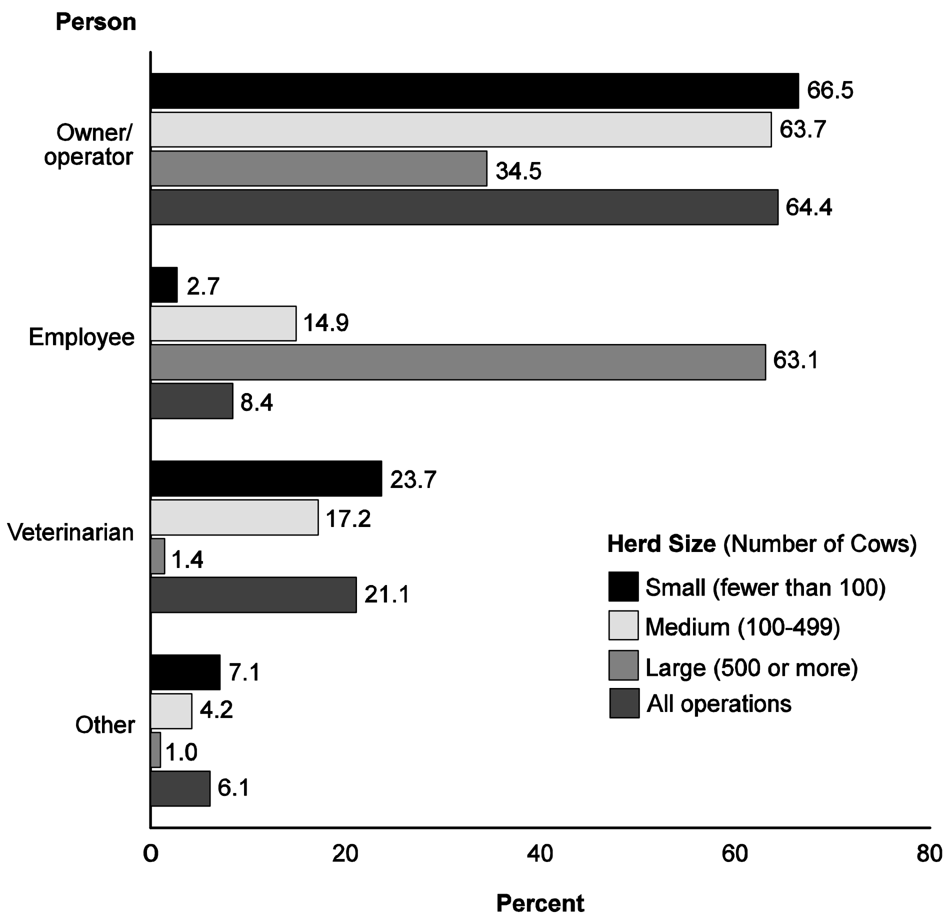
Percent Operations	Standard Error
46.4	(4.9)

On almost two-thirds of operations (64.4 percent), the owner/operator dehorned the majority of calves. The person who dehorned the majority of calves differed with operation size, however, with the owner/operator dehorning the majority of heifer calves on about two-thirds of small and medium operations (66.5 percent and 63.7 percent, respectively) but only on about one-third of large operations (34.5 percent). An employee dehorned the majority of calves on 63.1 percent of large operations, compared with 2.7 percent of small operations and 14.9 percent of medium operations. Veterinarians performed the majority of dehorning on 23.7 percent of small operations, 17.2 percent of medium operations, and 1.4 percent of large operations.

g. For the 94.0 percent of operations that routinely dehorned heifer calves during the previous 12 months, percentage of operations by person who dehorned the majority of heifer calves on the operation, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Person	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Owner/operator	66.5	(3.8)	63.7	(4.2)	34.5	(7.5)	64.4	(2.9)
Employee	2.7	(1.1)	14.9	(2.9)	63.1	(7.4)	8.4	(1.1)
Veterinarian	23.7	(3.4)	17.2	(3.4)	1.4	(0.5)	21.1	(2.6)
Other	7.1	(2.2)	4.2	(1.8)	1.0	(0.6)	6.1	(1.6)
Total	100.0		100.0		100.0		100.0	

For the 94.0 Percent of Operations that Routinely Dehorned Heifer Calves During the Previous 12 Months, Percentage of Operations by Person Who Dehorned the Majority of Heifer Calves on the Operation, and by Herd Size



Employees dehorned the majority of heifer calves on a higher percentage of operations in the West region (33.4 percent) than in the East region (6.4 percent), which may be due to the larger operations in the West.

h. For the 94.0 percent of operations that routinely dehorned heifer calves during the previous 12 months, percentage of operations by person who dehorned the majority of heifer calves on the operation, and by region

	Percent Operations			
	Region			
	West		East	
Person	Percent	Std. Error	Percent	Std. Error
Owner/operator	55.1	(6.8)	65.2	(3.1)
Employee	33.4	(5.5)	6.4	(1.1)
Veterinarian	11.5	(4.6)	21.8	(2.8)
Other	0.0	(--)	6.6	(1.8)
Total	100.0		100.0	

2. Extra teat removal

Extra teats on dairy cows can interfere with milking and lead to mastitis, and they are not acceptable in show cattle. As with dehorning, removing extra teats at an early age is usually less painful for calves and helps to ensure a quick recovery.

About one-half of operations (50.3 percent) routinely removed extra teats from heifer calves during the previous 12 months. The percentage of operations that removed extra teats did not differ by herd size.

a. Percentage of operations that routinely removed extra teats from heifer calves during the previous 12 months, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
46.4	(4.0)	57.1	(4.4)	66.4	(6.2)	50.3	(3.0)

About one-fifth of operations (20.3 percent) that routinely removed extra teats from heifer calves removed the teats when the heifers were less than 12 weeks old, while one-third (32.2 percent) removed teats at 12.0 to 17.9 weeks of age. About 20 percent of operations removed extra teats from animals in each of the next two age categories (18.0 to 23.9 weeks and 24.0 to 29.9 weeks).

b. For the 50.3 percent of operations that routinely removed extra teats from heifer calves during the previous 12 months, percentage of operations by age at which extra teats were removed

Age (Weeks)	Percent Operations	Standard Error
Less than 12.0	20.3	(3.4)
12.0 to 17.9	32.2	(3.8)
18.0 to 23.9	20.1	(3.4)
24.0 to 29.9	18.6	(3.5)
30.0 or more	8.8	(1.9)
Total	100.0	

One of 10 operations (10.6 percent) routinely used analgesia or anesthesia during extra teat removal, which is similar to usage for dehorning.

c. For the 50.3 percent of operations that routinely removed extra teats from heifer calves during the previous 12 months, percentage of operations that used analgesics or anesthesia to remove extra teats

Percent Operations	Standard Error
10.6	(3.0)

3. Tail docking

Tail docking was initially promoted to reduce the incidence of leptospirosis in milking personnel in New Zealand, but subsequent research demonstrated leptospiral titers of milkers had no relationship with tail docking. Tail docking is currently prohibited California and must not be performed as a routine management procedure in the European Union.

The AVMA is opposed to tail docking, and the American Association of Bovine Practitioners (AABP) states the following: “The AABP is not aware of sufficient scientific evidence in the literature to support tail docking in cattle. If it is deemed necessary for proper care and management of production animals in certain conditions, veterinarians should counsel clients on proper procedures, benefits and risks.”

About half of operations (51.4 percent) had no cows with the tail docked. A higher percentage of operations in the West region (81.3 percent) had no cows with the tail docked than in the East region (48.5 percent of operations). On about one of seven operations (14.6 percent), all cows had the tail docked.

a. Percentage of operations by percentage of dairy cows with the tail docked, and by region

	Percent Operations					
	Region					
	West		East		All Operations	
Percent Cows	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
0	81.3	(4.3)	48.5	(3.2)	51.4	(2.9)
0.1 to 24.9	0.7	(0.7)	11.8	(2.0)	10.8	(1.9)
25.0 to 75.9	9.6	(3.7)	8.8	(1.7)	8.9	(1.6)
76.0 to 99.9	5.5	(1.9)	15.1	(2.4)	14.3	(2.2)
100.0	2.9	(1.5)	15.8	(2.2)	14.6	(2.0)
Total	100.0		100.0		100.0	

Overall, about 4 of 10 cows (38.8 percent) had the tail docked. A higher percentage of cows on medium operations (55.5 percent) than on small or large operations (27.1 and 34.5 percent, respectively) had the tail docked.

b. Percentage of cows with the tail docked, and by herd size:

Percent Cows*							
Herd Size (Number of Cows)							
Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
27.1	(3.2)	55.5	(3.6)	34.5	(4.3)	38.8	(2.4)

*As a percentage of cows on the operation at the time of VS Initial Visit interview.

The majority of operations that had cows with the tail docked most commonly used a band to dock tails (87.2 percent); these operations represented 90.4 percent of cows with the tail docked. About 1 of 10 operations did not know what procedure was used, which suggests that the cattle were purchased with the tail already docked.

c. For the 48.6 percent of operations with tail-docked cows, percentage of operations (and percentage of tail-docked cows on these operations) by procedure most commonly used to dock tails

Procedure	Percent Operations	Std. Error	Percent Tail-Docked Cows	Std. Error
Band	87.2	(2.9)	90.4	(2.9)
Surgical removal	2.0	(1.0)	5.2	(2.4)
Hot knife	0.0	(--)	0.0	(--)
Other	1.9	(0.9)	2.7	(1.2)
Unknown procedure	8.9	(2.7)	1.7	(1.2)
Total	100.0		100.0	

Of operations with tail-docked cows, 61.0 percent (accounting for 38.0 percent of cows with the tail docked) performed tail-docking on the majority of animals when they were 2 years of age or older. The tail was docked on almost 3 of 10 cows (28.1 percent) when they were less than 2 months of age. About 10 percent of operations docked tails when cattle were less than 2 months of age (10.2 percent) or from 2 months to less than 6 months of age (10.5 percent).

d. For the 48.6 percent of operations with tail-docked cows, percentage of operations (and percentage of tail-docked cows on these operations) by age of the majority of animals when the tail was docked

Age	Percent Operations	Std. Error	Percent Tail-Docked Cows	Std. Error
Less than 2 months	10.2	(2.0)	28.1	(5.0)
2 to less than 6 months	10.5	(2.6)	17.1	(3.4)
6 months to less than 2 years	9.5	(2.0)	16.3	(3.5)
2 years or older	61.0	(4.0)	38.0	(4.9)
Unknown	8.8	(2.7)	0.5	(0.2)
Total	100.0		100.0	

The majority of operations with tail-docked cows (90.3 percent) did not routinely use analgesics or anesthetics for tail docking, compared with 1.1 percent that routinely used analgesics or anesthetics. Operations that routinely used analgesics or anesthetics represented 0.9 percent of cows with the tail docked.

e. For the 48.6 percent of operations with tail-docked cows, percentage of operations (and percentage of tail-docked cows on these operations) that routinely used analgesia or anesthesia

	Percent Operations	Std. Error	Percent Tail-Docked Cows	Std. Error
Yes	1.1	(0.6)	0.9	(0.6)
Don’t know	8.6	(2.6)	1.3	(0.6)
No	90.3	(2.7)	97.8	(0.9)
Total	100.0		100.0	

H. Biosecurity

Note: Estimates in the following tables represent operations with any dairy cows.

1. Introduction

Because infectious diseases can cause tremendous economic losses for dairy operations, biosecurity practices to prevent and control disease are an essential aspect of raising replacement heifers. Biosecurity on dairy operations results from implementing management practices designed to prevent the introduction of disease-causing agents onto the operation. Biocontainment is the result of implementing strategies designed to prevent the spread of disease agents between animal groups (Wells, 2000; Dargatz et al., 2002). Strategies directed at both biosecurity and biocontainment are necessary to minimize potential impacts of disease on dairy operations. These strategies are particularly important for calves because preweaned calves are the animals most susceptible to disease.

Recognizing and understanding all aspects of potential biosecurity breaches are important when managing a successful biosecurity program. Generally, the issues that receive the most attention are: the process of introducing new animals onto the farm, including knowledge of their source and health history; isolating new animals from the main herd, and testing them for appropriate diseases; designing strategic vaccination programs; and hygiene practices, including disinfecting equipment and manure management. However, many other key components of infectious disease control are often overlooked. For example, minimizing stress helps animals better resist and combat disease. Animal stress can be reduced by providing a comfortable, clean environment, sufficient housing space, adequate bunk space, and by segregating cattle into appropriate age and/or size groups. For calves, providing high quality colostrum, quality feed and water, maintaining adequate nutrient intake, and providing clean housing help to decrease nutritional stress and ensure optimal immune function for disease resistance. Managing and regulating visitor, service personnel, employee, and animal traffic are also essential aspects of biosecurity. For instance, workers should care for calves before they care for older animals on the operation, and the number of visitors should be limited (Wallace, 2001; McCluskey, 2002).

2. Source of heifer inventory

Although 4.7 percent of operations had heifers born on the operation but raised elsewhere, these operations accounted for 11.5 percent of all heifers. Of the remaining heifers, 87.4 percent were born and raised on the operation, and nearly all operations (96.5 percent) had at least some dairy heifers born and raised on the operation.

Percentage of operations and percentage of heifers, by source of heifers

Heifer Source	Percent Operations	Standard Error	Percent Heifers*	Standard Error
Born and raised on operation	96.5	(0.4)	87.4	(1.2)
Born on operation raised off operation	4.7	(0.5)	11.5	(1.2)
Born off operation	6.6	(0.8)	1.1	(0.2)
Total			100.0	

*As a percentage of January 1, 2007, heifer inventory.

3. Animals brought onto the operation

The introduction of new animals can introduce diseases to the herd, especially if the new additions are not properly screened for disease prior to introduction. Almost 4 of 10 operations (38.9 percent) brought at least 1 new addition onto the operation during 2006. Approximately one of eight operations (12.2 percent) brought on bred dairy heifers. A lower percentage of large operations brought on preweaned calves compared with small operations (1.0 and 3.8 percent, respectively), but a higher percentage of large operations brought on dairy heifers, bred dairy heifers, or any beef or dairy cattle compared with medium or small operations.

a. Percentage of operations that brought the following classes of cattle onto the operation during 2006, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Cattle Class	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Preweaned calves (dairy or beef)	3.8	(0.8)	2.5	(0.6)	1.0	(0.3)	3.4	(0.6)
Dairy heifers (weaned but not bred)	5.3	(0.8)	7.6	(1.2)	16.3	(2.6)	6.4	(0.7)
Bred dairy heifers	8.9	(1.0)	18.1	(1.8)	34.7	(2.6)	12.2	(0.9)
Any cattle (dairy or beef)	35.6	(1.7)	44.3	(2.3)	61.6	(2.8)	38.9	(1.4)

Although more operations in the West region brought on animals during 2006 than operations in the East region (49.3 and 38.0 percent, respectively), a higher percentage of operations in the East region brought on preweaned calves.

b. Percentage of operations that brought the following classes of cattle onto the operation during 2006, by region

	Percent Operations			
	Region			
	West		East	
Cattle Class	Percent	Std. Error	Percent	Std. Error
Preweaned calves (dairy or beef)	0.6	(0.3)	3.6	(0.6)
Dairy heifers (weaned but not bred)	12.6	(2.2)	5.9	(0.7)
Bred dairy heifers	21.1	(2.3)	11.5	(0.9)
Any cattle (dairy or beef)	49.3	(3.0)	38.0	(1.5)

For operations that introduced bred heifers, the percentage of cow inventory brought on as bred heifers was similar across herd sizes, ranging from 15.1 percent of small operations to 17.3 percent of large operations.

c. For the 12.2 percent of operations that brought bred heifers onto the operation during 2006, percentage* of cow inventory that was brought on as bred heifers, by herd size

Percent Cow Inventory*							
Herd Size (Number of Cows)							
Small (Fewer than 100)		Medium (100-499)		Large (500 or More)		All Operations	
Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
15.1	(1.7)	15.6	(1.8)	17.3	(1.4)	16.7	(1.1)

*As a percentage of January 1, 2007, cow inventory.

4. Quarantine of herd additions

Bred dairy heifers were quarantined on less than 20 percent of operations (14.5 percent). Approximately one of five operations (20.3 percent) that brought cattle onto the operation during 2006 quarantined new additions.

For operations that brought the following classes of cattle onto the operation during 2006, percentage of operations that quarantined the following classes of cattle upon arrival, percentage of arriving cattle quarantined, and operation average number of days quarantined

Cattle Class	Percent Operations	Std. Error	Percent Cattle Quarantined	Std. Error	Operation Average Days Quarantined	Std. Error
Preweaned calves (dairy or beef)	44.2	(8.3)	20.1	(12.6)	42.4	(4.8)
Dairy heifers (weaned but not bred)	23.0	(4.7)	7.1	(2.6)	20.0	(3.6)
Bred dairy heifers	14.5	(2.3)	19.7	(3.5)	22.0	(3.1)
Any cattle (dairy or beef)	20.3	(1.7)	16.7	(2.4)	31.2	(3.5)

5. Calf contact with other cattle

Separating calves from older animals is an effective management practice used to reduce disease exposure of preweaned calves. Seventy-six percent of operations, representing 84.4 percent of calves, did not allow preweaned calves to have physical contact with weaned calves, and about 85 percent of operations did not allow contact with either bred heifers or adult cattle. More than two of three operations (69.5 percent), representing 78.7 percent of heifer calves, did not allow preweaned calves to have contact with older cattle.

Percentage of operations (and percentage of heifer calves born on these operations) in which after separation from the dam preweaned heifer calves did not have physical contact* with the following cattle classes

Cattle Class	Percent Operations	Std. Error	Percent Calves	Std. Error
Weaned calves not yet of breeding age	76.0	(1.2)	84.4	(1.1)
Bred heifers not yet calved	86.8	(1.0)	91.3	(0.8)
Adult cattle	84.3	(1.1)	89.2	(0.9)
No contact with above classes	69.5	(1.3)	78.7	(1.2)

*Physical contact is defined as nose-to-nose contact or sniffing/touching/licking each other, including through a fence.

I. Health

Note: In this report antibiotic and antimicrobials are used synonymously (see Terms Used in This Report, p 4). A list of antibiotics and their respective classes are provided in Appendix III. Also, Estimates in the following tables represent only operations with 30 or more dairy cows.

1. Morbidity and antibiotic use in preweaned heifers

Almost one of four preweaned heifers had diarrhea (23.9 percent), and 17.9 percent of all preweaned heifers were treated with antibiotics for diarrhea. A lower percentage of preweaned heifers had respiratory disease (12.4 percent), and 11.4 percent of preweaned heifers were treated with antibiotics for respiratory disease.

a. Percentage of preweaned heifers affected and treated with antibiotics for a disease or disorder during the previous 12 months

	Percent Preweaned Heifers*			
	Affected		Treated	
Disease or Disorder	Percent	Std. Error	Percent	Std. Error
Respiratory	12.4	(1.3)	11.4	(1.3)
Diarrhea or other digestive problem	23.9	(1.9)	17.9	(1.7)
Navel infection	1.6	(0.2)	1.5	(0.2)
Other	0.6	(0.2)	0.6	(0.2)

*As a percentage of dairy heifer calves born alive in 2006.

More than 9 of 10 of calves affected with respiratory disease or navel infection were treated with an antibiotic (93.4 and 92.3 percent, respectively). Almost three-fourths of preweaned calves affected with diarrhea (74.5 percent) were treated with an antibiotic.

b. For preweaned heifers affected with a disease or disorder during the previous 12 months, percentage of preweaned heifers treated with an antibiotic

Disease or Disorder	Percent Affected Preweaned Heifers Treated	Standard Error
Respiratory	93.4	(2.3)
Diarrhea or other digestive problem	74.5	(4.8)
Navel infection	92.3	(2.4)
Other	97.2	(1.9)

Two-thirds of operations (66.7 percent) used an antibiotic to treat respiratory disease in preweaned heifers, and almost one-third (31.9 percent) had no respiratory disease in preweaned heifers. The primary antibiotics used to treat respiratory disease were florfenicol, macrolides, and noncephalosporin beta-lactams (18.3, 15.2, and 11.6 percent of operations, respectively). More than 6 of 10 operations (62.1 percent) treated preweaned heifers with antibiotics for diarrhea, while 17.4 percent of operations with preweaned heifers that had diarrhea did not treat these animals with antibiotics. The most commonly used primary antibiotics used for diarrhea were tetracycline, "other," noncephalosporin beta-lactams, and sulfonamides (16.2, 10.5, 9.4, and 9.2 percent, of operations, respectively). The primary antibiotics from the "other" category included trimethoprim sulfamethoxazole, amprolium, and lincomycin/spectinomycin. Navel infection was treated on 28.7 percent of operations, and the primary antibiotics used were noncephalosporin beta-lactams (21.2 percent of operations). Less than 5 percent of operations (4.5 percent) treated for other diseases.

c. Percentage of operations (including those not reporting diseases or disorders) by primary antibiotic used to treat preweaned heifers during the previous 12 months, and by disease or disorder treated

	Percent Operations							
	Disease/Disorder							
	Respiratory		Diarrhea*		Navel Infection		Other	
Primary Antibiotic Used	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Aminocyclitol	0.0	(0.0)	1.7	(0.7)	0.0	(--)	0.0	(--)
Aminoglycoside	0.6	(0.4)	4.0	(1.1)	0.0	(0.0)	0.4	(0.4)
Noncephalosporin beta-lactam	11.6	(2.0)	9.4	(1.8)	21.2	(2.5)	1.4	(0.7)
Cephalosporin	8.2	(1.5)	5.6	(1.1)	2.2	(0.6)	0.5	(0.4)
Florfenicol	18.3	(2.2)	4.0	(1.1)	1.1	(0.5)	0.0	(0.0)
Macrolide	15.2	(2.1)	1.5	(0.5)	0.8	(0.4)	0.3	(0.2)
Sulfonamide	1.9	(0.7)	9.2	(1.5)	0.9	(0.9)	0.2	(0.1)
Tetracycline	8.9	(1.7)	16.2	(2.3)	1.4	(0.4)	1.0	(0.6)
Other/unknown	2.0	(0.7)	10.5	(1.8)	1.1	(0.6)	0.7	(0.5)
Any antibiotic	66.7	(2.8)	62.1	(2.8)	28.7	(2.6)	4.5	(1.1)
No treatment but disease	1.4	(0.6)	17.4	(2.2)	2.5	(0.7)	0.2	(0.2)
No disease or disorder	31.9	(2.8)	20.5	(2.4)	68.8	(2.7)	95.3	(1.2)
Total	100.0		100.0		100.0		100.0	

*Or other digestive problem.

NOTE: To determine the percentage of treated preweaned heifers, the primary antibiotic used by the operation to treat a specific disease or disorder was applied to all treated heifers on the operation.

The majority of preweaned heifers treated for respiratory disease were on operations that used florfenicol, cephalosporins, macrolides, or tetracycline as the primary antibiotic to treat respiratory disease (25.4, 24.6, 19.8, and 13.2 percent of preweaned heifers, respectively). To treat diarrhea, sulfonamides, tetracycline, and "other" were the antibiotics used on operations for the highest percentage of preweaned heifers.

d. Of preweaned heifers treated with antibiotics during the previous 12 months, percentage of preweaned heifers by primary antibiotic used on the operation for the following diseases/disorders

	Percent Treated Preweaned Heifers					
	Disease/Disorder					
	Respiratory		Diarrhea*		Navel Infection	
Primary Antibiotic Used	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Aminocyclitol	0.1	(0.1)	5.1	(2.0)	0.0	(--)
Aminoglycoside	2.4	(1.7)	11.5	(3.9)	0.3	(0.2)
Noncephalosporin beta-lactam	7.9	(2.1)	11.0	(2.8)	69.6	(7.9)
Cephalosporin	24.6	(8.5)	9.5	(2.3)	5.0	(1.7)
Florfenicol	25.4	(5.5)	5.2	(1.8)	3.7	(2.0)
Macrolide	19.8	(3.7)	2.8	(1.6)	11.6	(8.9)
Sulfonamide	3.3	(1.8)	23.3	(6.2)	1.8	(1.8)
Tetracycline	13.2	(3.3)	16.5	(2.9)	6.7	(3.2)
Other	3.3	(1.5)	15.1	(3.0)	1.3	(0.6)
Total	100.0		100.0		100.0	

*Or other digestive problem.

2. Morbidity and antibiotic use in weaned heifers

Ionophores have not consistently been considered antibiotics, but according to Food and Drug Administration guidelines ionophores are a type of antibiotic. More than one-half of operations (50.9 percent) used antibiotics in rations for weaned heifers, including 32.7 percent that used only ionophores.

a. Percentage of operations by use of antibiotics in weaned-heifer rations during the previous 12 months to prevent disease or promote growth

Usage	Percent Operations	Standard Error
Antibiotics (other than ionophores) in heifer ration	18.2	(2.0)
Ionophores only in heifer ration	32.7	(2.6)
Did not know if antibiotics were in heifer ration	2.3	(0.9)
No antibiotics in heifer ration	44.2	(2.8)
No weaned heifers on operation	2.6	(0.8)
Total	100.0	

The majority of operations that used antibiotics in weaned heifer rations used ionophores (84.9 percent) followed by chlortetracycline (14.4 percent) and oxytetracycline compounds (10.9 percent).

b. For the 50.9 percent of operations that used antibiotics in rations for weaned dairy heifers during the previous 12 months, percentage of operations by antibiotic used

Antibiotic Used	Percent Operations	Std. Error
Bacitracin methylene disalicylate	0.0	(--)
Bambermycin	0.5	(0.5)
Chlortetracycline compounds	14.4	(2.3)
Neomycin sulfate	4.1	(1.8)
Ionophores	84.9	(2.8)
Neomycin-oxytetracycline	5.4	(1.9)
Oxytetracycline compounds	10.9	(2.2)
Sulfamethazine	5.7	(1.5)
Tylosin phosphate	0.0	(--)
Virginiamycin	0.2	(0.2)
Other antibiotics	2.0	(1.4)

Few weaned heifers were affected by or treated for disease. Only 5.9 percent of weaned heifers were recognized as having respiratory disease, and 5.5 percent of all weaned heifers were treated with antibiotics for respiratory disease. Diarrhea was reported in 1.9 percent of weaned heifers, and 1.6 percent of all weaned heifers were treated. Less than 2 percent of weaned heifers had other diseases or disorders.

c. Percentage of weaned heifers affected and treated with antibiotics for a disease or disorder during the previous 12 months

	Percent Weaned Heifers*			
	Affected		Treated	
Disease or Disorder	Percent	Std. Error	Percent	Std. Error
Respiratory	5.9	(0.5)	5.5	(0.5)
Diarrhea or other digestive problem	1.9	(0.7)	1.6	(0.7)
Other	1.7	(0.6)	1.4	(0.6)

*As a percentage of weaned heifer inventory on January 1, 2007.

More than 9 of 10 weaned heifers affected with respiratory disease (93.3 percent) were treated with antibiotics. About 8 of 10 weaned heifers with diarrhea or other digestive problems (85.4 percent) were treated with antibiotics.

d. For weaned heifers affected with a disease or disorder during the previous 12 months, percentage of weaned heifers treated with an antibiotic

Disease or Disorder	Percent Affected Weaned Heifers Treated	Standard Error
Respiratory	93.3	(1.8)
Diarrhea or other digestive problem	85.4	(7.8)
Other	81.3	(8.9)

Almost one-half of operations (49.2 percent) treated some weaned heifers for respiratory disease, while only 7.4 percent treated for diarrhea and 6.2 percent for other diseases. The primary antibiotics used on operations for respiratory disease in weaned heifers were florfenicol and tetracycline (12.4 and 11.0 percent of operations, respectively). Antibiotics used to treat diarrhea in weaned calves included "other" (primarily amprolium), noncephalosporin beta-lactams, and tetracycline. Other diseases were treated with noncephalosporin beta-lactams and tetracycline on 3.3 and 1.9 percent of operations, respectively.

e. Percentage of operations (including those not reporting diseases or disorders) by primary antibiotic used to treat weaned heifers during the previous 12 months, and by disease or disorder

	Percent Operations					
	Disease/Disorder					
	Respiratory		Diarrhea*		Other	
Primary Antibiotic Used	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Aminocyclitol	0.4	(0.2)	0.0	(--)	0.0	(--)
Aminoglycoside	0.0	(--)	0.2	(0.1)	0.0	(--)
Noncephalosporin beta-lactam	7.8	(1.6)	1.6	(0.8)	3.3	(1.1)
Cephalosporin	4.5	(1.3)	0.7	(0.2)	0.2	(0.2)
Florfenicol	12.4	(1.7)	0.4	(0.2)	0.0	(--)
Macrolide	8.0	(1.2)	0.2	(0.2)	0.2	(0.2)
Sulfonamide	1.5	(0.5)	0.4	(0.1)	0.2	(0.1)
Tetracycline	11.0	(1.7)	1.4	(0.5)	1.9	(0.6)
Other	3.6	(1.1)	2.5	(0.7)	0.4	(0.2)
Any antibiotic	49.2	(2.9)	7.4	(1.3)	6.2	(1.3)
No treatment but disease	5.1	(1.4)	4.2	(1.1)	4.7	(1.5)
No disease	45.7	(2.9)	88.4	(1.6)	89.1	(1.9)
Total	100.0		100.0		100.0	

*Or other digestive problem.

NOTE: To determine the percentage of treated weaned heifers, the primary antibiotic used by the operation to treat a specific disease or disorder was applied to all treated heifers on the operation.

The majority of weaned heifers treated for respiratory disease were on operations that primarily treated respiratory disease with florfenicol, tetracycline, and macrolides.

Tetracycline was the primary antibiotic used on operations to treat more than 50 percent of weaned heifers with diarrhea or "other" diseases (55.1 and 67.0 percent, respectively).

f. For weaned heifers treated with antibiotics during the previous 12 months, percentage of weaned heifers by primary antibiotic used on the operation for the following diseases/disorders

	Percent Treated Weaned Heifers					
	Disease/Disorder					
	Respiratory		Diarrhea*		Other	
Primary Antibiotic Used	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Aminocyclitol	2.8	(2.5)	0.0	(--)	0.0	(--)
Aminoglycoside	0.0	(--)	0.0	(--)	0.0	(--)
Noncephalosporin beta-lactam	3.4	(0.8)	3.9	(2.8)	24.1	(14.2)
Cephalosporin	9.8	(2.8)	3.2	(2.3)	0.9	(0.9)
Florfenicol	30.3	(4.9)	10.0	(8.3)	0.0	(--)
Macrolide	15.6	(3.2)	0.2	(0.2)	0.5	(0.4)
Sulfonamide	4.1	(1.7)	2.0	(1.2)	1.7	(1.4)
Tetracycline	25.0	(4.7)	55.1	(22.2)	67.0	(16.2)
Other	9.0	(3.5)	25.6	(15.1)	5.8	(4.1)
Total	100.0		100.0		100.0	

*Or other digestive problem.

J. Mortality and Carcass Disposal

Note: Estimates in the following tables represent operations with any dairy cows.

1. Mortality

Compared with small operations, large operations had a lower percentage of preweaned heifer deaths; 7.8 percent of preweaned heifers and 1.8 percent of weaned heifers died in 2006.

Percentage of preweaned heifers and weaned heifers that died during 2006, by herd size

	Percent							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Preweaned heifers[1]	8.3	(0.4)	9.1	(0.4)	6.5	(0.4)	7.8	(0.2)
Weaned heifers[2]	1.5	(0.1)	2.0	(0.1)	1.8	(0.1)	1.8	(0.1)

[1]As a percentage of heifers born during 2006 and alive at 48 hours.
[2]As a percentage of January 1, 2007, heifer inventory (weaning age to calving).

2. Necropsy

Determining the cause of death is important in preventing future deaths and improving the health of the herd. A relatively small percentage of operations performed necropsies on preweaned heifers or weaned heifers (8.0 and 7.1, respectively) in order to determine cause of death. The percentage of operations that performed necropsies increased as herd size increased.

a. For operations that had at least one death in the following cattle classes, percentage of operations that performed necropsies to determine the cause of death, by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Preweaned heifers	4.4	(0.9)	11.9	(1.4)	22.6	(2.5)	8.0	(0.7)
Weaned heifers	5.8	(1.4)	6.9	(1.2)	13.5	(2.1)	7.1	(0.9)

Necropsies were performed for 3.5 percent of preweaned heifer deaths and 4.1 percent of weaned heifer deaths.

b. For operations that had at least one death in the following cattle classes, percentage deaths in which necropsies were performed to determine cause of death, by herd size

	Percent Deaths Necropsied							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Cattle Class	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Preweaned heifers	1.8	(0.4)	4.7	(1.1)	3.8	(0.5)	3.5	(0.4)
Weaned heifers	3.9	(1.0)	4.8	(1.5)	3.7	(0.7)	4.1	(0.6)

3. Cause of death

Scours, diarrhea, or other digestive problems accounted for the highest percentage of preweaned heifer deaths (56.5 percent), followed by respiratory problems (22.5 percent). For weaned heifers, respiratory disease was the single largest cause of death (46.5 percent). Unknown reasons, lameness or injury, and scours, diarrhea, or other digestive problems each accounted for between 12 and 15 percent of weaned heifer deaths.

Percentage of preweaned heifer deaths and weaned heifer deaths, by producer-attributed cause

	Percent Deaths			
	Preweaned Heifers		Weaned Heifers	
Producer-Attributed Cause	Percent	Std. Error	Percent	Std. Error
Scours, diarrhea, or other digestive problem	56.5	(1.3)	12.6	(1.0)
Respiratory problem	22.5	(0.9)	46.5	(1.7)
Poison	0.0	(0.0)	1.9	(0.9)
Lameness or injury	1.7	(0.3)	12.8	(1.0)
Lack of coordination, severe depression, or other CNS problem	0.3	(0.1)	0.7	(0.2)
Calving problem	5.3	(0.7)	NA	
Joint or navel problem	1.6	(0.3)	1.0	(0.3)
Other known reason	4.3	(0.7)	9.9	(1.0)
Unknown reason	7.8	(0.9)	14.6	(1.2)
Total	100.0		100.0	

4. Carcass disposal

Rendering and burial were the two most common methods of disposing of dead calves (36.5 and 32.6 percent of operations, respectively). Burial as a disposal method decreased as herd size increased. Conversely, rendering increased as herd size increased. Almost two of three large operations (65.4 percent) disposed of dead calves by rendering. Composting calf carcasses was more common on medium operations (29.5 percent) than on large operations (21.8 percent).

Percentage of operations by primary method used to dispose of dead calves, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100-499)		**Large** (500 or More)		**All Operations**	
Disposal Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Buried	36.5	(1.7)	25.5	(1.9)	7.8	(1.2)	32.6	(1.3)
Burned/ incinerated	2.5	(0.6)	0.8	(0.3)	0.3	(0.1)	2.0	(0.4)
Rendered	33.5	(1.7)	39.6	(2.2)	65.4	(2.2)	36.5	(1.3)
Composted	22.8	(1.5)	29.5	(1.9)	21.8	(1.8)	24.2	(1.2)
Landfill	1.6	(0.4)	2.2	(0.5)	1.4	(0.5)	1.7	(0.3)
Other	3.1	(0.6)	2.4	(0.7)	3.3	(1.1)	3.0	(0.5)
Total	100.0		100.0		100.0		100.0	

Section II: Methodology

A. Needs Assessment

NAHMS develops study objectives by exploring existing literature and contacting industry members and other stakeholders about their informational needs and priorities during a needs assessment phase. The objective of the needs assessment for the NAHMS Dairy 2007 study was to collect information from U.S. dairy producers and other dairy specialists about what they perceived to be the most important dairy health and productivity issues. A driving force of the needs assessment was the desire of NAHMS researchers to receive as much input as possible from a variety of producers, industry experts and representatives, veterinarians, extension specialists, universities, and dairy organizations. Information was collected via focus groups and through a Needs Assessment Survey.

Focus group teleconferences and meetings were held to help determine the focus of the study:

Teleconference, March 30, 2006
National Johne's Working Group

Meeting, Louisville, KY, April 2, 2006
National Johne's Working Group
National Institute for Animal Agriculture

Meeting, Louisville, KY, April 3, 2006
National Milk Producers Federation
Animal Health Committee

Teleconference, December 15, 2006
Bovine Alliance on Management and Nutrition

In addition, a Needs Assessment Survey was designed to ascertain the top-three management issues, diseases/disorders, and producer incentives from producers, veterinarians, extension personnel, university researchers, and allied industry groups. The survey, created in SurveyMonkey, was available online from early February through late April 2006.The survey was promoted via electronic newsletters, magazines, and Web sites. Organizations/magazines promoting the study included Vance Publishing's "Dairy Herd Management–Dairy Alert," "Dairy Today," "Hoard's Dairyman," NMC, "Journal of the American Veterinary Medical Association," and the American Association of Bovine Practitioners. E-mail messages requesting input were also sent to cooperative members of the National Milk Producers Federation as well as State and Federal personnel. A total of 313 people completed the questionnaire.

Respondents to the Needs Assessment Survey represented the following affiliations:

- University/extension personnel—23 percent of respondents
- Producers—22 percent
- Veterinarians/consultants—20 percent
- Federal or State government personnel—15 percent
- Nutritionists—8 percent
- Allied industry personnel—8 percent
- Other—4 percent

Fort Collins, CO, May 18, 2006
CEAH Focus Group meeting

Draft objectives for the Dairy 2007 study, based on input from teleconferences, face-to-face meetings, and the online survey, were developed prior to the focus group meeting. Attendees included producers, university/extension personnel, veterinarians, and government personnel. The day-long meeting culminated in the formulation of eight objectives for the study:

1. Describe trends in dairy cattle health and management practices.
2. Evaluate management factors related to cow comfort and removal rates.
3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease-prevention practices.
4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVD).
5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens.
6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis* (Johne's disease).
7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices.
8. Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns.

B. Sampling and Estimation

1. State selection

The preliminary selection of States to be included in the study was done in February 2006, using the National Agricultural Statistics Service (NASS) January 27, 2006, "Cattle Report." A goal for NAHMS national studies is to include States that account for at least 70 percent of the animals and producer population in the United States. The initial review identified 16 major States representing 82.0 percent of the milk cow inventory and 79.3 percent of the operations with milk cows (dairy herds) on January 1, 2006. The States were California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Washington, and Wisconsin.

A memo identifying these 16 States was provided in March 2006 to the USDA:APHIS:VS:CEAH Director and, in turn, the VS Regional Directors. Each Regional Director sought input from the respective States about being included in or excluded from the study. Virginia expressed interest in participating and was included, bringing the total number of States to 17.

2. Operation selection

The list sampling frame was provided by NASS. Within each State a stratified random sample was selected. The size indicator was the number of milk cows for each operation. NASS selected a sample of dairy producers in each State for making the January 1 cattle estimates. The list sample from the January 2006 survey was used as the screening sample. Among those producers reporting 1 or more milk cows on January 1, 2006, a total of 3,554 operations were selected in the sample for contact in January 2007 during Phase I. Operations with 30 or more dairy cows that had participated in Phase I were invited to participate in data collection for Phase II. A total of 1,077 operations agreed to be contacted by veterinary medical officers to determine whether to complete Phase II.

3. Animal selection for IgG sampling

Operations that participated in Phase II of Dairy 2007 were given the opportunity to test newborn heifer calves for serum IgG and total protein levels. A maximum of 10 calves were tested from each operation. Instructions stated that to be considered for testing, calves should be 1 to 7 days of age, healthy, and should have received colostrum. For each calf tested, information was recorded about the calf's age, the quantity of colostrum the calf received at first feeding, and the method by which colostrum had been administered. A total of 2,030 serum samples were collected from 413 operations in 17 States. Serum samples were shipped on ice to the National Veterinary Services Laboratories, where IgG levels were determined by radial immunodiffusion (RID), and serum total protein was determined using a VITROS chemistry system.

Testing methods

Blood samples were received in serum separator tubes and centrifuged to separate the serum. Sample tubes were stored refrigerated at 4°C for up to 5 days and then stored at -20°C until tested. All serum samples were tested over a period of 16 days using a commercially available RID kit (Bovine IgG SRID Kit - Range 400 to 3,200 mg/dL, VMRD, Pullman, WA). The kit has an IgG detection range of 400 to 3,200 mg/dL (4 to 32 mg/mL). Briefly, 3 µl of each of 4 reference standards was placed into the first four wells of a plate from each kit. For each sample tested, 3 µl of serum was placed into a well of one plate from the kit. The plates were covered and left at room temperature for 18 to 21 hours. Subsequently, the diameters of the rings (in mm) were read using a Finescale comparator and a standard curve established. The IgG concentration of each sample was determined by finding the point on the standard curve that corresponded to the sample's ring diameter and then determining the immunoglobulin concentration that coordinated with that point. Samples with diameters that were too small to read were classified as < 4 mg/mL and those with too large of diameters were classified as > 32 mg/mL.

4. Population inferences

a. Phase I: General Dairy Management Report
Inferences cover the population of dairy producers with at least 1 milk cow in the 17 participating States. As of January 1, 2007, these States accounted for 82.5 percent (7,536,000 head) of milk cows and 79.5 percent (59,640) of operations with milk cows in the United States. (See Appendix IV for respective data on individual States.) All respondent data were statistically weighted to reflect the population from which they were selected. The inverse of the probability of selection for each operation was the initial selection weight. This selection weight was adjusted for nonresponse within each State and size group to allow for inferences back to the original population from which the sample was selected.

b. Phase II: VS Initial and Second Visits
For operations eligible for Phase II data collection (those with 30 or more dairy cows), weights were adjusted to account for operations that did not want to continue to Phase II. In addition, weights were adjusted for nonresponse to the questionnaire in each visit. The 17-State target population of operations with 30 or more dairy cows represented 82.5 percent of dairy cows and 84.7 percent of dairy operations (Appendix IV).

C. Data Collection

1. Phase I: General Dairy Management Report
From January 1 to 31, 2007, NASS enumerators administered the General Dairy Management Report questionnaire. The interview took slightly more than 1 hour.

2. Phase II: VS Initial Visit
From February 26 to April 30, 2007, Federal and State veterinary medical officers and/or animal health technicians collected data from producers during an interview that lasted approximately 2 hours.

3. Phase II: VS Second Visit
From May 1 to August 31, 2007, Federal and State veterinary medical officers and/or animal health technicians collected data from producers during an interview that lasted approximately 2 hours.

D. Data Analysis

Validation

a. Phase I: Validation—General Dairy Management Report
Initial data entry and validation for the General Dairy Management Report were performed in individual NASS State offices. Data were entered into a SAS data set. NAHMS national staff performed additional data validation on the entire data set after data from all States were combined.

b. Phase II: Validation—VS Initial and Second Visit Questionnaires
After completing the VS Initial and Second Visit questionnaires, data collectors sent them to their respective State NAHMS Coordinators, who reviewed the questionnaire responses for accuracy and sent them to NAHMS. Data entry and validation were completed by NAHMS staff using SAS.

E. Sample Evaluation

The purpose of this section is to provide various performance measurement parameters. Historically, the term “response rate” has been used as a catchall parameter, but there are many ways to define and calculate response rates. Therefore, the following tables present an evaluation based upon a number of measurement parameters, which are defined with an “x” in categories that contribute to the measurement.

1. Phase I: General Dairy Management Report
A total of 3,554 operations were selected for the survey. Of these operations, 3,304 (93.0 percent) were contacted. There were 2,519 operations that provided usable inventory information (70.9 percent of the total selected and 76.2 percent of those contacted). In addition, there were 2,194 operations (61.7 percent) that provided “complete” information for the questionnaire. Of operations that provided complete information and were eligible to participate in Phase II of the study (2,067 operations), 1,077 (52.1 percent) consented to be contacted for consideration/discussion about further participation.

Responses for Phase I: General Dairy Management Report (GDMR)

			Measurement Parameter		
Response Category	**Number Operations**	**Percent Operations**	**Contacts**	**Usable[1]**	**Complete[2]**
Survey complete and VMO consent	1,077	30.3	x	x	x
Survey complete, refused VMO consent	990	27.9	x	x	x
Survey complete, ineligible[3] for VMO	127	3.6	x	x	x
No dairy cows on January 1, 2007	214	6.0	x	x	
Out of business	111	3.1	x	x	
Out of scope	6	0.2			
Refusal of GDMR	785	22.1	x		
Office hold (NASS elected not to contact)	126	3.5			
Inaccessible	118	3.3			
Total	3,554	100.0	3,304	2,519	2,194
Percent of total operations			93.0	70.9	61.7
Percent of total operations weighted[4]			94.0	74.1	59.6

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—fewer than 30 head of milk cows on January 1, 2007.
[4]Weighted response—the rate was calculated using the initial selection weights.

2. Phase II: VS Initial Visit

There were 1,077 operations that agreed to be contacted by a veterinary medical officer during Phase I. Of these 1,077 operations, 582 (54.0 percent) agreed to continue in Phase II of the study and completed the VS Initial Visit questionnaire; 380 (35.3 percent) refused to participate. Approximately 10 percent of the 1,077 operations were not contacted, and 0.4 percent were ineligible because they had no dairy cows at the time they were contacted.

Responses for Phase II: VS Initial Visit

			Measurement Parameter		
Response Category	**Number Operations**	**Percent Operations**	**Contacts**	**Usable[1]**	**Complete[2]**
Survey complete	582	54.0	x	x	x
Survey refused	380	35.3	x		
Not contacted	111	10.3			
Ineligible[3]	4	0.4	x	x	
Total	1,077	100.0	966	586	582
Percent of total operations			89.7	54.4	54.0
Percent of total operations weighted[4]			87.5	50.8	50.4

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—no dairy cows at time of interview, which occurred from February 26 through April 30, 2007
[4]Weighted response—the rate was calculated using the turnover weights.

3. Phase II: VS Second Visit

Of the 582 operations that completed the VS Initial Visit Questionnaire, 519 (including one operation that completed the initial visit after the deadline) completed the VS Second Visit questionnaire; 47 operations (8.1 percent) refused to participate. Approximately 3 percent of the 583 operations were not contacted, and 0.3 percent were ineligible because they had no dairy cows at the time of the VS Second Visit.

Responses for Phase II: VS Second Visit

			Measurement Parameter		
Response Category	**Number Operations**	**Percent Operations**	**Contacts**	**Usable[1]**	**Complete[2]**
Survey complete	519	89.0	x	x	x
Survey refused	47	8.1	x		
Not contacted	15	2.6			
Ineligible[3]	2	0.3	x	x	
Total	583	100.0	568	521	519
Percent of total operations			97.4	89.4	89.0
Percent of total operations weighted[4]			98.1	90.6	90.3

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—no dairy cows at time of interview, which occurred from May 1 through August 31, 2007.
[4]Weighted response—the rate was calculated using the turnover weights.

Appendix I: Sample Profile

Responding Operations

a. Number of responding operations by herd size

Herd Size (Number of Cows)	**Phase I: General Dairy Management Report**	**Phase II: VS Initial Visit**	**Phase II: VS Second Visit**
Fewer than 100	1,028	233	211
100 to 499	691	215	188
500 or more	475	134	120
Total	2,194	582	519

b. Number of responding operations by region

Region	**Phase I: General Dairy Management Report**	**Phase II: VS Initial Visit**	**Phase II: VS Second Visit**
West	426	108	93
East	1,768	474	426
Total	2,194	582	519

Appendix II: Sample Profile for Passive Transfer Status and Growth

1. Number of calves sampled for IgG testing by age

For the IgG and total protein population estimates, calves fewer than 1 day old or older than 7 days at the time of blood collection were excluded. In addition, calves were excluded if they were ill at the time of testing, were bull calves, or had received a colostrum replacer product. A total of 214 samples were excluded for these reasons.

Number and percentage of heifer calves by age (days) when blood was collected for IgG testing

Age (Days)	Number Calves	Percent Calves
Less than 1	51	2.5
1	275	13.5
2	347	17.1
3	272	13.4
4	253	12.5
5	258	12.7
6	237	11.7
7	263	12.9
Greater than 7	60	3.0
Age not recorded	14	0.7
Total	2,030	100.0

2. Number of calves sampled for IgG testing by season

Most calves were tested in the spring or summer.

Number and percentage of heifer calves by season in which blood was collected for IgG testing

Season	Number Calves	Percent Calves
Winter (February, March)	243	12.0
Spring (April, May)	854	42.1
Summer (June, July, August)	933	45.9
Total	2,030	100.0

3. Number of preweaned heifer calves measured for growth, by age and breed

Number and percentage of preweaned heifer calves measured for growth, by age and breed

	Breed						
Age (Days)	**Holstein**	**Jersey**	**Guernsey**	**Brown Swiss**	**Other**	**Holstein/ Jersey Cross**	**Total Calves**
Less than 7	751	33	3	5	26	11	829
7 to 13	481	33	2	10	26	8	560
14 to 20	404	26	1	5	21	5	462
21 to 27	316	24	0	8	16	8	372
28 to 34	393	20	2	3	22	7	447
35 to 41	443	33	1	9	20	12	518
42 to 48	349	28	4	8	16	13	418
49 to 55	324	27	3	5	13	7	379
56 to 62	301	15	1	2	10	7	336
63 to 69	278	18	2	4	10	9	321
70 to 76	202	18	1	1	7	9	238
77 to 83	202	12	0	3	9	9	235
84 to 90	112	12	0	2	3	10	139
More than 90	111	4	0	4	5	3	127
Total	4,667	303	20	69	204	118	5,381
Percentage	86.7	5.6	0.4	1.3	3.8	2.2	100.0

Appendix III: Antibiotic/ Antimicrobial Class

Antibiotic/ Antimicrobial Class	Product Name	Active Ingredient
Aminocyclitol	Adspec®	Spectinomycin
Aminoglycoside	AmTech Neomycin Oral Solution	Neomycin
	Biosol® Liquid	Neomycin sulfate
	Gentamicin	Gentamicin
	Neomix Ag® 325 Soluble Powder	Neomycin sulfate
	Neomix® 325 Soluble Powder	Neomycin sulfate
	Neomycin 325 Soluble Powder	Neomycin sulfate
	Neomycin Oral Solution	Neomycin sulfate
	Neo-Sol 50	Neomycin sulfate
	Strep Sol 25%	Streptomycin sulfate
	Streptomycin Oral Solution	Streptomycin
Noncephalosporin beta-lactam	Agri-Cillin™	Penicillin G procaine
	Amoxi-Bol®	Amoxicillin
	Amoxi-Inject ®	Amoxicillin
	Amoxi-Mast® Intramammary Infusion	Amoxicillin
	Aquacillin™	Penicillin G procaine
	Aqua-Mast Intramammary Infusion	Penicillin G (procaine)
	Combi-Pen™-48	Penicillin G (benzathine)
	Crysticillin 300 AS Vet.	Penicillin G procaine
	Dariclox® Intramammary Infusion	Cloxacillin (sodium)
	Duo-Pen®	Penicillin G benzathine; procaine
	Durapen™	Penicillin G benzathine; procaine
	Hanford's/US Vet Masti-Clear Intramammary Infusion	Penicillin G (procaine)
	Hanford's/US Vet/Han-Pen G/Ultrapen	Penicillin G Procaine
	Hanford's/US Vet/Han-Pen-B/Ultrapen B	Penicillin G (benzathine)
	Hetacin®K Intramammary Infusion	Hetacillin (potassium)
	Microcillin	Penicillin G procaine
	Pen-G Max™	Penicillin G (procaine)
	Penicillin G Procaine	Penicillin G procaine
	PFI-Pen G®	Penicillin G procaine
	Polyflex®	Ampicillin
	Princillin Bolus	Ampicillin trihydrate
	Pro-Pen-G™ Injection	Penicillin G procaine

Antibiotic/ Antimicrobial Class	Product Name	Active Ingredient
Cephalosporin	Cefa-Lak®/Today Intramammary Infusion	Cephapirin (sodium)
	Excede™ Sterile Suspension	Ceftiofur crystalline free acid
	Excenel® RTU	Ceftiofur hydrochloride
	Naxcel®	Ceftiofur sodium
	Spectramast™ LC Intramammary Infusion	Ceftiofur
	ToDAY® Intramammary Infusion	Cephapirin (sodium)
Florfenicol	Nuflor Injectable Solution	Florfenicol
Lincosamide	Pirsue® Intramammary Infusion	Pirlimycin
Macrolide	Draxxin™	Tulathromycin
	Gallimycin®-100 Injection	Erythromycin
	Gallimycin®-36 Intramammary Infusion	Erythromycin
	Micotil® 300 Injection	Tilmicosin phosphate
	Tylan Injection 50/200 Tylosin Injection	Tylosin
Other	AS700	Chlortetracycline/sulfamethazine
	CORID 20% Soluble Powder	Amprolium
	CORID 9.6% Oral Solution	Amprolium
	Deccox-M	Decoquinate
	Linco-Spectin® Sterile Solution	Lincomycin/Spectinomycin
	TMZ	Trimethoprim sulfamethoxazole
Sulfonamide	20% SQX Solution	Sulfaquinoxaline
	Albon® Bolus	Sulfadimethoxine
	Albon® Concentrated Sol.12.5%	Sulfadimethoxine
	Albon® Injection 40%	Sulfadimethoxine
	Albon® SR Bolus	Sulfadimethoxine
	Di-Methox & 12.5% Oral Solution	Sulfadimethoxine
	Di-Methox Injection 40%	Sulfadimethoxine
	Di-Methox Soluble Powder	Sulfadimethoxine
	Liquid Sul-Q-Nox	Sulfaquinoxaline (sodium)
	SDM Injection	Sulfadimethoxine
	SDM Injection 40%	Sulfadimethoxine
	SDM Solution	Sulfadimethoxine
	Sulfadimethoxine 12.5% Oral Solution	Sulfadimethoxine
	Sulfadimethoxine Inj. 40%	Sulfadimethoxine
	Sulfadimethoxine Soluble Powder	Sulfadimethoxine
	Sulfa-Nox Concentrate	Sulfaquinoxaline
	Sulfa-Nox Liquid	Sulfaquinoxaline (sodium)
	Sulfaquinoxaline Sodium Solution 20%	Sulfaquinoxaline (sodium)
	SulfaSure™ SR Cattle/Calf Bolus	Sulfamethazine
	Sulmet® Drinking Water Solution 12.5%	Sulfamethazine (sodium)
	Sulmet® Oblets®	Sulfamethazine
	Sulmet® Soluble Powder	Sulfamethazine (sodium)
	Sustain III® Cattle Bolus	Sulfamethazine
	Vetisulid Injection	Sulfachlorpyridazine (sodium)
	Vetisulid Powder	Sulfachlorpyridazine (sodium)

Antibiotic/ Antimicrobial Class	Product Name	Active Ingredient
Tetracycline	Agrimycin™ 100	Oxytetracycline hydrochloride
	Agrimycin™ 200	Oxytetracycline hydrochloride
	AmTech Oxytetracycline HCL Solution Powder - 343	Oxytetracycline
	Aureomycin® Soluble Powder	Chlortetracycline hydrochloride
	Aureomycin® Soluble Powder Concentrate	Chlortetracycline hydrochloride
	Bio-Mycin® 200	Oxytetracycline
	Bio-Mycin® C	Oxytetracycline hydrochloride
	CLTC 100 MR	Chlortetracycline calcium
	Duramycin-100	Oxytetracycline hydrochloride
	Duramycin-200	Oxytetracycline hydrochloride
	Liquamycin® LA-200®	Oxytetracycline
	Maxim-200®	Oxytetracycline
	Maxim™-100	Oxytetracycline hydrochloride
	Oxy 500 and 1000 Calf Bolus	Oxytetracycline hydrochloride
	Oxybiotic™ 200	Oxytetracycline
	Oxycure™ 100	Oxytetracycline hydrochloride
	Oxy-Mycin™ 100	Oxytetracycline hydrochloride
	Oxy-Mycin™ 200	Oxytetracycline hydrochloride
	Oxytetracycline HCL Soluble Powder	Oxytetracycline hydrochloride
	Oxytetracycline HCL Soluble Powder 343	Oxytetracycline hydrochloride
	Panmycin® 500 Bolus	Tetracycline hydrochloride
	Pennchlor™ 64 Soluble Powder	Chlortetracycline hydrochloride
	Pennox™ 200 Injectable	Oxytetracycline
	Pennox™ 343 Soluble Powder	Oxytetracycline hydrochloride
	Polyotic® Soluble Powder	Tetracycline hydrochloride
	Promycin™ 100	Oxytetracycline hydrochloride
	Solu/Tet Soluble Powder	Tetracycline hydrochloride
	Terramycin® 343 Soluble Powder	Oxytetracycline hydrochloride
	Terramycin® Scours Tablets	Oxytetracycline hydrochloride
	Terramycin® Soluble Powder	Oxytetracycline hydrochloride
	Terra-Vet 100	Oxytetracycline hydrochloride
	Tet-324	Tetracycline hydrochloride
	Tetra-Bac 324	Tetracycline hydrochloride
	Tetracycline HCL Soluble Powder-324	Tetracycline hydrochloride
	Tetradure™ 300	Oxytetracycline
	Tetrasol Soluble Powder	Tetracycline hydrochloride
	Tet-Sol™ 324	Tetracycline hydrochloride

Appendix IV: U.S. Milk Cow Population and Operations

Number of milk cows on January 1, 2007*

		Number of Milk Cows, January 1, 2007 (Thousand Head)		Number of Operations 2006		Average Herd Size	
Region	State	Milk Cows on Operations with 1 or More Head	Milk Cows on Operations with 30 or More Head	Operations with 1 or More Head	Operations with 30 or More Head	Operations with 1 or More head	Operations with 30 or More Head
West	California	1,790	1,788.2	2,200	1,920	813.6	931.4
	Idaho	502	501.0	800	620	627.5	808.1
	New Mexico	360	358.9	450	180	800.0	1,993.9
	Texas	347	344.2	1,300	660	266.9	521.5
	Washington	235	234.3	790	540	297.5	433.9
	Total	3,234	3,226.6	5,540	3,920	583.8	823.1
East	Indiana	166	154.4	2,100	1,150	79.0	134.3
	Iowa	210	203.7	2,400	1,870	87.5	108.9
	Kentucky	93	86.5	2,000	1,180	46.5	73.3
	Michigan	327	320.5	2,700	1,910	121.1	167.8
	Minnesota	455	441.3	5,400	4,800	84.3	91.9
	Missouri	114	108.3	2,600	1,400	43.8	77.4
	New York	628	612.3	6,400	5,100	98.1	120.1
	Ohio	274	252.1	4,300	2,400	63.7	105.0
	Pennsylvania	550	536.3	8,700	7,000	63.2	76.6
	Vermont	140	137.2	1,300	1,100	107.7	124.7
	Virginia	100	97.0	1,300	820	76.9	118.3
	Wisconsin	1,245	1,213.9	14,900	12,800	83.6	94.8
	Total	4,302	4,163.5	54,100	41,530	79.5	100.3
Total (17 States)		7,536	7,390.1	59,640	45,450	126.4	162.6
Percent of U.S.		82.5	82.5	79.5	84.7		
Total U.S. (50 States)		9,132.0	8,958.5	74,980	53,680	121.8	166.9

*Source: NASS Cattle report, February 1, 2008, and NASS Farms, Land in Farms, and Livestock Operations 2007 Summary report, February 1, 2008. An operation is any place having one or more head of milk cows, excluding cows used to nurse calves, on hand at any time during the year.

Appendix V: Study Objectives and Related Outputs

1. Describe trends in dairy cattle health and management practices
- Part II: Changes in the U.S. Dairy Cattle Industry, 1991–2007, March 2008
- Part V: Changes in Dairy Cattle Health and Management in the United States, 1996–2007, June 2009

2. Evaluate management factors related to cow comfort and removal rates
- Part VI: Dairy Facilities and Cow Comfort on U.S. Dairy Operations, 2007, Interpretive Report, expected spring 2010

3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices
- Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
- Off-Site Heifer Raising on U.S. Dairy Operations, 2007, info sheet, November 2007
- Colostrum Feeding and Management on U.S. Dairy Operations, 1991–2007, info sheet, March 2008
- Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, February 2009
- Calving Intervention on U.S. Dairy Operations, 2007, info sheet, February 2009
- **Heifer Calf Health and Management Practices on U.S. Dairy Operations, 2007, Interpretive Report, January 2010**
- Passive Transfer in Dairy Heifer Calves, 1991–2007, info sheet, December 2009

4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVDV)
- Bovine Viral Diarrhea (BVD) Management Practices and Detection in Bulk Tank Milk in the United States, 2007, info sheet, October 2008

5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens
- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
- Milking Procedures on U.S. Dairy Operations, 2007, info sheet, October 2008
- Prevalence of Contagious Mastitis Pathogens on U.S. Dairy Operations, 2007, info sheet, October 2008

6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis*
- Johne's Disease on U.S. Dairies, 1991–2007 info sheet, April 2008

7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices
- Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007

- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
- Biosecurity Practices on U.S. Dairy operations, 1991–2007, Interpretive Report, expected winter 2009–10

8. Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns

- Antibiotic Use on U.S. Dairy Operations, 2002 and 2007, info sheet, September 2008
- Prevalence of *Listeria* and *Salmonella* in Bulk Tank Milk and In-line Filters on U.S. Dairies, 2007, info sheet, July 2009
- *Salmonella* and *Campylobacter* on U.S. Dairy Operations, 2002–07, info sheet, July 2009
- Food Safety Pathogens Isolated from U.S. Dairy Operations, 2007, Interpretive Report, expected spring 2010
- Prevalence of *Coxiella burnetti* on U.S. Dairy Operations, 2007, info sheet, expected spring 2010

Additional information sheets

- Dairy Cattle Identification Practices in the United States, 2007, info sheet, November 2007
- Bovine Leukosis Virus (BLV) on U.S. Dairy Operations, 2007, info sheet, September 2008
- Reproduction Practices on U.S. Dairy Operations, 2007, info sheet, February 2009
- Injection Practices on U.S. Dairy Operations, 2007, info sheet, February 2009
- Methicillin-Resistant *Staphylococcus aureus* (MRSA) Isolation from Bulk Tank Milk in the United States, 2007, info sheet, expected spring 2010

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Dairy 2007

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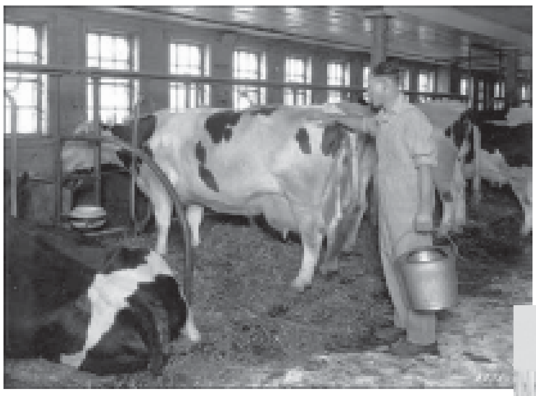

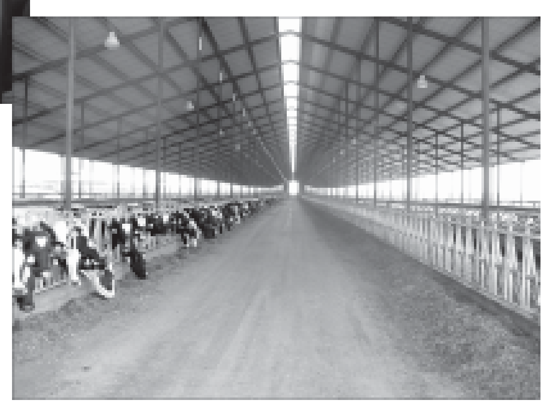

USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
(970) 494-7000
Email: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Photograph of cattle in tie-stall facility courtesy of Jeffrey Hoffelt.
Other photographs courtesy of Dr. Jason Lombard.

Items of Note

More than four of five dairy cows in the United States were raised on conventional dairy operations in which the majority of forage was harvested and delivered to the cows. About one of three operations was a combination of conventional and grazing operations types.

During the last 50 years, housing types on U.S. dairies have changed from predominantly stanchion facilities to tie stalls, freestalls, and dry lots. In 2007, almost three of four lactating cows were housed in freestall or dry lot/ multiple-animal areas, and these cows were milked in parlor facilities. The more modern housing types allow cows more freedom of movement compared with the traditional tie-stall and stanchion facilities. Data from the Dairy 2007 study indicate that freestall housing provided an environment that promoted improved hygiene and reduced hock injuries; however, freestall facilities had the highest percentage of cows with lameness compared with other housing types. Unless allowed access to dry lots or pasture, cows in freestall housing were typically on concrete flooring, which may have contributed to the increased lameness reported.

On tie-stall and stanchion operations, cows have their own stall where they eat, drink, and rest, so space allotment in square footage per cow, cows per stall, feedbunk space, and cows per headlock is not applicable. In freestall housing, all cows are not typically doing the same activity, so it is not necessary to have the same amount of stalls, bunk space, or headlocks, if present, for all the cows in the pen.

Freestall features

The type of freestall barn impacts the ratio of stalls to feed bunk space or, if present, headlocks. Two- and four-row barns provide more feed bunk space and square footage per cow than three- or six-row barns. More than 6 of 10 freestall barns were two- or four-row barns. Research indicates that having up to 10 percent more cows than stalls in a pen (1.1 cows per stall) does not affect the cows' behavior. At the time of the Dairy 2007 assessment, about 7 of 10 freestall operations had less than 1.1 cows per stall. However, when these operations were at maximum cow numbers, only 5 of 10 had less than 1.1 cows per stall. On freestall operations with headlocks, about one-third of operations had less than one cow per headlock at the time of the assessment, and when at maximum cow numbers, about one of six operations had less than one cow per headlock.

Stall management

Stall management is important in providing a clean, comfortable place for cows to lie down. One of the most important aspects of stall management involves the stall base (floor upon which bedding is added) and bedding. Typical stall bases are composed of concrete, dirt, rubber mats, and mattresses. Straw, sawdust, sand, or combinations of the three were the most common bedding types for all housing types.

Stall base, bedding type, and management differed by housing type. Tie-stall and stanchion operations primarily used concrete, rubber mats, and mattresses as stall bases. In general, tie-stall and stanchion operations used straw or sawdust as bedding and changed or added bedding every 1 to 2 days. At the time of the Dairy 2007 assessment, the stall base was exposed—not covered by bedding—on about three of four operations with tie-stall and stanchion housing.

For operations with freestall and other multiple-animal area housing (including dry lots), the most commonly used stall bases were concrete, dirt, and mattresses. The most common bedding used on these operations were straw, sawdust, sand and, in the case of other multiple-animal areas, none. Bedding on freestall and other multiple-animal area housing was added or changed less frequently than on tie-stall or stanchion housing. However, even though these operations added/changed bedding less frequently than tie-stall or stanchion operations, at the time of the Dairy 2007 assessment the overall bedding quality/stall condition was better in freestall housing because a higher percentage did not have exposed stall bases.

Cow health

Housing type did appear to have an influence on the health of dairy cows. Although freestall and other multiple-animal area housing improve production, hygiene, and reduce hock injuries, health problems still exist in these housing types. While more clinical mastitis, infertility, and displaced abomasums were reported on tie-stall and stanchion operations, a higher percentage of lameness was reported for cows on freestall operations. A lower percentage of cows on stanchion operations were permanently removed compared with cows on tie-stall or freestall operations. Mastitis accounted for a higher percentage of cow deaths on freestall operations and operations with other multiple-animal areas compared with stanchion operations.

Hygiene scoring

Hygiene is important in reducing cows' exposure to pathogens, especially in regard to mastitis and lameness. Features of cow housing generally thought to improve cow hygiene include bedding and bedding management, and the presence of neck rails, brisket locators, gutter grates, and cow trainers.

There were no differences by housing type in the percentages of cows with hygiene scores of 1 (clean). A lower percentage of cows had a hygiene score of 3 (dirty) on freestall operations compared with cows on tie-stall, stanchion, and dry lot operations. The higher percentage of cows with hygiene scores of 3 on tie-stall, stanchion, and dry lot operations might be due to the fact that cows on these operations typically have access to dirt or pasture. Hygiene on freestall operations, in which cows are not allowed on dirt or pasture, is dependent on freestall and alleyway management.

The use of concrete or rubber mats as stall bases was associated with poorer hygiene compared with the use of dirt or mattresses as stall bases. The use of coarse sand or dried or composted manure was associated with better hygiene compared with the use of other bedding types. Deep, well-bedded stalls were also associated with cleaner cows compared with stalls with less bedding. Moveable neck rails were associated with a higher percentage of cows with hygiene scores of 1, but the horizontal distance from the curb or the vertical distance from the bed did not influence cow hygiene. There were no consistent trends in the effect of brisket locators on hygiene scores; operations that used wood locators had a higher percentage of dirty cows compared with the operations that did not use any brisket locators. The use of gutter grates and cow trainers were both associated with improved hygiene

Hock scoring

Hock injuries are generally assumed to be related to the surfaces upon which cows lie. Cows housed in dry lot facilities and other multiple-animal areas where cows lie primarily on dirt had the highest percentage of cows without hair loss or lesions of the hocks (hock score=1). Hock lesions were generally more prevalent in tie-stall and stanchion housing types. Stall bases constructed of concrete, mattresses, and rubber mats were associated with increased hock lesions compared with dirt stall bases. Typical bedding types used in freestalls and facilities that generally do not use bedding (e.g., dry lots) were associated with better hock scores than facilities that bedded primarily with straw or sawdust (e.g., tie-stall and stanchions). Hock scores of 1 increased with the days since bedding was added, which was highly associated with housing type and bedding type. Fewer hock lesions were observed when bedding quantity was good and the stall base was not exposed than when bedding quantity was poor and the stall base was exposed.

Comfort parameters

Four comfort parameters were assessed during the study: perching (standing with the front feet inside the stall), standing (with all feet inside the stall), lying, and the cow comfort index (CCI), which is the proportion of cows in contact with a stall that are lying down. These comfort parameters were evaluated only on freestall operations or operations with other multiple-animal areas that included a combination of freestalls and other housing types, such as dry lots. Since cows spend almost 12 hours a day lying, it is important that they do not spend an inordinate amount of time perching or standing in the stall, although cows entering and leaving stalls are included in these two categories. Bedding type and management and specific stall features such as neck rails, brisket locators, stall length and width, and temperature have been shown to influence these parameters.

Perching

The percentage of cows perching increased when the stall base was completely covered with bedding, regardless of the type of stall base or bedding type. Although perching has been associated with shorter stalls and stalls with restrictive neck rails, neither impacted perching in this assessment. Curb height was associated with perching, as curb heights of 13.0 or more inches resulted in less perching, possibly due to increased proportion of weight being placed on the rear legs. Perching was also increased in summer months compared with spring months, likely due to cows attempting to dissipate heat during the summer.

Standing

Contrary to findings associated with perching, standing in stalls was not associated with bedding quantity but was associated with certain bedding types; a lower percentage of cows were standing in stalls bedded with straw, coarse sand, composted manure or no bedding compared with most other bedding types. Operations without neck rails had the lowest percentage of cows standing compared with operations with neck rails. Stall length did not impact standing. These were unexpected findings, since it was thought that less restrictive stalls (i.e., longer stalls, no neck rail) would lead to more cows standing in the stall.

Lying

A higher percentage of cows lying occurred on operations that used coarse sand as bedding compared with cows on operations that used straw, composted or dried manure, or "other" bedding types. In addition, a higher percentage of cows were lying when bedding had been changed/added within 1 to 2 days of the assessment than when bedding had been changed/added within 7 or more days of the assessment . Other features of bedding and stall management were not associated with the percentage of cows lying. Stall widths of 50 inches or more were associated with increased lying but stall length was not associated with lying. The absence of a neck rail was associated with a lower percentage of cows perching and standing and was also associated with a lower percentage of cows lying. Similarly, the absence of a brisket locator was associated with a lower percentage of cows lying. Curb height was also associated with lying, as curb heights of 13 inches or more were associated with a lower percentage of cows lying. The percentage of cows lying also decreased in summer compared with spring, which was likely due to improved dissipation of heat.

Cow comfort index

The CCI was higher for cows housed in facilities bedded with coarse sand compared with most other bedding types. The CCI was higher when bedding was level with the curb than when bedding was slightly dished out or more than 50 percent of the base was exposed. Season, which was associated with perching and lying, was also associated with the CCI, as a higher CCI was observed during the spring months.

Summary

Components of freestalls designed to keep cows comfortable, clean, and free of injury—such as neck rails and brisket locators—did not have much of an impact on hygiene, hock health, and comfort, which was unexpected. Stall base, bedding type and frequency, and bedding quality/stall condition were important for improving hygiene, hock health, and cow comfort. There also appears to be a trade off in keeping cows clean and keeping hocks healthy, as dry lots generally had dirtier cows but also had cows with much healthier hocks compared with cows housed in stalls. The findings in this report should assist in determining areas for improvement for each housing type, while also providing relevant information that may contribute to the development of new housing systems that provide optimal welfare for dairy cows.

Selected Highlights

The Dairy 2007 study marks the first time that the National Animal Health Monitoring System has studied parameters associated with cow comfort on dairy operations. A few highlights from this report follow.

Almost one-half of operations (49.2 percent) housed lactating cows primarily in a tie-stall/ stanchion facility and nearly one of three operations (32.6 percent) housed cows in freestalls. However, almost 60 percent of cows were housed on freestall operations due to the fact that a high percentage of large operations use freestalls.

Concrete was the predominant flooring type on approximately one-half of operations and for 55.6 percent of cows. Pasture was the predominant flooring type on 10.1 percent of operations and for 5.1 percent of cows. Dirt was the predominant flooring type on 5.4 percent of operations and for 20.0 percent of cows, which likely reflects the use of dry lots on large operations.

Heat abatement methods, including shade, fans, sprinklers, or misters, were provided during the summer months by more than 9 of 10 operations.

The following highlights refer only to operations that completed the facility, cow, and/or comfort assessments (see Section II, p 49).

About 8 of 10 operations used tie stalls or freestalls to house cattle. On average, stanchion barns were constructed in 1949 and were the oldest housing type. Freestall barns and other multiple-animal areas were constructed more recently than tie-stall barns. For all operations, 1976 was the average year of construction for all housing types.

A total of 69.6 percent of freestall operations housed fewer than 1.10 cows per stall at the time of the assessment. By design, tie-stall and stanchion operations housed one cow per stall.

All tie-stall and stanchion operations provided 32 inches or more of bunk space per cow. In contrast, 57.1 percent of freestall operations provided less than the minimum recommended 24 inches of bunk space per cow at the time of the assessment. At maximum cow numbers (i.e., minimum feedbunk space), 67.9 percent of freestall operations provided less than the recommended minimum of 24 inches.

Hygiene scoring was performed on 477 operations. Freestall operations accounted for 282 of these operations and provided the majority (68.3 percent) of all cows scored. Approximately twice as many cows were scored on freestall, dry lot, and other multiple-animal area operations than operations with tie stalls or stanchions. These differences in animals scored among different housing types are directly related to herd size.

There were no differences by housing type in the percentages of cows with hygiene scores of 1 (clean). A lower percentage of cows had a hygiene score of 3 (dirty) on freestall operations (10.0 percent) compared with tie-stall, stanchion, and dry lot operations (16.2, 21.4, and 22.3 percent, respectively).

Bedding type influenced hygiene scores. The lowest percentage of cows with a hygiene score of 3 were on operations that bedded stalls with coarse sand, composted manure, or dried manure (primarily freestall operations). As bedding quantity/stall condition decreased until the stall base was exposed, the percentage of cows with a hygiene score of 3 increased.

Freestall operations with stall lengths of less than 82.0 inches or 96.0 inches or more had a higher percentage of cows with a hygiene score of 1 (61.1 and 54.8 percent, respectively) compared with freestall operations with stall lengths of 86.0 to 91.9 inches (35.7 percent). The width of stalls did not have an impact on hygiene scores. The forward location of the neck rail was not associated with the percentage of cows by hygiene score.

Operations with any gutter grates had a higher percentage of cows assigned a hygiene score of 1 compared with operations without gutter grates. The presence of cow trainers was also associated with cleaner cows; 50.3 percent of cows on operations with trainers had a hygiene score of 1 compared with 37.6 percent of cows on operations without trainers. Almost twice the percentage of cows on operations that did not use trainers had a hygiene score of 3 compared with operations that used trainers (23.6 and 14.1 percent, respectively).

No differences were observed in spring (March–May) and summer (June–September) in the percentage of cows by hygiene score.

Hock scoring was performed on 477 operations; freestall operations accounted for 282 of these operations, providing the majority of all cows scored (67.9 percent). Approximately twice as many cows were scored on freestall, dry lot, and other multiple-animal area operations compared with operations that used tie stalls or stanchions. These differences in animals scored among different housing types are directly related to herd size.

Operations with dry lots and other multiple-animal areas had the highest percentage of cows assigned a hock score of 1 [no hair loss or swelling] (91.1 and 90.8 percent, respectively). Approximately three of four cows on freestall operations (76.8 percent) were assigned a hock score of 1, while tie-stall and stanchion operations had the lowest percentage of cows with a score of 1 (65.7 and 61.9 percent, respectively). Dry-lot operations had a lower percentage of cows with hock scores of 3 (swelling or skin lesion present) compared with tie-stall, stanchion, and freestall operations.

Almost 9 of 10 cows (89.5 percent) on operations that used dirt as a stall base were assigned a hock score of 1. The lowest percentage of cows assigned a hock score of 1 were on operations that used concrete, rubber mats, or mattresses as a stall base (72.8, 65.9, and 60.6 percent, respectively). The lowest percentage of cows assigned a hock score of 3 were on operations that used dirt as a stall base (0.7 percent), while the highest percentage of cows with a score of 3 were on operations that used concrete, rubber mats, or mattresses as a stall base (5.6, 7.2, and 5.0 percent, respectively).

A higher percentage of cows bedded with fine or coarse sand, composted or dried manure, or no bedding (primarily operations with freestalls, dry lots, or other multiple-animal areas) had hock scores of 1 compared with cows bedded with straw or sawdust (primarily tie-stall and stanchion operations). Similarly, a lower percentage of cows bedded in coarse sand and composted manure had hock scores of 3 compared with cows on straw, sawdust, or “other” bedding.

As the number of days since bedding was added increased, the percentage of cows assigned a hock score of 1 increased. The percentage of cows by hock scores was associated with bedding quantity. As bedding quantity decreased until the stall base was mostly exposed, a lower percentage of cows had hock scores of 1. In addition, a higher percentage of cows had hock scores of 1 when no bedding was present than when the stall base was exposed.

The season in which assessments were made (spring or summer) did not impact hock scores.

Comfort parameters were evaluated on 485 operations, and the pens and areas evaluated housed 52,490 cows. The majority of operations (290) and cows (39,014) assessed were on freestall operations. Four comfort parameters were assessed: perching (standing with the front feet inside the stall), standing (with all feet inside the stall), lying, and the cow comfort index (the proportion of cows in contact with a stall that are lying down) [CCI].

The percentages of cows perching were similar across all bedding types. Standing in stalls was observed for a lower percentage of cows when straw, coarse sand, composted manure, or no bedding was used compared with most other bedding types. A higher percentage of cows were lying in stalls bedded with coarse sand (48.0 percent) compared with stalls bedded with straw, composted or dried manure, or “other” bedding types (33.6, 30.2, 28.5, and 30.8 percent, respectively). With the exception of composted manure, the CCI was highest for operations that bedded with coarse sand compared with all other bedding types.

The percentage of cows perching in stalls was higher on operations in which the stall base was not exposed, bedding level with curb or slightly dished out (8.2 and 10.2 percent, respectively) compared with operations in which the stall base was less than 50 percent exposed (6.0 percent). Bedding quantity/stall condition was not associated with standing or lying parameters. The CCI was higher when bedding was level with the curb (74.2 percent) compared with bedding slightly dished out or more than 50 percent of the base exposed (63.7 and 66.2 percent, respectively).

The type or presence of a neck rail did not impact the percentage of cows perching or the CCI. A lower percentage of cows were standing in the stall when no neck rail was present (4.0 percent) compared with either the presence of a stationary or moveable neck rail (9.7 and 11.9 percent, respectively). Similarly, a lower percentage of cows were lying when no neck rail was present compared with operations with stationary or moveable neck rails.

The presence of a brisket locator or the locator material did not affect the percentage of cows that were perching, standing, or the CCI. However, operations that did not have a brisket locator had a lower percentage of cows lying (32.6 percent) compared with operations that had brisket locators made of wood (41.9 percent) or PVC or other plastic pipe (46.4 percent).

Season had a significant impact on the percentage of cows perching, lying, and on the CCI. The percentage of cows perching was lower in spring (March–May) than in summer (June–September), while the percentage of cows lying and the CCI were higher in spring than in summer.

Acknowledgments

This study was a cooperative effort between two U.S. Department of Agriculture (USDA) agencies: the National Agricultural Statistics Service (NASS) and the Animal and Plant Health Inspection Service (APHIS).

Thank you to the NASS enumerators, State and Federal veterinary medical officers (VMOs), and animal health technicians (AHTs) who visited the operations and collected the data for the Dairy 2007 study. Their hard work and dedication to USDA's National Animal Health Monitoring System (NAHMS) were invaluable. The roles of the producers, area veterinarians in charge (AVICs), NAHMS coordinators, VMOs, AHTs, and NASS enumerators were critical in providing quality data for Dairy 2007 reports. Recognition also goes to the personnel at the Centers for Epidemiology and Animal Health for their efforts in generating and distributing valuable reports from Dairy 2007 data.

Additional biological sampling and testing were afforded by the generous contributions of collaborators for the Dairy 2007 study, including

- USDA–APHIS, National Veterinary Services Laboratories;
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- Antel BioSystems, Inc.;
- Cornell University Animal Health Diagnostic Center;
- Quality Milk Production Services;
- Tetracore, Inc.;
- University of British Columbia, Canada, Animal Welfare Program;
- University of California, Davis;
- University of Pennsylvania, New Bolton Center;
- University of Wisconsin, Madison; and
- Wisconsin Veterinary Diagnostic Laboratory.

All participants are to be commended, particularly the producers whose voluntary efforts made the Dairy 2007 study possible.

Larry M. Granger
Director
Centers for Epidemiology and Animal Health

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Contacts for further information:
Questions or comments on data analysis: Dr. Jason Lombard (970) 494-7000
Information on reprints or other reports: Ms. Abby Fienhold (970) 494-7000
Email: NAHMS@aphis.usda.gov

Feedback
Feedback, comments, and suggestions regarding the Dairy 2007 study reports are welcomed. Please forward correspondence via email at: NAHMS@aphis.usda.gov, or you may submit feedback via online survey at: http://nahms.aphis.usda.gov (Click on “FEEDBACK on NAHMS reports.”)

Table of Contents

Introduction

The National Animal Health Monitoring System (NAHMS) is a nonregulatory program of the Animal and Plant Health Inspection Service (APHIS), a branch of the U.S. Department of Agriculture (USDA). Designed to help meet the animal health information needs of a variety of stakeholders, NAHMS has collected data on dairy health and management practices through four previous studies.

The NAHMS 1991–92 National Dairy Heifer Evaluation Project (NDHEP) provided the dairy industry's first national information on the health and management of dairy cattle in the United States. Just months after the study's first results were released in 1993, cases of acute bovine viral diarrhea (BVD) surfaced in the United States following a 1993 outbreak in Canada. NDHEP information on producer vaccination and biosecurity practices helped officials address the risk of disease spread and target educational efforts on vaccination protocols. When an outbreak of human illness related to *Escherichia coli* O157:H7 was reported in 1993 in the Pacific Northwest, NDHEP data on the bacteria's prevalence in dairy cattle helped officials define public risks as well as research needs. This baseline picture of the industry also helped identify additional research and educational needs in various production areas, such as feed management and weaning age.

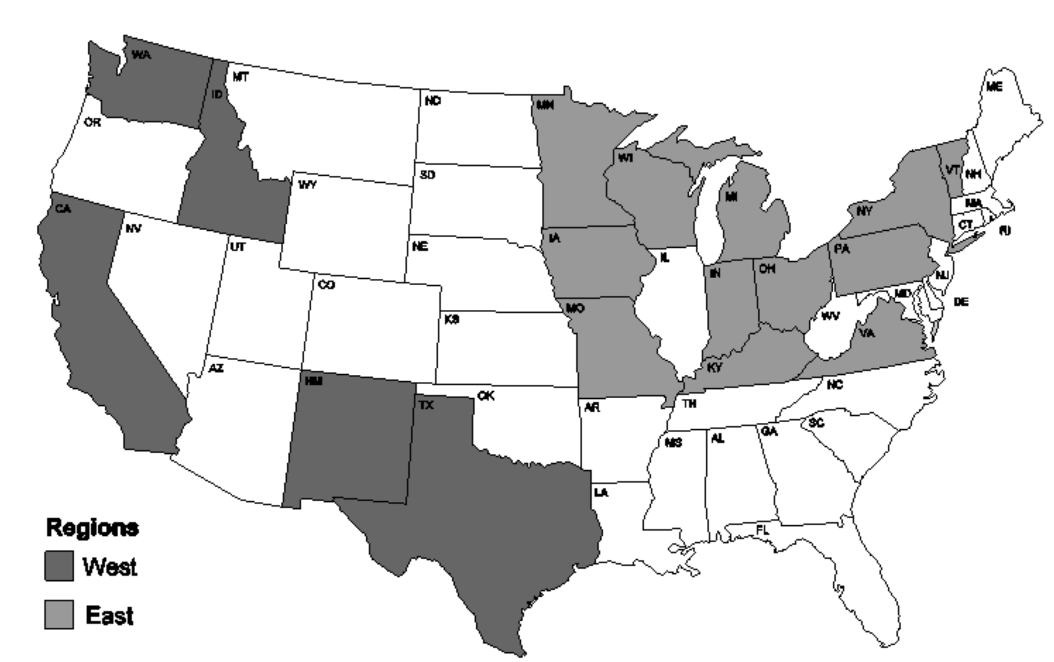
Information from the NAHMS Dairy 1996 study helped the U.S. dairy industry identify educational needs and prioritize research efforts on such timely topics as antibiotic use; Johne's disease; digital dermatitis; bovine leukosis virus (BLV); and potential foodborne pathogens, including *E. coli*, *Salmonella*, and *Campylobacter*. A total of 26 States participated in Dairy 1996.

Two major goals of the Dairy 2002 study were to describe management strategies that prevent and reduce Johne's disease and to determine management factors associated with *Mycoplasma* and *Listeria* in bulk-tank milk. The study was designed also to describe levels of participation in quality assurance programs, the incidence of digital dermatitis, animal-waste handling systems used on U.S. dairy operations, and industry changes since the NDHEP in 1991 and the Dairy 1996 study. A total of 21 States participated in Dairy 2002.

The Dairy 2007 study was conducted in 17 of the Nation's major dairy States (see map next page) and provides participants, stakeholders, and the industry as a whole with valuable information representing 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. Phase I data were collected from 2,194 dairy operations by National Agricultural Statistics Service enumerators from January 1–31, 2007. For phase II of the Dairy 2007 study, data were collected from a subset of Phase I participants (582 operations with 30 or more dairy cows). Phase II data were collected by State and Federal veterinary medical officers (VMOs) and animal health technicians (AHTs) between February 26 and August 31, 2007.

One objective of the Dairy 2007 study was to evaluate management factors related to cow comfort and removal rates. This report provides information collected during the Dairy 2007 study about facilities and cow comfort on U.S. dairy operations.

Dairy 2007 Participating States



Information on the methods used and number of respondents in the study can be found at the end of this report.

All Dairy 2007 study reports, as well as reports from previous NAHMS dairy studies, are available online at http://nahms.aphis.usda.gov

For questions about this report or additional copies, please contact:

USDA–APHIS–VS–CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000

Study Objectives and Related Outputs

1. Describe trends in dairy cattle health and management practices
- Part II: Changes in the U.S. Dairy Cattle Industry, 1991–2007, March 2008
- Part V: Changes in Dairy Cattle Health and Management Practices in the United States, 1996–2007, July 2009

2. Evaluate management factors related to cow comfort and removal rates
- **Facility Characteristics and Cow Comfort on U.S. Dairy Operations, 2007, Interpretive Report, December 2010**

3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices
- Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
- Off-Site Heifer Raising on U.S. Dairy Operations, 2007, info sheet, November 2007
- Colostrum Feeding and Management on U.S. Dairy Operations, 1991–2007, info sheet, March 2008
- Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, February 2009
- Calving Intervention on U.S. Dairy Operations, 2007, info sheet, February 2009
- Heifer Calf Health and Management Practices on U.S. Dairy Operations, 2007, Interpretive Report, February 2010
- Passive Transfer in Dairy Heifer Calves, 1991–2007, info sheet, March 2010

4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVDV)
- Bovine Viral Diarrhea (BVD) Management Practices and Detection in Bulk Tank Milk in the United States, 2007, info sheet, October 2008

5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens
- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
- Milking Procedures on U.S. Dairy Operations, 2007, info sheet, October 2008
- Prevalence of Contagious Mastitis Pathogens on U.S. Dairy Operations, 2007, info sheet, October 2008

6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis*
- Johne's Disease on U.S. Dairies, 1991–2007, info sheet, April 2008

7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices
- Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
- Biosecurity Practices on U.S. Dairy operations, 1991–2007, Interpretive Report, May 2010

8. Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns

- Antibiotic Use on U.S. Dairy Operations, 2002 and 2007, info sheet, October 2008
- Prevalence of *Salmonella* and *Listeria* in Bulk Tank Milk and In-line Filters on U.S. Dairies, 2007, info sheet, July 2009
- *Salmonella* and *Campylobacter* on U.S. Dairy Operations, 2002–07, info sheet, July 2009
- *Salmonella*, *Listeria*, and *Campylobacter* on U.S. Dairy Operations, 2007, Interpretive Report, expected winter 2011
- Prevalence of *Coxiella burnetii* on U.S. Dairy Operations, 2007, info sheet, expected winter 2011
- Prevalence of *Clostridium difficile* on U.S. Dairy Operations, 2007, info sheet, expected winter 2011

Additional information sheets

- Dairy Cattle Identification Practices in the United States, 2007, info sheet, November 2007
- Bovine Leukosis Virus (BLV) on U.S. Dairy Operations, 2007, info sheet, October 2008
- Reproduction Practices on U.S. Dairy Operations, 2007, info sheet, February 2009
- Injection Practices on U.S. Dairy Operations, 2007, info sheet, February 2009
- Methicillin-Resistant *Staphylococcus aureus* (MRSA) Isolation from Bulk Tank Milk in the United States, 2007, info sheet, November 2010

Terms Used in This Report

Brisket locator: A feature of freestalls designed to help prevent cows from lying too far forward in the stall. Brisket locators are usually constructed of wood and placed at the front of the stall bed.

Cow: Female dairy bovine that has calved at least once.

Cow average: The average value for all cows; the reported value for each operation multiplied by the number of cows on that operation is summed over all operations and divided by the number of cows on all operations. This way, results are adjusted for the number of cows on each operation. For instance, on p 13 the rolling herd average milk production per cow is multiplied by the number of cows for each operation. This product is then summed over all operations and divided by the sum of cows over all operations. The result is the rolling herd average milk production for all cows.

Cow comfort index (CCI): A measure of cow comfort calculated as the percentage of cows in contact with a stall and lying down. The recommended CCI is 85 percent or more when measured 1 hour after cows return from the morning milking. Recent research suggests that CCI is not associated with lying times and may not be the best comfort parameter to measure.

Cow density: The number of cows per stall or headlock.

Cow trainer: A tin or wire structure placed a few inches above a cow to prevent her from soiling the platform of her stall by administering a gentle electric shock if she arches her back to urinate or defecate while too far forward in the stall.

Curb: A feature of freestalls that separates the stall area from the alley. Curbs are generally constructed of concrete.

Dry-lot housing: An open dirt lot that has no vegetative cover and is used for housing cows in more arid climates.

Freestall housing: Housing consisting of resting cubicles or “beds” in which dairy cows are free to enter and leave at will.

Gutter: A channel located behind cows in tie-stall and stanchion barns to capture manure and urine.

Gutter grates: Coverings for gutters that assist in keeping the cow’s tail clean while allowing manure and urine to pass through.

Heifer: Female dairy bovine that has not yet calved.

Headlocks: Self-locking stanchions along a feed alley in which multiple cows can be restrained at once.

Herd size: Herd size is based on January 1, 2007, dairy cow inventory. Small herds are those with fewer than 100 head; medium herds are those with 100 to 499 head; and large herds are those with 500 or more head.

Loose housing system: Facility that allows the cows to move around and choose among eating, drinking, standing, or lying. Freestall and dry-lot housing are common types of loose housing. A loose-housing system is in contrast to a tie-stall or stanchion operation in which cows are restrained to individual stalls.

Lunge space: The area in front or to the side of the stall bed that allows cows to move their head forward or sideways when rising.

Neck rail: A feature of freestalls usually made of pipe or cable and mounted across the top of the freestall loops. Neck rails were designed to discourage cows from moving too far forward when entering the stall and encourage cows to move backward when rising.

Operation average: The average value for all operations. A single value for each operation is summed over all operations reporting divided by the number of operations reporting. For example, operation average rolling herd average (RHA) milk production (shown on p 13) is calculated by summing reported average RHA milk production over all operations divided by the number of operations.

Other multiple-animal area: Cow housing areas such as pasture or a combination of housing types such as freestall and dry-lot housing. Refers to housing other than tie stall, stanchion, freestall, or dry lot. In some instances in this report, which will be noted, operations with dry lots were included in this category due to small sample size.

Perching: A term commonly used to describe cows that have both front feet in the stall and both back feet in the alleyway.

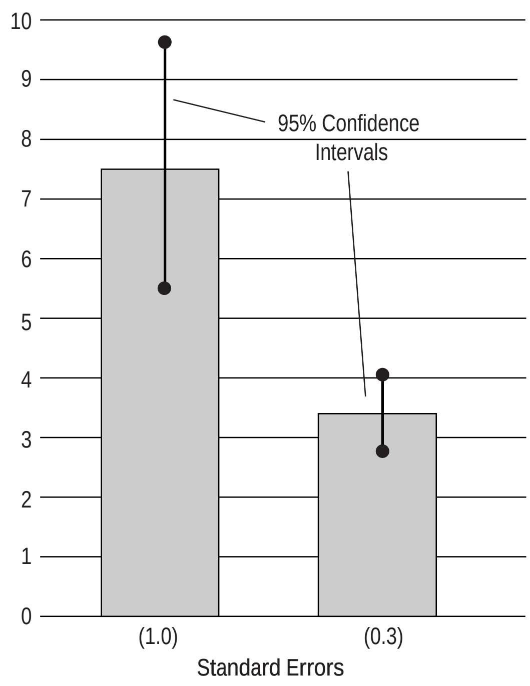
Population estimates: The estimates in this report make inference to all operations or dairy cattle in the target population (see Methodology section, p 156). Data from the operations responding to the survey are weighted to reflect their probability of selection during sampling and to account for any survey nonresponse.

Precision of population estimates: Estimates in this report are provided with a measure of precision called the standard error. A 95-percent confidence interval can be created with bounds equal to the estimate plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean 95 out of 100 times. In the example to the right, an estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). The second estimate of 3.4 shows a standard error of 0.3 and results in limits of 2.8 and 4.0. Alternatively, the 90-percent confidence interval would be created by multiplying the standard error by 1.65 instead of 2. Most estimates in this report are rounded to the nearest tenth. If rounded to 0, the standard error was reported (0.0). If there were no reports of the event, no standard error was reported (—). References to estimates being "higher" or "lower" than other estimates are based on the 95-percent confidence intervals not overlapping. Where noted in this report, STATA and SUDAAN were used to compare estimates and determine significance. P values less than 0.05 were considered statistically significant.

Regions:

- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

Examples of a 95% Confidence Interval



Sample profile: Information that describes characteristics of the operations from which Dairy 2007 data were collected. See Appendix I, p 164.

Season: For this report, spring included the months of March, April, and May. Summer included the months of June, July, August, and September.

Space allotment: A measure of space for cows. Commonly used measures include square feet for cows in pens and inches of bunk space per cow.

Stall base: The floor of the stall usually comprised of permanent or semipermanent materials upon which bedding is usually added. Common materials used for stall bases include dirt, concrete, rubber mats, and mattresses.

Stall partition (loop): A wooden or steel structure that separates adjacent resting spaces. Used in tie-stall, stanchion, and freestall housing systems.

Stanchion housing: Housing in which a cow is restrained to a particular stall in a device with two rails that close around the cow's neck after she enters a stall. Cows are not able to enter and leave the stalls at will.

Tie-stall housing: Housing in which a cow is restrained to a particular stall by a neck collar attached to the stall by a chain. Cows are not able to enter and leave the stalls at will.

Usual calving area: An area designated specifically for calving separate from housing for lactating cows. Tie stalls and stanchions were not considered usual calving areas for the purpose of this report.

Section I: Population Estimates

Note: Unless otherwise specified, estimates in Section I represent operations with any dairy cows.

A. Operation and Facility Characteristics

1. Operation types

Producers were asked to identify their operations by type: conventional, grazing, combination, or organic. On conventional operations, the majority of forage was harvested and "delivered" to cows; on grazing operations, the majority of forage was "harvested" by cows; combination operations used both conventional and grazing practices; and organic operations met USDA organic standards.

The majority of dairy operations (63.9 percent) were conventional operations, and the majority of dairy cows (82.2 percent) were on these operations. Grazing and organic operations accounted for only 3.1 and 1.7 percent of operations, respectively, and together represented less than 3.0 percent of dairy cows.

a. Percentage of operations (and percentage of cows on these operations), by operation type

Operation Type	Percent Operations	Standard Error	Percent Cows*	Standard Error
Conventional	63.9	(1.4)	82.2	(0.9)
Grazing	3.1	(0.6)	1.7	(0.4)
Combination of conventional and grazing	31.1	(1.3)	14.9	(0.8)
Organic	1.7	(0.4)	1.2	(0.3)
Other	0.2	(0.1)	0.0	(0.0)
Total	100.0		100.0	

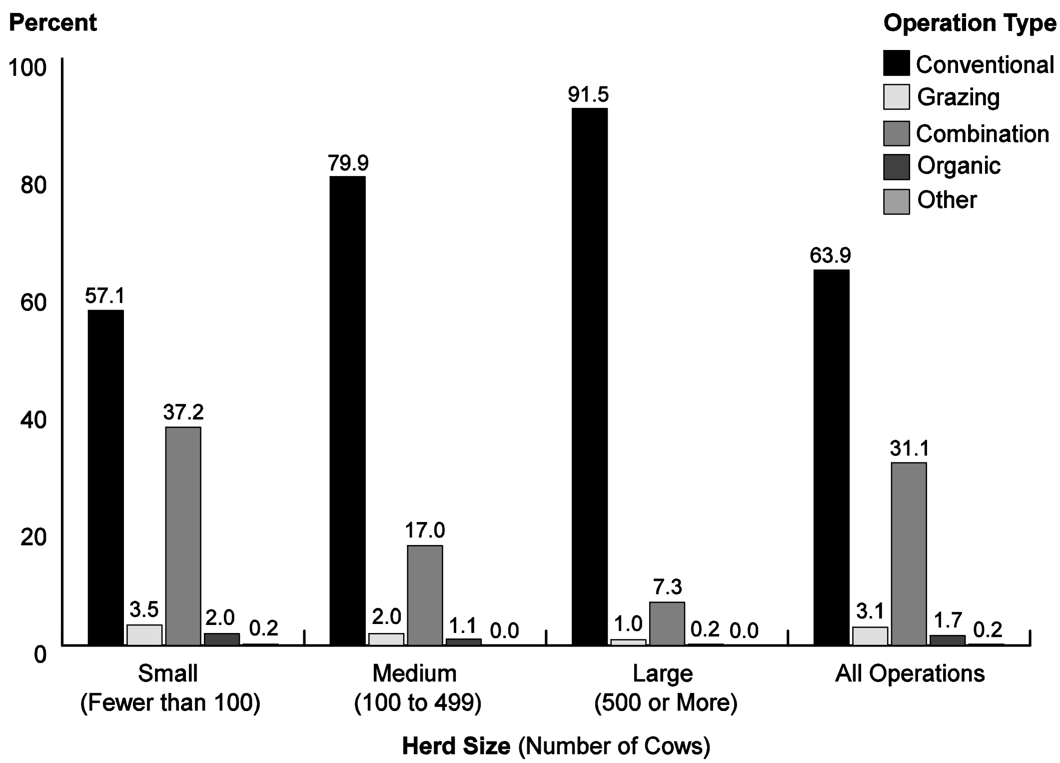
*As a percentage of January 1, 2007, cow inventory.

The percentage of conventional dairy operations increased as herd size increased, while the percentage of combination operations decreased as herd size increased.

b. Percentage of operations by operation type and by herd size

	Percent Operations					
	Herd Size (Number of Dairy Cows)					
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)	
Operation Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Conventional	57.1	(1.8)	79.9	(1.7)	91.5	(1.4)
Grazing	3.5	(0.7)	2.0	(0.7)	1.0	(0.4)
Combination of conventional and grazing	37.2	(1.7)	17.0	(1.6)	7.3	(1.3)
Organic	2.0	(0.6)	1.1	(0.3)	0.2	(0.1)
Other	0.2	(0.1)	0.0	(0.0)	0.0	(0.0)
Total	100.0		100.0		100.0	

Percentage of Operations by Operation Type and by Herd Size



The West region had a higher percentage of conventional operations than the East region (72.4 and 63.2 percent, respectively). Conversely, the East region had a higher percentage of combination operations than the West region (32.4 and 15.8 percent, respectively). The percentages of grazing and organic operations were similar in the West and East regions.

c. Percentage of operations by operation type and by region

	Percent Operations			
	Region			
	West		East	
Operation Type	Percent	Std. Error	Percent	Std. Error
Conventional	72.4	(2.9)	63.2	(1.4)
Grazing	8.0	(2.4)	2.7	(0.6)
Combination	15.8	(2.0)	32.4	(1.4)
Organic	3.8	(1.3)	1.5	(0.4)
Other	0.0	(0.0)	0.2	(0.1)
Total	100.0		100.0	

Conventional operations and the dairy cows on these operations had the highest rolling herd average (RHA) milk production (20,253 and 22,182 lb/cow, respectively). RHA milk production was similar for grazing, organic, and other operations.

d. Operation average (and cow average) RHA* milk production (lb/cow), by operation type

Operation Type	Operation Average (lb/cow)	Std. Error	Cow Average (lb/cow)	Std. Error
Conventional	20,253	(135)	22,182	(126)
Grazing	15,146	(608)	15,903	(457)
Combination	17,587	(213)	18,696	(217)
Organic	15,266	(714)	16,369	(728)
Other	15,760	(1,520)	14,757	(1,709)
All	19,175	(112)	21,483	(115)

*Average milk production per cow during a 12-month period.

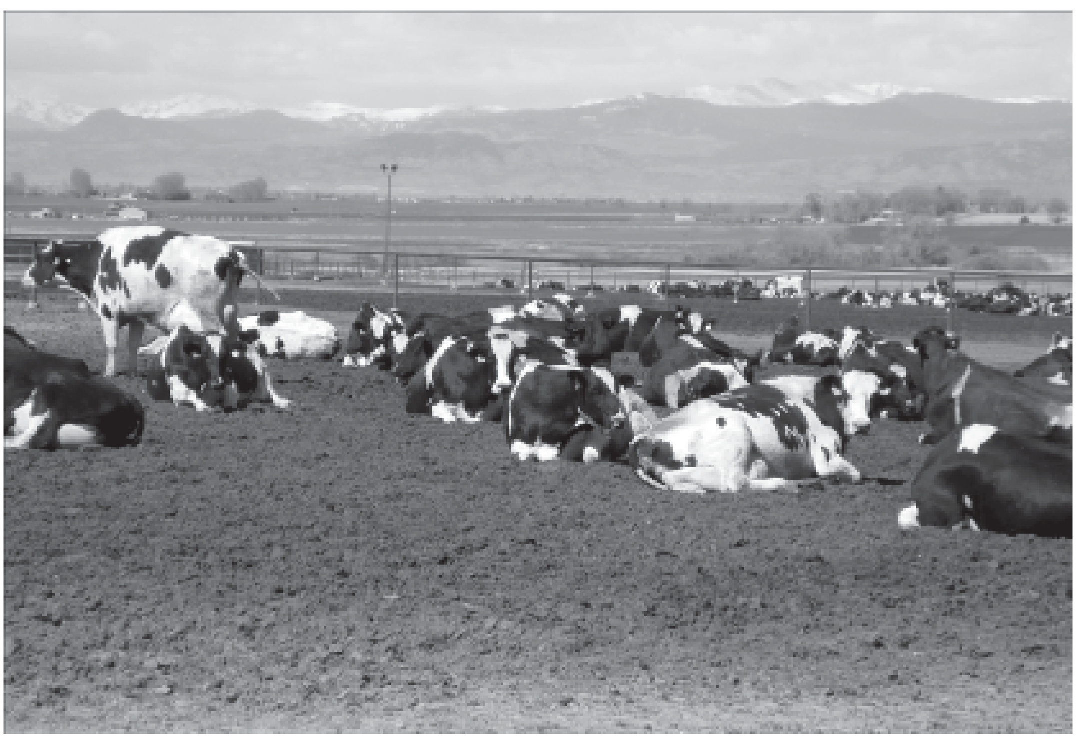


Photo courtesy Dr. Jason Lombard

2. Housing facilities

The majority of operations across herd sizes used primarily individual pens/hutches to house preweaned heifers. The percentage of operations that used tie stall/stanchions or multiple-animal inside areas to house preweaned heifers decreased as herd size increased. More than one-third of large operations (35.4 percent) did not raise preweaned heifers on the operation.

a. Percentage of operations by primary housing facility/outside area used for *preweaned heifers* during 2006, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Housing Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall/ stanchion	10.1	(1.1)	6.9	(1.3)	0.4	(0.2)	8.9	(0.8)
Freestall	2.8	(0.6)	3.0	(0.7)	1.0	(0.5)	2.7	(0.5)
Individual pen/ hutch	65.9	(1.7)	75.9	(2.0)	62.5	(2.9)	67.9	(1.3)
Dry lot/multiple-animal outside area	0.6	(0.3)	0.5	(0.2)	0.0	(0.0)	0.6	(0.2)
Multiple-animal inside area	17.8	(1.4)	5.8	(1.0)	0.7	(0.4)	14.2	(1.1)
Pasture	0.6	(0.2)	0.8	(0.6)	0.0	(0.0)	0.6	(0.2)
Not housed on operation	1.7	(0.5)	7.1	(1.2)	35.4	(2.9)	4.7	(0.5)
Other	0.5	(0.2)	0.0	(0.0)	0.0	(0.0)	0.4	(0.2)
Total	100.0		100.0		100.0		100.0	

Regional differences were observed in primary housing for preweaned heifers. A lower percentage of operations in the West region than in the East region housed preweaned heifers in tie stalls or stanchions (1.4 and 9.5 percent, respectively). Multiple-animal inside areas were used by more than twice the percentage of operations in the East region than in the West region (14.8 and 6.4 percent, respectively). More than one of five operations in the West region (21.9 percent) did not house preweaned heifers compared with 3.3 percent in the East region.

b. Percentage of operations by primary housing facility/outside area used for *preweaned heifers* during 2006, and by region

	Percent Operations			
	Region			
	West		East	
Housing Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Tie stall/stanchion	1.4	(0.6)	9.5	(0.9)
Freestall	3.3	(1.1)	2.7	(0.5)
Individual pen/hutch	64.0	(3.0)	68.3	(1.4)
Dry lot/multiple-animal outside area	1.2	(0.6)	0.5	(0.2)
Multiple-animal inside area	6.4	(1.8)	14.8	(1.2)
Pasture	1.8	(1.7)	0.5	(0.1)
Not housed on operation	21.9	(2.4)	3.3	(0.5)
Other	0.0	(0.0)	0.4	(0.2)
Total	100.0		100.0	

About one-third of operations housed weaned heifers primarily in a multiple-animal inside area (34.6 percent), while approximately one-fourth housed weaned heifers in a dry lot/multiple-animal outside area (22.9 percent). Small operations primarily housed weaned heifers in dry lots/multiple-animal outside and inside areas (22.3 and 37.8 percent, respectively). More than 4 of 10 large operations primarily housed weaned heifers in a dry lot/multiple-animal outside area (43.2 percent). The percentage of operations that did not house weaned heifers increased as herd size increased; nearly one-fourth of large operations did not house weaned heifers (24.8 percent).

c. Percentage of operations by primary housing facility/outside area used for *weaned heifers,* and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Housing Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall/ stanchion	6.7	(1.0)	4.6	(1.1)	0.5	(0.2)	5.9	(0.7)
Freestall	10.2	(1.1)	18.2	(1.8)	13.7	(2.2)	12.1	(0.9)
Individual pen/hutch	6.3	(0.9)	3.0	(0.9)	1.9	(0.8)	5.3	(0.7)
Dry lot/multiple-animal outside area	22.3	(1.4)	19.8	(1.8)	43.2	(2.7)	22.9	(1.1)
Multiple-animal inside area	37.8	(1.8)	29.8	(2.0)	10.1	(1.9)	34.6	(1.4)
Pasture	11.7	(1.1)	9.4	(1.2)	4.6	(1.0)	10.8	(0.9)
Not housed on operation	4.6	(0.7)	13.8	(1.6)	24.8	(2.4)	7.7	(0.7)
Other	0.4	(0.2)	1.4	(0.7)	1.2	(0.7)	0.7	(0.2)
Total	100.0		100.0		100.0		100.0	

Almost one-half of operations in the West region (46.2 percent) housed weaned heifers primarily in a dry lot/multiple-animal outside area compared with almost one-fifth of operations in the East region (20.9 percent). Approximately one of eight operations in the West region (12.1 percent) housed weaned heifers in multiple-animal inside areas compared with approximately one of three operations in the East region (36.4 percent).

d. Percentage of operations by primary housing facility/outside area used for *weaned heifers,* and by region

	Percent Operations			
	Region			
	West		East	
Housing Type	Percent	Std. Error	Percent	Std. Error
Tie stall/stanchion	0.4	(0.2)	6.4	(0.8)
Freestall	12.7	(2.0)	12.1	(0.9)
Individual pen/hutch	3.3	(1.2)	5.5	(0.7)
Dry lot/multiple-animal outside area	46.2	(2.9)	20.9	(1.2)
Multiple-animal inside area	12.1	(1.9)	36.4	(1.5)
Pasture	12.7	(2.3)	10.7	(0.9)
Not housed on operation	12.1	(1.9)	7.3	(0.7)
Other	0.5	(0.3)	0.7	(0.2)
Total	100.0		100.0	

Almost one-half of operations (49.2 percent) housed lactating cows primarily in a tie-stall/stanchion facility. Nearly one of three operations (32.6 percent) housed cows in freestalls. Use of tie-stall/stanchion facilities decreased from 63.0 percent of small operations to 0.7 percent of large operations. Alternatively, a higher percentage of medium and large operations housed lactating cows in freestalls (67.5 and 72.6 percent, respectively) compared with small operations (19.0 percent). Almost one-fourth of large operations (24.2 percent) housed lactating cows primarily in dry lots/multiple-animal outside areas.

e. Percentage of operations by primary housing facility/outside area used for *lactating cows,* and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Housing Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall/ stanchion	63.0	(1.6)	15.7	(1.9)	0.7	(0.3)	49.2	(1.3)
Freestall	19.0	(1.3)	67.5	(2.1)	72.6	(2.3)	32.6	(1.1)
Individual pen	0.1	(0.0)	0.3	(0.2)	0.2	(0.1)	0.1	(0.1)
Dry lot/multiple-animal outside area	3.4	(0.6)	4.1	(0.7)	24.2	(2.3)	4.6	(0.5)
Multiple-animal inside area	3.5	(0.7)	3.3	(0.7)	0.8	(0.5)	3.4	(0.6)
Pasture	10.8	(1.1)	8.8	(1.2)	1.0	(0.3)	9.9	(0.8)
Other	0.2	(0.1)	0.3	(0.2)	0.5	(0.4)	0.2	(0.1)
Total	100.0		100.0		100.0		100.0	

Almost one-half of operations in the West region (49.7 percent) housed lactating cows primarily in freestalls; 29.8 percent of operations housed cows in dry lot/multiple-animal outside areas and 15.0 percent housed cows on pasture. The majority of operations in the East region (53.1 percent) housed lactating cows primarily in tie stalls/stanchions. A lower percentage of operations in the East region housed cows in freestalls compared with operations in the West region (31.2 and 49.7 percent, respectively). Pasture was the primary housing for lactating cows on about 1 of 10 operations in the East region (9.4 percent).

f. Percentage of operations by primary housing facility/outside area used for *lactating cows*, and by region

	Percent Operations			
	Region			
	West		East	
Housing Type	Percent	Std. Error	Percent	Std. Error
Tie stall/stanchion	1.3	(0.5)	53.1	(1.4)
Freestall	49.7	(2.9)	31.2	(1.1)
Individual pen	0.8	(0.5)	0.1	(0.0)
Dry lot/multiple-animal outside area	29.8	(2.6)	2.6	(0.5)
Multiple-animal inside area	2.6	(0.9)	3.4	(0.6)
Pasture	15.0	(2.7)	9.4	(0.9)
Other	0.8	(0.5)	0.2	(0.1)
Total	100.0		100.0	

The single highest percentage of small operations kept dry cows in tie-stall/stanchion housing (30.6 percent), followed by pasture, freestall housing, and dry lot/multiple-animal outside area. More than one-third of medium operations (35.6 percent) housed dry cows in freestall housing. More than 40 percent of large operations used either freestalls or dry lot/multiple-animal outside areas. Overall, about 20 percent of operations housed dry cows in tie stall/stanchion, freestalls, dry lot/multiple-animal outside area, or pasture.

g. Percentage of operations by primary housing facility/outside area used for *dry cows* during 2006, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Housing Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall/ stanchion	30.6	(1.7)	5.0	(1.1)	0.4	(0.2)	23.3	(1.3)
Freestall	17.5	(1.3)	35.6	(2.2)	40.9	(2.5)	22.8	(1.1)
Individual pen/ hutch	0.9	(0.3)	0.9	(0.5)	1.3	(0.7)	1.0	(0.3)
Dry lot/multiple-animal outside area	16.7	(1.3)	19.1	(1.7)	45.4	(2.6)	18.7	(1.0)
Multiple-animal inside area	12.6	(1.2)	16.4	(1.7)	3.6	(0.9)	12.9	(0.9)
Pasture	21.1	(1.4)	21.6	(1.8)	7.2	(1.3)	20.5	(1.1)
Not housed on operation	0.1	(0.1)	0.4	(0.2)	0.4	(0.2)	0.2	(0.1)
Other	0.5	(0.2)	1.0	(0.5)	0.8	(0.5)	0.6	(0.2)
Total	100.0		100.0		100.0		100.0	

The most noticeable regional difference in housing for dry cows was that a higher percentage of operations in the West region than in the East region used a dry lot/multiple-animal outside area (48.1 and 16.3 percent, respectively). Tie stalls/stanchions and multiple-animal inside areas were used by a higher percentage of operations in the East region than in the West region (25.2 and 0.5 percent, respectively).

h. Percentage of operations by primary housing facility/outside area used for *dry cows* during 2006, and by region

	Percent Operations			
	Region			
	West		East	
Housing Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Tie stall/stanchion	0.5	(0.2)	25.2	(1.4)
Freestall	23.3	(2.5)	22.7	(1.2)
Individual pen/hutch	1.5	(0.6)	0.9	(0.3)
Dry lot/multiple-animal outside area	48.1	(2.9)	16.3	(1.1)
Multiple-animal inside area	5.0	(1.4)	13.6	(1.0)
Pasture	20.1	(2.7)	20.5	(1.2)
Not housed on operation	0.0	(0.0)	0.2	(0.1)
Other	1.5	(0.7)	0.6	(0.2)
Total	100.0		100.0	

About two-thirds of preweaned heifers (68.2 percent) were housed in individual pens; 19.8 percent of preweaned heifers were not housed on the operation. The majority of weaned heifers were housed in dry lot/multiple-animal outside or inside areas (37.5 and 24.6 percent, respectively). Almost 6 of 10 lactating cows (56.4 percent) were in freestall housing, while approximately 2 of 10 lactating cows were housed in tie stall/stanchion or dry lot/multiple-animal outside areas. About 3 of 10 dry cows were housed in a freestall or dry lot/multiple-animal outside area.

i. Percentage of cattle by primary housing facility/outside area used during 2006, and by cattle class

	Percent Cattle							
	Cattle Class							
	Preweaned Heifers[1]		Weaned Heifers[2]		Lactating Cows[3]		Dry Cows[3] (Nonlactating)	
Housing Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Tie stall/ stanchion	3.6	(0.4)	2.6	(0.3)	18.3	(0.6)	7.8	(0.5)
Freestall	2.1	(0.5)	15.1	(1.2)	56.4	(1.4)	31.9	(1.3)
Individual pen	68.2	(1.5)	3.1	(0.5)	0.3	(0.1)	0.9	(0.2)
Dry lot/multiple-animal outside area	0.3	(0.1)	37.5	(1.5)	18.3	(1.3)	36.9	(1.4)
Multiple-animal inside area	5.7	(0.5)	24.6	(1.2)	1.6	(0.3)	8.9	(0.7)
Pasture	0.2	(0.1)	6.8	(0.6)	4.8	(0.4)	12.5	(0.7)
Not housed	19.8	(1.5)	9.6	(1.0)	NA		0.4	(0.2)
Other	0.1	(0.0)	0.7	(0.2)	0.3	(0.2)	0.7	(0.3)
Total	100.0		100.0		100.0		100.0	

[1]As a percentage of heifer calves born during 2006.
[2]As a percentage of January 1, 2007, heifer inventory.
[3]As a percentage of January 1, 2007, cow inventory.

3. Freestall barn configurations

About 8 of 10 large and medium operations housed lactating cows in freestall barns (83.2 and 81.9 percent, respectively), compared with about 3 of 10 small operations (27.2 percent). Less than one-half of all operations (44.3 percent) housed cows in freestall barns.

a. Percentage of operations* that housed lactating cows in freestall barns

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Percent	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
27.2	(3.0)	81.9	(3.2)	83.2	(4.2)	44.3	(2.5)

*Operations with 30 or more dairy cows.

The type of freestall barn affects ventilation, feedbunk space, and square footage per cow. Freestall barns are usually described by the number of stall rows along a feed line. Two- and four-row barns require less air movement to properly ventilate and provide more feedbunk space and square footage per cow than three- or six-row barns (Smith et al., 2001). For the 44.3 percent of operations that used freestall barns to house lactating cows, two-row freestall barns were the predominant setup on small and large operations (48.1 and 49.5 percent, respectively). Only 1.1 percent of small operations used six-row barns to house lactating cows, compared with 17.9 percent of medium and 19.8 percent of large operations.

b. For operations that used freestall barns to house lactating cows, percentage of operations* by type of barn setup that housed the majority of cows, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Freestall Barn Setup	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Two-row	48.1	(6.6)	19.5	(3.5)	49.5	(5.3)	35.2	(3.4)
Three-row	20.7	(5.7)	22.2	(3.8)	8.3	(3.3)	19.9	(3.0)
Four-row	22.7	(5.0)	31.7	(4.4)	22.2	(4.8)	26.7	(3.0)
Six-row	1.1	(0.8)	17.9	(3.7)	19.8	(3.4)	11.0	(1.9)
Other	7.4	(3.7)	8.7	(2.6)	0.2	(0.1)	7.2	(2.0)
Total	100.0		100.0		100.0		100.0	

*Operations with 30 or more dairy cows.

4. Milking facilities

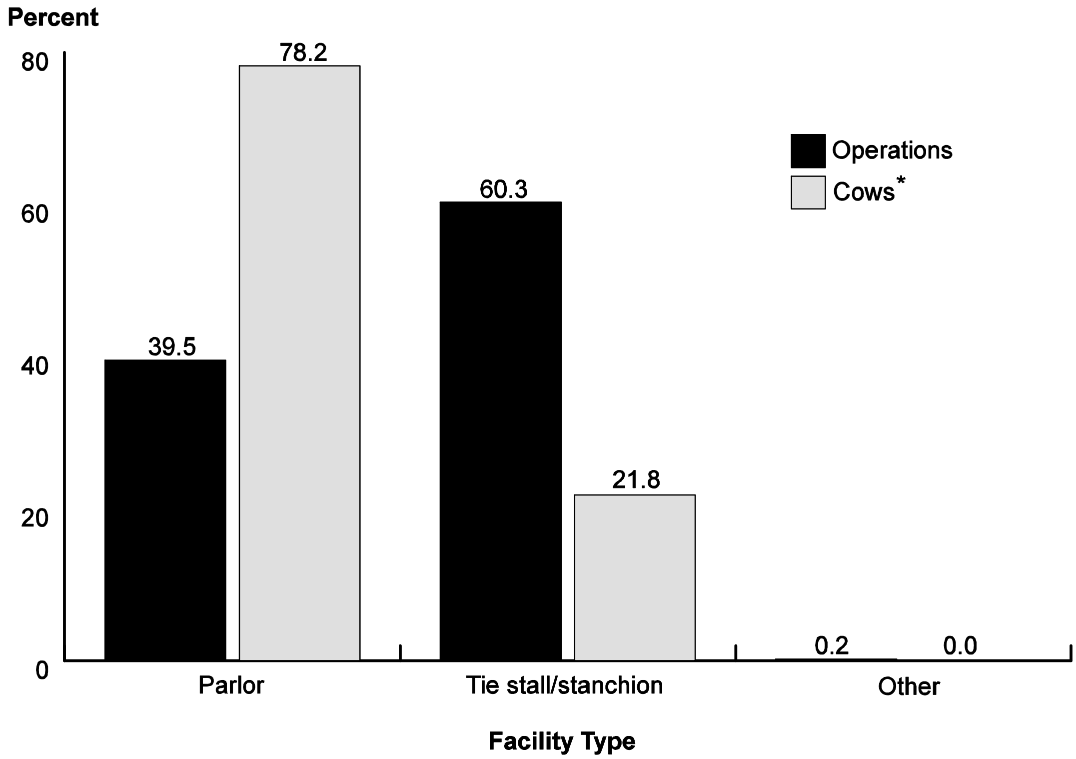
The majority of operations (60.3 percent) had a tie-stall or stanchion milking facility. Although only 39.5 percent of operations used parlors, 78.2 percent of cows were on operations that milked in parlors.

a. Percentage of operations (and percentage of cows on these operations) by primary milking facility used

Facility Type	Percent Operations	Std. Error	Percent Cows*	Std. Error
Parlor	39.5	(1.0)	78.2	(0.6)
Tie stall/stanchion	60.3	(1.0)	21.8	(0.6)
Other	0.2	(0.1)	0.0	(0.0)
Total	100.0		100.0	

*As a percentage of January 1, 2007, cow inventory.

Percentage of Operations (and Percentage of Cows on These Operations) by Primary Milking Facility Used



*As a percentage of January 1, 2007, cow inventory.

Herringbone and parallel parlors were the two most common parlor types. Over one-half of operations that primarily used parlors (54.4 percent) used a herringbone parlor, and these operations accounted for 48.7 percent of cows. Approximately one-fifth of operations (19.7 percent) used a parallel parlor for milking, and 30.6 percent of cows were on these operations.

b. For operations that primarily used a parlor milking facility, percentage of operations (and percentage of cows on these operations) by parlor type

Parlor Type	Percent Operations	Std. Error	Percent Cows	Std. Error
Side-opening (tandem)	6.6	(0.9)	3.7	(0.7)
Herringbone (fishbone)	54.4	(1.8)	48.7	(1.9)
Parallel (side-by-side)	19.7	(1.3)	30.6	(1.7)
Parabone (herringbone-parallel hybrid)	3.8	(0.6)	3.8	(0.6)
Swing	2.2	(0.6)	0.8	(0.2)
Rotary (carousel)	1.1	(0.3)	5.2	(1.3)
Flat barn	9.9	(1.2)	6.2	(0.8)
Other	2.3	(0.6)	1.0	(0.3)
Total	100.0		100.0	

Photo courtesy of Dr. Jason Lombard

B. General Management

Note: Unless otherwise specified, estimates in the following tables represent operations with 30 or more dairy cows.

1. Primary outside access areas

On the majority of operations (50.9 percent) lactating cows had routine access to pasture during summer. No outside access was allowed on 13.1 percent of operations in summer. In winter, lactating cows had access to a concrete alleyway or pen, dry lot, or allowed no outside access on 35.0, 28.9, and 25.2 percent of operations, respectively.

a. Percentage of operations by primary outside area that *lactating* cows had routine access to during summer and winter

	Percent Operations			
	Summer		Winter	
Primary Outside Area	Percent	Std. Error	Percent	Std. Error
Pasture	50.9	(2.7)	9.4	(1.5)
Concrete alleyway or pen	12.8	(1.6)	35.0	(2.8)
Dry lot	20.8	(2.2)	28.9	(2.7)
Other	2.4	(0.8)	1.5	(0.6)
None	13.1	(1.7)	25.2	(2.3)
Total	100.0		100.0	

During summer, 39.5 percent of lactating cows were on operations in which the primary outside area was a dry lot; 22.3 percent were on operations in which the primary outside area was pasture; and 19.0 percent were on operations with no outside access. In winter, similar percentages of lactating cows were on operations in which primary outside access was a concrete alleyway or pen, dry lot, or allowed no outside access (32.3, 32.7, and 29.7 percent, respectively).

b. Percentage of cows by primary outside area that *lactating* cows had routine access to during summer and winter*

	Percent Cows			
	Summer		Winter	
Primary Outside Area	Percent	Std. Error	Percent	Std. Error
Pasture	22.3	(1.6)	4.4	(0.7)
Concrete alleyway or pen	16.5	(2.1)	32.3	(3.3)
Dry lot	39.5	(3.0)	32.7	(3.5)
Other	2.7	(1.4)	0.9	(0.3)
None	19.0	(2.0)	29.7	(2.9)
Total	100.0		100.0	

*It was presumed that all lactating cows had access to the operation's primary outside area.

Dry cows had access to pasture on 67.2 percent of operations during summer and on 18.4 percent during winter. Dry cows had no outside access on 6.5 percent of operations during the summer and on 18.5 percent during winter.

c. Percentage of operations by primary outside area that *dry* cows had routine access to during summer and winter

	Percent Operations			
	Summer		Winter	
Primary Outside Area	Percent	Std. Error	Percent	Std. Error
Pasture	67.2	(2.5)	18.4	(2.2)
Concrete alleyway or pen	5.7	(1.1)	24.1	(2.4)
Dry lot	18.5	(2.0)	34.2	(2.7)
Other	2.1	(0.8)	4.8	(1.3)
None	6.5	(1.2)	18.5	(2.1)
Total	100.0		100.0	

The majority of dry cows were on operations in which pasture or dry lot were the primary outside access areas during summer (38.5 and 41.9 percent of cows, respectively). Dry lot was the most common outside access area for dry cows in winter (43.5 percent of cows).

d. Percentage of cow inventory by primary outside area that *dry* cows had routine access to during summer and winter*

	Percent Cows			
	Summer		Winter	
Primary Outside Area	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Pasture	38.5	(2.4)	11.9	(1.5)
Concrete alleyway or pen	7.3	(1.3)	19.3	(2.3)
Dry lot	41.9	(2.6)	43.5	(3.2)
Other	1.7	(0.5)	3.4	(0.8)
None	10.6	(1.7)	21.9	(2.5)
Total	100.0		100.0	

*It was presumed that all dry cows had access to the operation's primary outside area.

2. Flooring type

Flooring surfaces are important to cow health and longevity. When given an option, cows select flooring that compresses and provides cushion, such as rubber mats, pasture, or dirt. Concrete flooring is associated with increased lameness, injuries, and decreased expression of estrus. On approximately one-half of operations (51.1 percent)—representing 55.6 percent of cows—flooring for lactating cows was predominantly concrete. Pasture was the predominant flooring on 10.1 percent of operations and for 5.1 percent of cows. Dirt was the predominant flooring on 5.4 percent of operations, representing 20.0 percent of cows, which probably reflects the use of dry lots on large operations.

a. Percentage of operations (and percentage of cows on these operations) by predominant flooring type lactating cows stood or walked on when not being milked

Flooring Type	Percent Operations	Std. Error	Percent Cows	Std. Error
Concrete–grooved/textured	34.3	(2.4)	48.7	(3.5)
Concrete–slatted	1.3	(0.5)	1.1	(0.5)
Concrete–smooth	15.5	(2.3)	5.8	(0.8)
Rubber mats over concrete	22.9	(2.5)	13.9	(2.2)
Pasture	10.1	(1.7)	5.1	(0.9)
Dirt	5.4	(1.1)	20.0	(3.5)
Other	10.5	(1.8)	5.4	(1.1)
Total	100.0		100.0	

For operations with concrete flooring, the use of rubber belting or a similar material in cow areas reduces the amount of time cows spend on concrete and may decrease lameness and injuries and increase time spent at the feedbunk. Rubber belting was present on 21.2 percent of operations and was accessible to 44.4 percent of cows.

b. For operations that used parlors and on which concrete was the predominant flooring type, percentage of operations (and percentage of cows on these operations) that had rubber belting or similar flooring, by location of rubber belting

Location of Belting	Percent Operations	Std. Error	Percent Cows	Std. Error
Immediately in front of feedbunk	11.9	(2.3)	29.2	(5.1)
Walkway to parlor	6.2	(1.4)	18.9	(4.7)
Holding pen	8.1	(1.9)	14.2	(3.1)
Other	7.5	(1.7)	11.1	(1.8)
Any	21.2	(2.8)	44.4	(4.8)

3. Surface moisture

Wet flooring can be detrimental to hoof health. Cows on wet surfaces have increased hoof horn moisture and are more prone to infectious hoof diseases. The ground or flooring surface for lactating cows was usually dry on 60.3 percent of operations during summer and 49.5 percent in winter. Lactating cows usually stood in water or slurry on less than 1 percent of operations (0.6 percent).

Percentage of operations by category that best characterizes the surface moisture of the ground or flooring that lactating cows stood on most of the time during summer and winter

	Percent Operations			
	Summer		Winter	
Flooring Surface Moisture	Percent	Std. Error	Percent	Std. Error
Usually dry	60.3	(2.7)	49.5	(2.6)
Wet about half the time	22.8	(2.4)	21.8	(2.2)
Almost always wet, but no standing water	16.3	(1.7)	28.1	(2.1)
Usually standing water or slurry	0.6	(0.3)	0.6	(0.3)
Total	100.0		100.0	

4. Heat abatement

Heat has many harmful effects on dairy cattle, including decreased feed intake and milk production, reduced estrous behavior, altered formation and ovulation of follicles, and increased susceptibility to mastitis. Providing cows with shade, water sprinklers, or increased air circulation is important during summer in almost all areas of the United States. A combination of sprinklers and fans is the most common recommendation for keeping cows cool. For medium and small operations, fans were the most common method of heat abatement (74.3 and 77.7 of operations, respectively), while similar percentages of large operations provided shade, sprinklers or misters, or fans (55.6, 61.6, and 61.0 percent, respectively). Overall, 94.0 percent of operations provided some form of heat abatement for lactating cows.

a. Percentage of operations by method used to provide heat abatement for *lactating* cows during summer, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Method	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Shade (other than inside building)	49.2	(3.8)	28.7	(3.4)	55.6	(5.6)	44.5	(2.8)
Sprinklers or misters	12.0	(2.4)	32.9	(3.7)	61.6	(5.8)	20.3	(1.9)
Fans	74.3	(3.2)	77.7	(3.3)	61.0	(5.3)	74.3	(2.4)
Tunnel ventilation	28.3	(3.6)	12.7	(3.0)	3.8	(2.2)	22.9	(2.6)
Other	4.9	(1.8)	6.1	(2.3)	2.5	(1.6)	5.0	(1.3)
Any	96.3	(1.2)	89.1	(2.7)	88.5	(3.7)	94.0	(1.1)

Regional differences were observed in heat abatement methods used for lactating cows. A higher percentage of operations in the West region used sprinklers or misters (42.1 percent) compared with operations in the East region (18.2 percent). Alternatively, a higher percentage of operations in the East region used fans, tunnel ventilation, or any heat abatement method compared with operations in the West region.

b. Percentage of operations by method used to provide heat abatement for *lactating cows* during summer, and by region

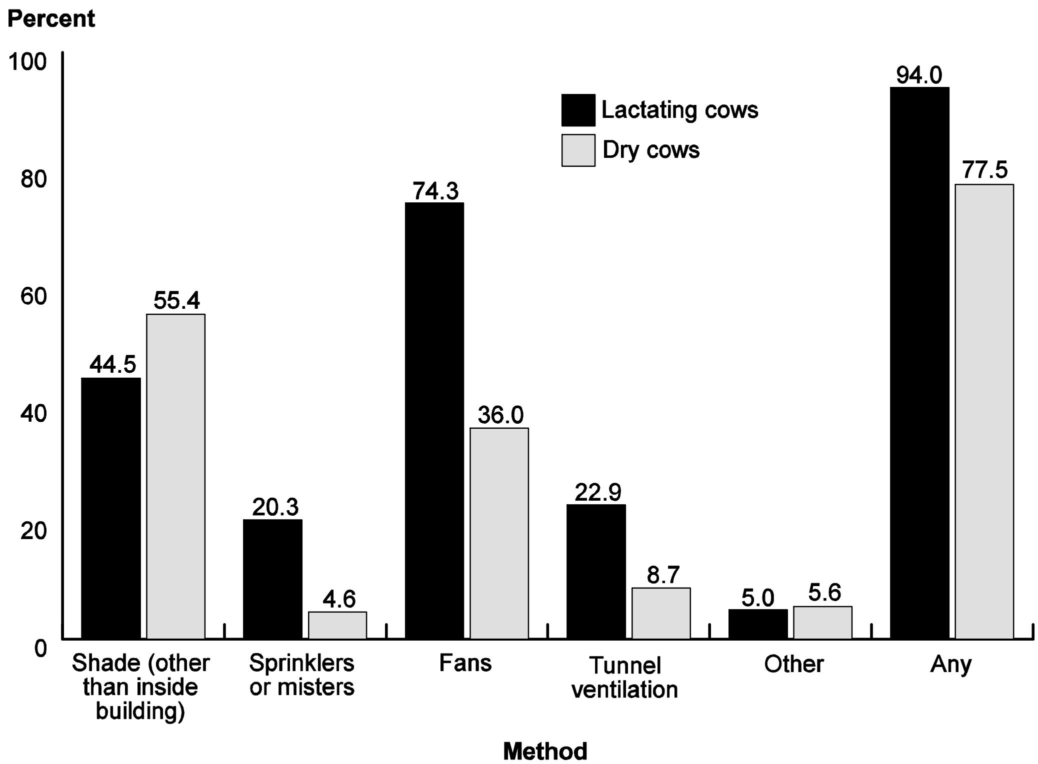
	Percent Operations			
	Region			
	West		East	
Method	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Shade (other than inside building)	56.3	(5.3)	43.4	(3.1)
Sprinklers or misters	42.1	(4.7)	18.2	(2.1)
Fans	37.0	(4.5)	77.9	(2.6)
Tunnel ventilation	1.2	(0.9)	25.0	(2.8)
Other	5.3	(1.9)	5.0	(1.5)
Any	68.2	(5.0)	96.5	(1.1)

Shade and fans were the most common heat abatement methods used for dry cows on 55.4 and 36.0 percent of operations, respectively. More than three of four operations (77.5 percent) provided some method of heat abatement for dry cows.

c. Percentage of operations by method used to provide heat abatement for *dry cows* during summer, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Method	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Shade (other than inside building)	61.0	(3.6)	41.0	(3.9)	49.8	(5.4)	55.4	(2.7)
Sprinklers or misters	3.8	(1.6)	3.8	(1.7)	16.2	(4.5)	4.6	(1.2)
Fans	36.2	(3.8)	37.8	(4.0)	27.2	(4.3)	36.0	(2.8)
Tunnel ventilation	11.8	(2.7)	1.7	(0.9)	2.0	(1.3)	8.7	(1.9)
Other	6.3	(2.0)	4.7	(2.1)	1.8	(1.6)	5.6	(1.5)
Any	81.4	(2.8)	68.9	(3.9)	69.2	(5.9)	77.5	(2.2)

Percentage of Operations by Method Used to Provide Heat Abatement for Lactating and Dry Cows During Summer



A higher percentage of operations in the East region provided fans, tunnel ventilation, or any heat abatement method for dry cows compared with operations in the West region.

d. Percentage of operations by method used to provide heat abatement for *dry cows* during summer, and by region

	Percent Operations			
	Region			
	West		East	
Method	Percent	Std. Error	Percent	Std. Error
Shade (other than inside building)	50.2	(5.1)	55.9	(2.9)
Sprinklers or misters	7.9	(3.2)	4.3	(1.3)
Fans	6.3	(2.0)	38.9	(3.1)
Tunnel ventilation	0.8	(0.8)	9.4	(2.1)
Other	3.0	(1.6)	5.9	(1.6)
Any	53.4	(5.1)	79.9	(2.4)

5. Calving areas

Ideally, calving areas are clean, dry, quiet, and provide enough room for a cow to comfortably lie down and deliver a calf. The majority of operations (70.0 percent) used a multiple-animal calving area/pen. A lower percentage of small operations (65.6 percent) than medium operations (79.8 percent) used a multiple-animal calving area. Approximately one-fourth of operations used an individual calving area that was either cleaned between each calving or cleaned after two or more calvings (25.5 and 26.2 percent, respectively). A higher percentage of small operations (30.6 percent) used an individual-animal pen that was cleaned between each calving compared with medium and large operations (14.6 and 13.5 percent, respectively).

a. Percentage of operations by area usually used for calving, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Calving Area	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Multiple-animal area/pen	65.6	(3.5)	79.8	(3.5)	78.5	(4.3)	70.0	(2.6)
Individual animal area/pen cleaned between each calving	30.6	(3.4)	14.6	(3.3)	13.5	(3.9)	25.5	(2.5)
Individual animal area/pen cleaned after two or more calvings	25.4	(3.3)	27.4	(3.7)	30.3	(5.6)	26.2	(2.5)
Other	5.1	(1.7)	3.6	(1.4)	3.1	(1.7)	4.6	(1.2)

The percentage of operations with a usual calving area ranged from 62.5 percent of small operations to 98.2 percent of large operations.

b. Percentage of operations that had a usual calving area

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Percent	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
62.5	(3.8)	83.7	(3.3)	98.2	(1.2)	70.1	(2.7)

Photo courtesy of Dr. Jason Lombard

6. Bedding types

Note: Some of the bedding types listed in the following tables are more commonly referred to as stall bases (i.e., the materials are covered with bedding) and are classified as such in Section II: Facility and Cow Assessments.

The ideal bedding for cows is dry and clean, provides cushion, and does not support bacterial growth. Sand has these characteristics and is one of the best bedding options for cows, although sand can lead to excessive wear of manure-handling equipment. For lactating cows, straw and/or hay was used on 54.1 percent of operations, representing 33.4 percent of cows.

Sawdust/wood products and rubber mats were used on similar percentages of operations (35.0 and 30.2 percent, respectively), although sawdust/wood products were used for a higher percentage of cows (31.2 percent) than were rubber mats (18.5 percent). Sand was used on 21.9 percent of operations and for 30.3 percent of cows.

Straw and/or hay was used as bedding for dry cows on 62.2 percent of operations, representing 47.2 percent of cows. Most operations (92.5 percent) provided bedding to dry cows, and most dry cows (92.7 percent) had access to bedding.

a. Percentage of operations (and percentage of cows on these operations) by type of bedding used for *lactating* and *dry* cows during the last quarter of 2006

	Percent Operations				Percent Cows			
	Lactating Cows		Dry Cows		Lactating Cows		Dry Cows	
Bedding Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Straw and/or hay	54.1	(2.7)	62.2	(2.7)	33.4	(2.8)	47.2	(3.2)
Sand	21.9	(2.0)	14.4	(1.7)	30.3	(2.6)	19.0	(2.0)
Sawdust/wood products	35.0	(2.6)	25.2	(2.3)	31.2	(2.8)	28.2	(2.6)
Composted/dried manure	3.9	(0.5)	4.8	(0.8)	24.2	(2.6)	23.5	(2.9)
Rubber mats	30.2	(2.7)	15.2	(2.2)	18.5	(2.1)	11.8	(2.3)
Rubber tires	1.6	(0.6)	1.0	(0.5)	1.1	(0.4)	0.7	(0.3)
Shredded newspaper	5.2	(1.2)	3.6	(1.1)	3.1	(0.7)	2.5	(0.8)
Mattresses	23.7	(2.4)	10.6	(1.8)	20.1	(1.9)	9.5	(1.4)
Corn cobs and stalks	11.0	(1.9)	18.5	(2.2)	5.7	(1.0)	10.7	(1.3)
Waterbeds	1.7	(0.8)	0.3	(0.3)	2.3	(1.0)	0.4	(0.3)
Other	11.7	(1.9)	9.5	(1.7)	13.3	(2.5)	12.4	(2.5)
Any	97.0	(0.8)	92.5	(1.4)	94.9	(1.9)	92.7	(1.9)

The primary bedding types used for lactating and dry cows in the last quarter of 2006 were straw and/or hay, sand, sawdust/wood products, or composted/dried manure. Composted/dried manure was used on less than 5 percent of operations, but these operations represented almost 25 percent of cows, suggesting that mostly large operations were using this bedding type.

b. For operations that used bedding during the last quarter of 2006, percentage of operations (and percentage of cows on these operations) by primary bedding type used for *lactating* and *dry* cows

	Percent Operations				Percent Cows			
	Lactating Cows		Dry Cows		Lactating Cows		Dry Cows	
Bedding Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Straw and/or hay	37.3	(2.9)	43.1	(3.0)	21.1	(2.6)	27.3	(2.6)
Sand	18.0	(2.0)	13.2	(1.8)	25.8	(2.7)	17.5	(2.1)
Sawdust/wood products	21.1	(2.2)	15.9	(2.1)	16.4	(1.7)	15.6	(2.3)
Composted/ dried manure	3.8	(0.5)	4.0	(0.7)	24.9	(2.5)	23.7	(3.0)
Rubber mats	1.7	(0.7)	2.3	(1.0)	0.8	(0.4)	1.8	(0.9)
Rubber tires	0.0	(--)	0.0	(--)	0.0	(--)	0.0	(--)
Shredded newspaper	1.0	(0.4)	1.0	(0.8)	0.5	(0.2)	0.4	(0.3)
Mattresses	5.6	(1.6)	3.8	(1.5)	2.6	(0.7)	1.8	(0.6)
Corn cobs and stalks	2.7	(1.1)	9.3	(1.6)	1.1	(0.4)	5.1	(0.9)
Waterbeds	0.6	(0.4)	0.4	(0.3)	1.2	(0.8)	0.3	(0.3)
Other	8.2	(1.6)	7.0	(1.6)	5.6	(1.3)	6.5	(1.7)
Total	100.0		100.0		100.0		100.0	

7. Feedline and feeding practices

The configuration of the feedline can impact the feeding behavior of dairy cattle. An increased amount of feedbunk space per cow and some form of physical separation between cows—such as the use of headlocks—reduce competition and have the greatest positive impact on subordinate cows. The most common feedline for small operations was a tie stall (46.2 percent of operations) while post and rail was the most common feedline on medium operations (37.1 percent of operations). The majority of large operations (79.6 percent) used headlocks at the feedline.

a. Percentage of operations by feedline used for the majority of lactating cows and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Feedline	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall	46.2	(3.8)	9.2	(2.8)	0.0	(--)	34.1	(2.8)
Stanchion	14.2	(2.8)	3.9	(1.5)	0.0	(--)	10.7	(1.9)
Post and rail	11.3	(2.2)	37.1	(4.0)	15.7	(4.1)	18.0	(1.9)
Headlocks	3.8	(1.2)	22.2	(3.2)	79.6	(4.7)	13.2	(1.3)
Elevated feed bunk in pen	17.8	(2.7)	20.3	(3.2)	0.1	(0.1)	17.3	(2.0)
Other	6.7	(1.8)	7.3	(2.0)	4.6	(2.5)	6.7	(1.3)
Total	100.0		100.0		100.0		100.0	

Photo courtesy of Dr. Jason Lombard

Separating close-up cows makes it possible to change feeding strategies, such as increasing energy levels or adding anionic salts to the diet. The percentage of operations that separated close-up cows increased as herd size increased. Overall, 57.1 percent of all operations separated close-up cows from other dry cows.

b. Percentage of operations that separated close-up cows from other dry cows, by herd size

Percent Operations							
Herd Size (Number of Cows)							
Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Percent	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
47.1	(3.9)	74.9	(3.7)	96.0	(2.1)	57.1	(2.9)

8. Water sources and chlorination

Water is the most important nutrient for cows (NRC, 2001). Lactating cows consume, either directly or in feed, between 20 and 35 gallons of water per day. In addition to providing clean water, cattle water sources should be easy to clean, readily accessible, and always available. A water tank or trough was the most common water source across all herd sizes.

a. Percentage of operations by source of drinking water for any cows during the previous 12 months, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Water Source	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Single cup/bowl waterer used by one cow only	13.3	(2.8)	8.6	(2.6)	2.4	(1.9)	11.4	(2.0)
Single cup/bowl waterer used by multiple cows	74.5	(3.1)	47.7	(4.2)	15.0	(4.4)	64.1	(2.4)
Water tank or trough (covered or uncovered)	91.8	(2.1)	97.4	(1.6)	92.9	(3.4)	93.2	(1.5)
Lake, pond, stream, river, etc.	37.2	(3.7)	29.2	(3.7)	8.7	(2.9)	33.4	(2.7)
Other source	4.4	(1.7)	3.5	(1.5)	0.6	(0.5)	3.9	(1.3)

A higher percentage of operations in the East region used single cup/bowl waterers used by one or multiple cows compared with operations in the West region.

b. Percentage of operations by source of drinking water for any cows during the previous 12 months, and by region

	Percent Operations			
	Region			
	West		East	
Water Source	Percent	Std. Error	Percent	Std. Error
Single cup/bowl waterer used by one cow only	2.2	(1.6)	12.3	(2.2)
Single cup/bowl waterer used by multiple cows	12.9	(3.5)	69.0	(2.6)
Water tank or trough (covered or uncovered)	94.8	(2.5)	93.1	(1.6)
Lake, pond, stream, river, etc.	21.7	(4.7)	34.6	(2.9)
Other source	2.1	(1.1)	4.1	(1.4)

Cleaning water sources may reduce cattle exposure to pathogens such as *E. coli* and *Salmonella*. The average number of times per year that dairy operations cleaned water sources varied. About 1 of 3 operations cleaned single cup/bowl waterers for 1 cow or water tank/trough 13 or more times per year. No cleaning was reported on 14.2 percent of operations using a single cup/bowl waterer for one cow, on 24.2 percent of operations using a single cup/bowl waterer for multiple cows, and on 4.6 percent of operations using a water tank/trough.

c. Percentage of operations by average number of times per year water sources were drained and cleaned, and by water source

	Percent Operations					
	Water Source					
	Single Cup/Bowl, One Cow		Single Cup/Bowl, Multiple Cows		Water Tank/ Trough	
Number of Times	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
0	14.2	(7.3)	24.2	(3.9)	4.6	(1.4)
1 to 4	27.0	(10.4)	37.0	(4.3)	37.1	(3.2)
5 to 12	26.2	(10.4)	18.7	(3.4)	24.1	(2.8)
13 or more	32.6	(10.2)	20.1	(3.1)	34.2	(2.8)
Total	100.0		100.0		100.0	

Chlorinating water sources may reduce bacterial counts. Only 8.7 percent of operations used chlorinated water for cows. A higher percentage of medium operations (14.9 percent) than small operations (6.0 percent) used chlorinated water. These percentages may not reflect water sources that are chlorinated prior to arriving at the operations, such as municipal water supplies.

d. Percentage of operations by whether usual water source for cows was chlorinated, and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Chlorinated Water	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Yes	6.0	(1.4)	14.9	(2.9)	13.8	(3.8)	8.7	(1.2)
Do not know	0.9	(0.7)	1.8	(1.0)	0.6	(0.3)	1.1	(0.5)
No	93.1	(1.5)	83.3	(3.0)	85.6	(3.8)	90.2	(1.3)
Total	100.0		100.0		100.0		100.0	

There were no regional differences in the percentages of operations that used or did not use chlorinated water for cows.

e. Percentage of operations by whether usual water source for cows was chlorinated, and by region

	Percent Operations			
	Region			
	West		East	
Chlorinated Water	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Yes	16.7	(4.0)	7.9	(1.3)
Do not know	0.4	(0.4)	1.2	(0.6)
No	82.9	(4.0)	90.9	(1.4)
Total	100.0		100.0	

Photo courtesy of Dr. Jason Lombard

Section II: Facility and Cow Assessments

A. Facility Assessments[1]

Note: Data for all estimates in Section II A were obtained from operations with 30 or more cows that completed the cow comfort assessment (n=485). Housing types in this section refer to the buildings or areas that housed the majority of fresh (recently calved) cows. For most operations, these housing areas also housed the majority of lactating cows.

1. Housing types

Note: "other multiple-animal area" housing includes pasture, loafing areas, or a combination of freestalls and open housing, such as dry lot, pasture, or other loose-housing systems.

Almost 8 of 10 operations housed lactating cows in either tie-stall or freestall barns (39.3 and 37.7 percent, respectively). The majority of small operations (53.4 percent) housed cows in tie-stall barns, while more than 70 percent of medium and large operations (76.8 and 73.7 percent, respectively) housed cows in freestall barns. The use of tie-stall and stanchion barns decreased as herd size increased; large operations did not use either housing type. A higher percentage of large operations (16.3 percent) housed cows in dry lots compared with medium operations (3.6 percent).

a. Percentage of operations by housing type and by herd size

	Percent Operations							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Housing Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall	53.4	(4.2)	10.2	(3.2)	0.0	(--)	39.3	(3.1)
Stanchion	18.1	(3.4)	2.6	(1.8)	0.0	(--)	13.1	(2.4)
Freestall	20.3	(3.0)	76.8	(3.9)	73.7	(5.6)	37.7	(2.5)
Dry lot	4.0	(1.8)	3.6	(1.0)	16.3	(4.6)	4.7	(1.3)
Other multiple-animal area	4.2	(1.2)	6.8	(1.8)	10.0	(4.1)	5.2	(1.0)
Total	100.0		100.0		100.0		100.0	

[1] Freestall components and measurements included in the assessments are presented in Appendix III, p 166.

The diversity of housing types between regions was evident. Operations in the West region housed cows primarily in freestall barns and dry lots (57.1 and 25.0 percent of operations, respectively), while operations in the East region used primarily tie-stall, freestall, and stanchion barns (43.1, 35.8, and 14.4 percent of operations, respectively).

b. Percentage of operations by housing type and by region

	Percent Operations			
	Region			
	West		East	
Housing Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Tie stall	0.0	(--)	43.1	(3.4)
Stanchion	0.0	(--)	14.4	(2.7)
Freestall	57.1	(5.6)	35.8	(2.7)
Dry lot	25.0	(5.5)	2.7	(1.3)
Other multiple-animal area	17.9	(5.4)	4.0	(0.9)
Total	100.0		100.0	

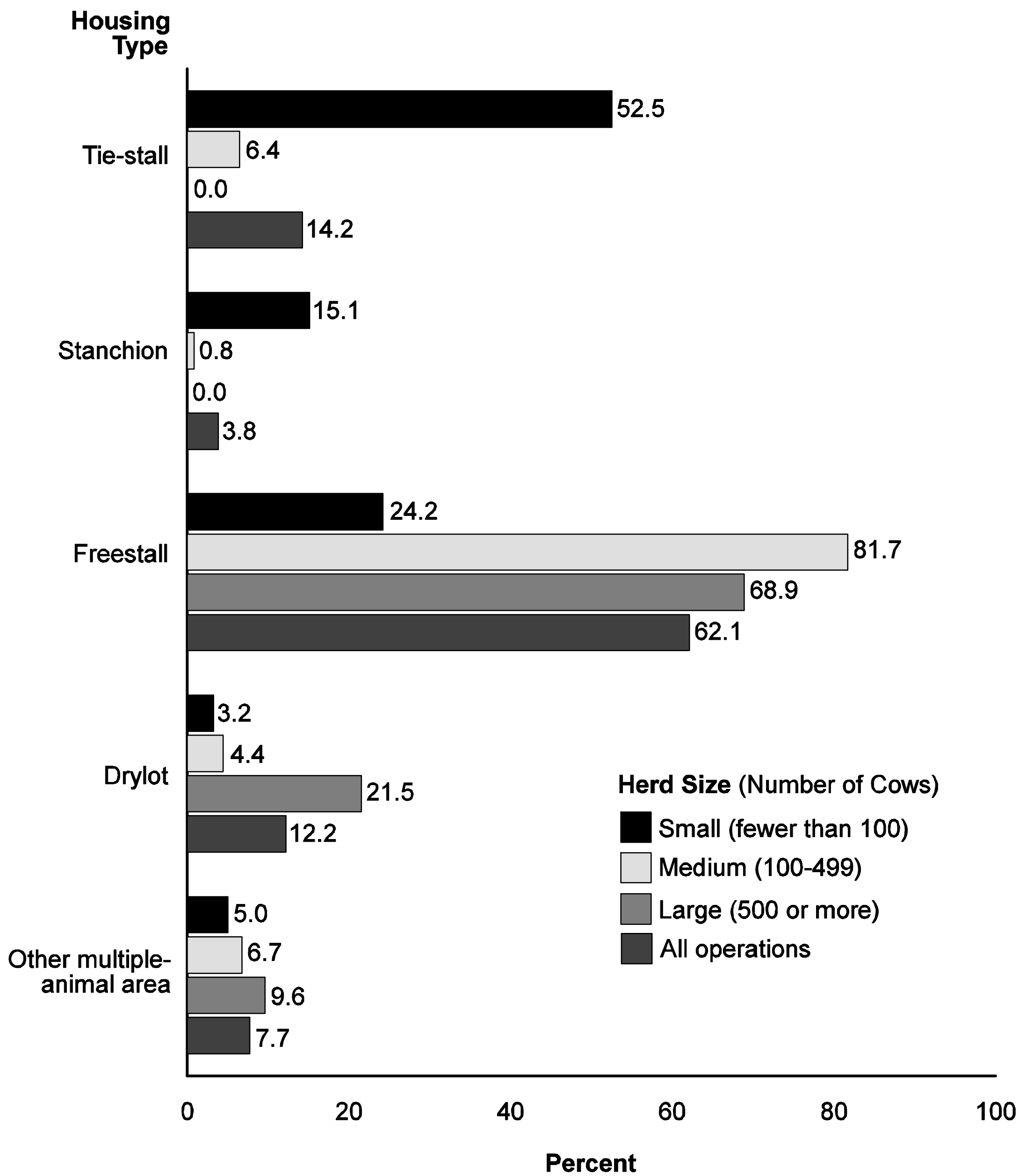
Overall, the majority of cows (62.1 percent) were housed in freestall barns. More than one-half of cows on small operations (52.5 percent) were housed in tie-stall barns, while more than two of three cows on medium and large operations were housed in freestall barns (81.7 and 68.9 percent of operations, respectively).

c. Percentage of lactating cows by housing type and by herd size

	Percent Cows*							
	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Housing Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Tie stall	52.5	(4.2)	6.4	(2.2)	0.0	(--)	14.2	(1.4)
Stanchion	15.1	(3.0)	0.8	(0.6)	0.0	(--)	3.8	(0.7)
Freestall	24.2	(3.3)	81.7	(3.0)	68.9	(7.5)	62.1	(3.7)
Dry lot	3.2	(1.3)	4.4	(1.2)	21.5	(7.1)	12.2	(3.6)
Other multiple-animal area	5.0	(1.6)	6.7	(1.8)	9.6	(4.5)	7.7	(2.2)
Total	100.0		100.0		100.0		100.0	

*As a percentage of cows present at the time of the interview.

Percentage of Lactating Cows* by Housing Type and by Herd Size



*As a percentage of cows present at the time of the interview.

The majority of cows in both the West and the East regions were housed in freestall barns (58.6 and 64.5 percent, respectively).

d. Percentage of cows by housing type and by region

	Percent Cows*			
	Region			
	West		East	
Housing Type	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Tie-stall barn	0.0	(--)	24.1	(2.2)
Stanchion barn	0.0	(--)	6.4	(1.2)
Freestall barn	58.6	(8.4)	64.5	(2.2)
Dry lot	28.1	(8.0)	1.3	(0.6)
Other multiple-animal area	13.3	(5.3)	3.7	(0.8)
Total	100.0		100.0	

*As a percentage of cows present at the time of the interview.

2. Housing age

Note: Due to small sample sizes, operations with dry lot facilities are included with operations that had other multiple-animal areas.

On average, stanchion barns were constructed in 1949 and were the oldest housing type. Freestall barns and other multiple-animal areas were constructed more recently than tie-stall barns. For all operations, 1976 was the average year of construction for all housing types.

a. Operation average year of construction, by housing type

Operation Average Year of Construction									
Housing Type									
Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error
1971	(3.4)	1949	(5.9)	1989	(1.0)	1983	(3.6)	1976	(1.8)

The majority of tie-stall barns (71.6 percent) were built between 1950 and 1999, while the majority of stanchion barns (66.9 percent) were built prior to 1975. The majority of other housing types were built in 1975 or later.

b. Percentage of operations by year housing was constructed and by housing type

	Percent Operations									
	Housing Type									
	Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Year	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Before 1950	15.6	(4.3)	43.7	(10.0)	0.0	(--)	5.5	(4.1)	12.5	(2.3)
1950 to 1974	32.2	(5.5)	23.2	(8.2)	13.6	(2.7)	24.7	(7.7)	23.3	(2.8)
1975 to 1999	39.4	(5.7)	30.0	(9.3)	62.0	(4.1)	41.0	(7.8)	46.9	(3.2)
2000 or later	12.8	(3.9)	3.1	(3.0)	24.4	(3.6)	28.8	(9.2)	17.3	(2.3)
Total	100.0		100.0		100.0		100.0		100.0	

3. Cow space allotment

Note: Current space allotment refers to the number of cows present in the building or area at the time of the assessment. Minimum space allotment refers to the maximum number of cows ever housed in the area/pen. Average space allotment refers to the usual number of cows housed in the area assessed.

The amount of space per cow is usually expressed as the number of square feet in the pen divided by the number of cows in the pen. Recommendations as to how many square feet an individual cow needs depend on many factors, e.g., total precipitation, presence of shade, and other factors. Ideally, each cow should have at least 110 square feet of pen space; transition cows should have 120 square feet each (Cook, 2008). Square feet per cow is not usually calculated for areas in which cows have their own stalls, i.e., tie-stall and stanchion barns. When assessing freestall operations, other measures, such as cows per stall or cows per headlock, are more commonly used.

The majority of freestall operations (62.0 percent) provided fewer than 100 square feet per cow at the time of the assessment, which was similar to the average space allotment. At minimum space allotment (maximum cows in pen), almost three-fourths of freestall operations (74.4 percent) provided fewer than 100 square feet per cow.

a. Percentage of freestall operations by current, minimum, and average space allotment (sq ft/cow)

	Percent Operations					
	Space Allotment					
	Current		Minimum		Average	
Square Feet per Cow	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Fewer than 100	62.0	(4.2)	74.4	(3.8)	67.1	(4.0)
100 to 199	28.4	(3.9)	19.6	(3.3)	25.5	(3.6)
200 to 399	9.0	(2.9)	5.4	(2.5)	6.8	(2.6)
400 to 799	0.6	(0.6)	0.6	(0.6)	0.6	(0.6)
800 to 1,599	0.0	(--)	0.0	(--)	0.0	(--)
1,600 or more	0.0	(--)	0.0	(--)	0.0	(--)
Total	100.0		100.0		100.0	

About 9 of 10 operations with other multiple-animal areas (92.3 percent) provided 100 or more square feet per cow at the time of the assessment. More than one of four operations with other multiple-animal areas (28.3 percent) provided 1,600 square feet per cow or more at the time of the assessment. About 8 of 10 operations (80.1 percent) provided 100 or more square feet per cow or more at minimum space allotment (maximum cows in pen).

b. Percentage of other multiple-animal area operations by current, minimum, and average space allotment (sq ft/cow)

	Percent Operations					
	Space Allotment					
	Current		Minimum		Average	
Square Feet per Cow	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Fewer than 100	7.7	(3.5)	19.9	(6.2)	9.3	(3.8)
100 to 199	27.8	(8.2)	17.4	(7.5)	27.9	(8.3)
200 to 399	10.4	(5.6)	15.4	(6.1)	10.3	(5.7)
400 to 799	14.4	(4.0)	15.2	(4.3)	15.6	(4.3)
800 to 1,599	11.4	(4.8)	8.3	(4.3)	10.6	(4.7)
1,600 or more	28.3	(9.1)	23.8	(9.3)	26.3	(9.2)
Total	100.0		100.0		100.0	

The percentage of operations with freestalls and other multiple-animal areas by average space allotment per cow was similar to the current space allotment determined at the time of the assessment. At minimum space allotment (maximum cows in pen), almost two of three operations (63.6 percent) provided fewer than 100 square feet per cow.

c. Percentage of operations with freestalls and other multiple-animal areas by current, minimum, and average space allotment (sq ft/cow)

	Percent Operations					
	Space Allotment					
	Current		Minimum		Average	
Square Feet per Cow	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Fewer than 100	51.1	(3.7)	63.6	(3.7)	55.7	(3.7)
100 to 199	28.3	(3.5)	19.2	(3.1)	26.0	(3.3)
200 to 399	9.3	(2.6)	7.4	(2.3)	7.5	(2.4)
400 to 799	3.3	(0.9)	3.5	(0.9)	3.5	(0.9)
800 to 1,599	2.3	(0.9)	1.6	(0.8)	2.1	(0.9)
1,600 or more	5.7	(2.2)	4.7	(2.1)	5.2	(2.1)
Total	100.0		100.0		100.0	

4. Cows per stall

On operations with freestall barns, the number of cows per stall is one of the most commonly used measures of density. Studies have shown that when cows are not allowed to lie down or eat for a period of time, they choose to rest rather than eat when access to both is renewed. Cows-per-stall stocking rates of 1.1 or higher (fewer stalls than cows) increased idle standing time (Krawczel et al., 2008), and when rates were above 1.5, lying times were reduced as well (Wierenga and Hopster, 1990; Fregonesi et al., 2007). Most references suggest that having 1.1 to 1.15 cows per stall is not associated with behavioral changes. It is important to note that these assessments were in buildings or pens that housed the majority of fresh cows, where recommended stocking density is 0.8 cows per stall (Nordlund et al., 2006).

Almost 3 of 10 freestall operations (30.4 percent) had 1.10 or more cows per stall, which equates to a stocking density of 110 percent or more at the time of the assessment (current). The majority of operations averaged less than 1.05 cows per stall. At maximum density, almost one-half of operations (48.5 percent) had 1.10 or more cows per stall. The average density was similar to the current density, with 28.8 percent of operations having 1.10 or more cows per stall.

Percentage of freestall operations by current , maximum, and average number of cows per stall

	Percent Operations					
	Density					
	Current		Maximum		Average	
Cows per Stall	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Less than 0.95	38.9	(4.2)	13.4	(3.5)	34.9	(4.1)
0.95 to 0.99	7.4	(1.9)	3.1	(1.1)	8.1	(2.0)
1.00 to 1.04	12.6	(2.7)	25.7	(3.7)	16.2	(3.1)
1.05 to 1.09	10.7	(2.3)	9.3	(2.2)	12.0	(2.5)
1.10 or more	30.4	(3.7)	48.5	(4.2)	28.8	(3.7)
Total	100.0		100.0		100.0	

5. Feedbunk space

Feedbunk space on tie-stall and stanchion operations is usually not an issue, since the feedbunk space is the same as the width of the stall and there is no competition for feed. On operations with loose-housing systems (freestall barns, dry lots, or other multiple-animal areas), adequate bunk space ensures that cows always have access to feed. The recommended bunk space in loose-housing facilities is 24 to 30 inches per cow. Providing adequate bunk space is especially critical in minimizing the normal decrease in feed intake observed around calving; 30 inches of bunk space is recommended for transition cows from 3 weeks before to 3 weeks after calving. Decreased bunk space has been associated with increased competition and slug feeding (increased rate of eating), which can lead to rumen acidosis (Shaver, 2002).

All tie-stall and stanchion operations provided 32 inches or more of feedbunk space per cow (data not shown in table below). In contrast, more than one-half of freestall operations (57.1 percent) provided fewer than 24 inches of bunk space at the time of the assessment. At maximum cow numbers (minimum feedbunk space), 67.9 percent of freestall operations provided less than the recommended minimum of 24 inches. Feedbunk space was similar for current and average cow numbers in the pen.

a. Percentage of freestall operations by current, minimum, and average feedbunk space per cow (inches)

	Percent Operations					
	Feedbunk Space					
	Current		Minimum		Average	
Inches per Cow	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Fewer than 20.0	34.4	(3.8)	48.6	(4.2)	36.0	(3.9)
20.0 to 23.9	22.7	(3.4)	19.3	(3.1)	22.2	(3.6)
24.0 to 27.9	14.0	(3.0)	17.1	(3.2)	13.5	(2.5)
28.0 to 31.9	8.6	(2.1)	3.7	(1.2)	13.9	(2.9)
32.0 or more	20.3	(3.7)	11.3	(2.9)	14.4	(3.2)
Total	100.0		100.0		100.0	

About two-thirds of operations with other multiple-animal areas (65.9 percent) provided at least the recommended minimum 24 inches of bunk space at current cow numbers. At maximum cow numbers, less than one-half of operations (47.2 percent) provided the recommended amount of space. As with freestall operations, the current and average feedbunk space estimates were similar.

b. Percentage of other multiple-animal operations by current, minimum, and average feedbunk space per cow (inches)

	Percent Operations					
	Feedbunk Space					
	Current		Minimum		Average	
Inches per Cow	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Fewer than 20.0	26.2	(8.6)	40.9	(9.2)	28.8	(8.7)
20.0 to 23.9	7.9	(3.4)	11.9	(4.3)	7.7	(3.5)
24.0 to 27.9	24.7	(7.5)	36.9	(9.1)	27.0	(7.8)
28.0 to 31.9	23.5	(8.6)	6.7	(4.7)	16.9	(8.3)
32.0 or more	17.7	(5.8)	3.6	(1.8)	19.6	(6.0)
Total	100.0		100.0		100.0	

More than one-half of operations with freestalls and other multiple-animal areas provided less than the recommended minimum 24 inches of bunk space at current, maximum (minimum feedbunk space per cow), and average cow numbers (52.5, 64.9, and 54.0 percent, respectively).

c. Percentage of operations with freestalls and other multiple-animal areas by current, minimum, and average feedbunk space per cow (inches)

	Percent Operations					
	Feedbunk Space					
	Current		Minimum		Average	
Inches per Cow	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Fewer than 20.0	32.8	(3.5)	47.1	(3.8)	34.6	(3.5)
20.0 to 23.9	19.7	(2.9)	17.8	(2.6)	19.4	(3.1)
24.0 to 27.9	16.1	(2.8)	21.0	(3.2)	16.1	(2.5)
28.0 to 31.9	11.6	(2.5)	4.3	(1.4)	14.5	(2.9)
32.0 or more	19.8	(3.2)	9.8	(2.4)	15.4	(2.8)
Total	100.0		100.0		100.0	

In addition to adequate bunk space per cow, it is important to distribute feed along the entire feedbunk. If feed is not distributed along the entire bunk, the percentage of the feedbunk space that provides accessible feed is reduced. More than 80 percent of operations had feed accessible along more than 75 percent of the feedbunk.

d. Percentage of operations by percentage of the feedbunk that provided easily accessible feed, and by housing type

	Percent Operations									
	Housing Type									
	Tie stall		Stanchion		Freestall		Dry lot		All Operations	
Percent of Feedbunk	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Less than 26	4.0	(2.7)	3.0	(2.9)	3.1	(1.4)	9.2	(4.7)	4.1	(1.3)
26 to 75	14.5	(4.7)	9.0	(5.0)	9.8	(2.4)	7.6	(3.1)	11.2	(2.2)
More than 75	81.5	(5.0)	88.0	(5.7)	87.1	(2.7)	83.2	(5.5)	84.7	(2.5)
Total	100.0		100.0		100.0		100.0		100.0	

Photo courtesy of Dr. Jason Lombard

6. Headlocks

Headlocks are used to restrain cattle while performing procedures such as vaccination, treatment, and reproductive exams. Additionally, headlocks are usually positioned between the cow alley and feed alley, which allows cows access to feed when they put their heads through the headlocks. Headlocks reduce feeding time compared with a post-and-rail feedline but reduce the number of times cows are displaced from the bunk by other cows (Huzzey et al., 2006). Approximately 4 of 10 operations (40.2 percent) with loose-housing systems had headlocks at the feedline.

a. For operations with loose-housing systems, percentage of operations with headlocks, by housing type

Percent Operations					
Housing Type					
Freestall		Other Multiple-animal Area		All Operations	
Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
43.2	(3.9)	28.9	(5.9)	40.2	(3.4)

Ideally, the average number of cows per headlock would be 1.00 or less so that each cow has the opportunity to access feed at any time. If the average number of cows per headlock is more than 1.00, then problems similar to those observed with decreased feed-bunk space are observed: decreased feeding times, increased competition, and increased idle standing in the feed area (Huzzey et al., 2006).

The percentage of freestall operations was similar for both current and average cows per headlock. About one of three operations averaged less than 1.00 cows per headlock at current and average cows per headlock. At the maximum cows per headlock, 42.7 percent of operations averaged 1.20 or more cows per headlock.

b. For freestall operations with headlocks, percentage of operations by current, maximum, and average number of cows per headlock

	Percent Operations					
	Cows per Headlock					
	Current		Maximum		Average	
Cows per Headlock	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Less than 1.00	32.8	(6.0)	15.6	(4.5)	35.4	(6.1)
1.00 to 1.09	21.3	(4.6)	21.8	(5.3)	20.2	(4.5)
1.10 to 1.19	15.5	(4.8)	19.9	(4.8)	16.6	(5.1)
1.20 or more	30.4	(5.5)	42.7	(6.1)	27.8	(5.1)
Total	100.0		100.0		100.0	

The majority of operations with other multiple-animal areas averaged less than 1.00 cow per headlock at current stocking levels (53.7 percent) and at average stocking levels (50.1 percent). Almost two of three operations with other multiple-animal areas (64.9 percent) averaged 1.00 to 1.09 cows per headlock.

c. For other multiple-animal area operations with headlocks, percentage of operations by current, maximum, and average number of cows per headlock

	Percent Operations					
	Cows per Headlock					
	Current		Maximum		Average	
Cows per Headlock	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Less than 1.00	53.7	(10.2)	7.1	(5.0)	50.1	(10.5)
1.00 to 1.09	32.6	(10.0)	64.9	(10.0)	36.1	(10.5)
1.10 to 1.19	11.7	(7.6)	20.0	(8.8)	11.7	(7.6)
1.20 or more	2.0	(1.7)	8.0	(5.9)	2.1	(1.7)
Total	100.0		100.0		100.0	

More than one-third of all operations (36.8 percent) averaged 1.20 cows per headlock or more when at maximum capacity, while 14.1 percent averaged less than 1.00 cow per headlock.

d. For operations with headlocks, percentage of all operations by current, maximum, and average number of cows per headlock

	Percent Operations					
	Cows per Headlock					
	Current		Maximum		Average	
Cows per Headlock	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Less than 1.00	36.4	(5.2)	14.1	(3.8)	37.9	(5.3)
1.00 to 1.09	23.3	(4.2)	29.2	(4.8)	23.0	(4.2)
1.10 to 1.19	14.8	(4.2)	19.9	(4.3)	15.7	(4.4)
1.20 or more	25.5	(4.6)	36.8	(5.2)	23.4	(4.3)
Total	100.0		100.0		100.0	

7. Stall base

Stall base refers to material immediately under the bedding. Stall base and quantity of bedding are important in keeping cows clean and in preventing hock injuries. Abrasive stall bases, such as rubber mats and mattresses, have been associated with increased incidence of hock lesions (Weary and Taszkum, 2000; Fulwider et al., 2007).

Concrete was used as a stall base on 33.2 percent of operations. Concrete was used on a higher percentage of stanchion operations than freestall operations (59.4 and 20.8 percent, respectively). As expected, dirt was not used on any tie-stall or stanchion operations but was used on 43.7 percent of operations with other multiple-animal areas, which included dry lots. Rubber mats were used by about one of three tie-stall and stanchion operations. Mattresses were used by approximately 25 percent of tie-stall and freestall operations. “Other” stall bases were generally a combination of the types listed.

Percentage of operations by type of stall base used and by housing type

	Percent Operations									
	Housing Type									
	Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Stall Base Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Concrete	35.8	(5.4)	59.4	(10.6)	20.8	(3.4)	35.0	(9.0)	33.2	(3.1)
Dirt	0.0	(--)	0.0	(--)	29.2	(3.6)	43.7	(8.8)	15.2	(1.8)
Rubber mat	31.2	(5.1)	35.5	(10.3)	9.2	(2.3)	4.1	(4.1)	20.8	(2.6)
Mattress	29.5	(4.9)	0.0	(--)	22.1	(3.2)	0.1	(0.1)	20.0	(2.5)
Waterbed	1.1	(0.8)	0.0	(--)	1.7	(1.1)	0.0	(--)	1.1	(0.5)
Other	2.4	(1.5)	5.1	(4.9)	17.0	(3.3)	17.1	(5.4)	9.7	(1.7)
Total	100.0		100.0		100.0		100.0		100.0	

8. Bedding

Bedding is an important aspect of cow comfort since cows generally spend 8 to 16 hours per day lying down (Cook, 2010). Bedding is used to cover the stall base, and the ideal bedding for cattle is dry, clean, easy to maintain, provides cushion and insulation, absorbs moisture, and discourages bacterial growth. Sand is considered the best bedding because of the cushion and traction it provides, especially to lame cows. Sand also appears to have an effect on hygiene since cows that bed on sand are cleaner than cows that bed on mattresses. However, sand is not necessarily easy to maintain and does support bacterial growth once contaminated (Cook, 2004). Organic bedding types should be removed and replaced frequently since they quickly become soiled and contaminated with bacteria.

Straw was the single most common bedding type used in tie stalls, stanchion housing, and all operation types (45.4, 64.7, and 34.7 percent, respectively). Sand—either fine or coarse—was used in 45.0 percent of freestall housing. More than one-third of other multiple-animal areas did not have bedding, since this group included dry lot housing in which cows lie primarily on dirt. “Other” bedding types included hay or a combination of the types listed.

a. Percentage of operations by bedding type and by housing type

	Percent Operations									
	Housing Type									
	Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Bedding Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Straw	45.4	(5.6)	64.7	(10.1)	14.4	(2.9)	29.7	(7.6)	34.7	(3.1)
Sawdust	27.1	(4.8)	20.1	(8.6)	21.1	(3.1)	8.5	(3.1)	22.1	(2.5)
Fine sand	0.8	(0.8)	0.0	(--)	26.4	(3.8)	0.0	(--)	10.3	(1.7)
Coarse sand	1.0	(1.0)	0.0	(--)	18.6	(3.4)	0.0	(--)	7.4	(1.4)
Composted manure	0.0	(--)	0.0	(--)	3.2	(1.0)	2.7	(1.9)	1.5	(0.4)
Dried manure	0.0	(--)	0.0	(--)	4.1	(1.2)	8.8	(3.2)	2.4	(0.5)
Shredded newspaper	1.3	(0.9)	0.0	(--)	0.6	(0.4)	1.5	(1.5)	0.9	(0.4)
Other	18.9	(4.2)	13.6	(7.9)	10.2	(2.3)	10.4	(4.3)	14.1	(2.2)
None	5.5	(3.2)	1.6	(1.5)	1.4	(1.3)	38.4	(8.5)	6.6	(1.7)
Total	100.0		100.0		100.0		100.0		100.0	

Almost 9 of 10 tie-stall and stanchion operations that provided bedding (87.7 and 88.3 percent, respectively) changed bedding every 1 to 2 days. Freestall operations generally bedded with sand (see previous table), which was not added to or changed as frequently as organic bedding types. Almost two of three freestall operations (64.4 percent) and one-half of operations with other multiple-animal areas (45.1 percent) changed bedding every 7 or more days. Dry lot facilities, which are included in other multiple-animal areas, generally provided bedding only during inclement weather to provide a clean, dry surface for cows.

b. For operations that provided bedding, percentage of operations by number of days between bedding additions/changes, and by housing type

	Percent Operations									
	Housing Type									
	Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Days Between Bedding Additions/ Changes	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1 to 2	87.7	(3.7)	88.3	(5.8)	21.7	(3.6)	33.7	(9.8)	58.3	(3.0)
3 to 4	6.1	(2.4)	7.8	(4.7)	11.3	(2.4)	18.8	(10.9)	9.2	(1.7)
5 to 6	0.0	(--)	0.0	(--)	2.6	(1.1)	2.4	(2.3)	1.2	(0.5)
7 or more	6.2	(3.0)	3.9	(3.8)	64.4	(4.0)	45.1	(11.7)	31.3	(2.7)
Total	100.0		100.0		100.0		100.0		100.0	

At the time of the assessment, about three of four tie-stall and stanchion operations had changed bedding within the past 24 hours.

Nearly 70 percent of all operations (69.1 percent) had changed bedding within the past 2 days.

c. For operations that provided bedding, percentage of operations by days since bedding was added/changed, and by housing type

	Percent Operations									
	Housing Type									
	Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Days Since Bedding Added/ Changed	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Less than 1	73.5	(4.9)	76.3	(8.2)	18.4	(3.5)	28.6	(9.6)	49.3	(3.1)
1 to 2	18.9	(4.4)	13.8	(6.9)	23.4	(3.5)	17.2	(10.7)	19.8	(2.5)
3 to 4	4.4	(2.0)	6.9	(4.7)	13.5	(2.6)	14.7	(7.4)	9.0	(1.5)
5 to 6	1.8	(1.8)	0.0	(--)	11.1	(2.3)	7.4	(3.9)	5.6	(1.2)
7 or more	1.4	(1.3)	3.0	(2.9)	33.6	(4.0)	32.1	(12.2)	16.3	(2.1)
Total	100.0		100.0		100.0		100.0		100.0	

Cows in well-bedded stalls (defined as base not exposed and enough bedding to provide cushion) have increased lying times compared with cows lying in scant bedding (Tucker et al., 2009). Inadequate bedding over any stall base, especially mattresses, is likely to increase the incidence of hock lesions from the friction associated with cow contact with stall bases and concrete curbs (Weary and Taszkun, 2000).

At the time of the assessment, stall bases were exposed on the majority of tie-stall and stanchion operations (71.0 and 81.7 percent, respectively). Stall bases were not exposed on the majority of freestall operations (65.7 percent). On operations with other multiple-animal areas, bases (primarily dirt or concrete) were generally exposed or no bedding was present (24.5 and 44.4 percent, respectively). On 60.9 percent of all operations, stall bases were exposed or did not have bedding present.

d. Percentage of operations by bedding quantity/stall condition in the majority of stalls, and by housing type

	Percent Operations									
	Housing Type									
	Tie stall		Stanchion		Freestall		Other Multiple-animal Area		All Operations	
Bedding Quantity/Stall Condition	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Base not exposed, bedding level with curb	4.5	(2.0)	3.3	(3.2)	28.2	(3.6)	9.0	(3.6)	13.8	(1.8)
Base not exposed, bedding slightly dished out	18.0	(4.5)	13.5	(6.4)	37.5	(4.1)	14.3	(5.5)	24.4	(2.7)
Base exposed (less than 50 percent)	37.5	(5.2)	38.3	(9.5)	19.8	(3.3)	2.2	(1.7)	27.6	(2.8)
Base mostly exposed (more than 50 percent)	33.5	(5.5)	43.4	(10.0)	11.4	(2.7)	22.3	(8.0)	25.4	(2.9)
No bedding present*	6.5	(3.4)	1.5	(1.5)	2.6	(1.5)	44.4	(8.8)	7.9	(1.8)
Other	0.0	(--)	0.0	(--)	0.5	(0.5)	7.8	(5.0)	0.9	(0.5)
Total	100.0		100.0		100.0		100.0		100.0	

*80.9 percent of operations on which no bedding was present were dry lot operations or operations with other multiple-animal areas.

The number of days between bedding changes differed based on bedding type. The majority of operations that bedded with straw, sawdust, shredded newspaper, or "other" (primarily tie-stall and stanchion operations) added new bedding every 1 to 4 days. More than 8 of 10 operations that bedded with fine or coarse sand or composted or dried manure (primarily freestall operations) bedded stalls weekly or less often.

e. Percentage of operations by bedding type and by number of days between bedding additions/changes

	Percent Operations								
	Days Between Bedding Additions/Changes								
	1 to 2		3 to 4		5 to 6		7 or More		
Bedding Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Total
Straw	81.1	(4.0)	9.9	(3.2)	0.3	(0.3)	8.7	(2.7)	100.0
Sawdust	64.1	(6.1)	11.2	(3.5)	1.9	(1.0)	22.8	(5.4)	100.0
Fine sand	0.2	(0.2)	6.3	(3.6)	3.5	(3.4)	90.0	(4.8)	100.0
Coarse sand	11.5	(8.9)	5.9	(5.2)	1.0	(0.7)	81.6	(9.7)	100.0
Composted manure	0.8	(0.8)	1.4	(1.3)	0.0	(--)	97.8	(1.6)	100.0
Dried manure	7.5	(7.1)	0.4	(0.4)	0.0	(--)	92.1	(7.1)	100.0
Shredded newspaper	100.0	(--)	0.0	(--)	0.0	(--)	0.0	(--)	100.0
Other	73.1	(6.1)	11.5	(4.4)	0.8	(0.8)	14.6	(4.3)	100.0

The percentage of operations by days since bedding was last changed was similar to days between bedding changes. As expected, most operations that bedded with straw, sawdust, shredded newspaper, or "other" had added bedding within 2 days. Operations that used other bedding types were more variable in the days since last bedded, but more than 50 percent of operations using fine sand or composted or dried manure had last added new bedding 7 or more days prior to the interview.

f. Percentage of operations by bedding type and by days since bedding was added/changed

	Percent Operations										
	Days Since Bedding Added/Changed										
	Less than 1		1 to 2		3 to 4		5 to 6		7 or More		
Bedding Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Total
Straw	66.9	(5.3)	17.0	(4.4)	6.7	(2.5)	3.7	(2.3)	5.7	(2.0)	100.0
Sawdust	53.0	(6.5)	25.1	(5.7)	8.3	(2.9)	4.5	(1.7)	9.1	(3.3)	100.0
Fine sand	1.1	(1.1)	13.7	(5.0)	16.4	(6.1)	13.8	(5.0)	55.0	(8.2)	100.0
Coarse sand	12.3	(8.9)	35.6	(10.6)	16.2	(6.0)	7.7	(3.7)	28.2	(9.6)	100.0
Composted manure	0.8	(0.8)	35.0	(16.2)	1.4	(1.3)	2.7	(2.7)	60.1	(16.4)	100.0
Dried manure	0.0	(--)	15.4	(9.5)	18.5	(11.7)	12.5	(8.4)	53.6	(13.4)	100.0
Shredded newspaper	100.0	(--)	0.0	(--)	0.0	(--)	0.0	(--)	0.0	(--)	100.0
Other	65.8	(7.0)	16.9	(5.4)	7.1	(3.3)	4.7	(2.5)	5.5	(2.3)	100.0

More than 85 percent of operations that bedded with fine or coarse sand or composted manure did not have the stall base exposed at the time of the assessment. More than 3 of 10 operations that bedded with straw, sawdust, shredded newspaper, or “other” had more than 50 percent of the stall base exposed.

g. Percentage of operations by bedding type and by bedding quantity/stall condition in majority of stalls

	Percent Operations								
	Bedding Quantity/Stall Condition								
	Base not Exposed, Bedding Level with Curb		Base not Exposed, Bedding Slightly Dished Out		Base Exposed (Less than 50 Percent)		Base Mostly Exposed (More than 50 Percent)		
Bedding Type	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Total
Straw	3.0	(1.5)	16.3	(4.3)	48.6	(6.0)	32.1	(6.1)	100.0
Sawdust	11.9	(3.5)	24.6	(5.9)	27.5	(5.5)	36.0	(6.7)	100.0
Fine sand	43.0	(8.4)	56.7	(8.4)	0.2	(0.2)	0.1	(0.1)	100.0
Coarse sand	40.6	(10.1)	45.1	(10.7)	2.8	(2.7)	11.5	(8.6)	100.0
Composted manure	51.7	(15.3)	46.6	(15.4)	1.7	(1.3)	0.0	(--)	100.0
Dried manure	16.0	(8.6)	37.0	(12.0)	29.7	(12.1)	17.3	(8.6)	100.0
Shredded newspaper	49.9	(24.1)	0.0	(--)	7.3	(7.4)	42.8	(23.4)	100.0
Other	8.4	(4.0)	21.1	(6.9)	32.4	(7.4)	38.1	(8.7)	100.0

Frequent bedding did not equate to improved bedding quantity/stall conditions in the assessed operations. As days since bedding was added or changed increased, the percentage of operations in which the stall base was not exposed, bedding slightly dished out increased from 18.2 to 48.1 percent. Alternatively, as days since bedding increased, a lower percentage of operations had less than 50 percent of the stall base exposed (44.1 to 7.4 percent).

h. Percentage of operations by days since bedding was added/changed, and by bedding quantity/stall condition in majority of stalls

	Percent Operations								
	Bedding Quantity/Stall Condition								
	Base not Exposed, Bedding Level with Curb		**Base not Exposed, Bedding Slightly Dished Out**		**Base Exposed** (Less than 50 Percent)		**Base Mostly Exposed** (More than 50 Percent)		**Total**
Days Since Bedding Added/ Changed	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**
Less than 1	7.8	(2.5)	18.2	(4.2)	44.1	(5.0)	29.9	(5.1)	100.0
1 to 2	19.9	(4.6)	24.6	(6.1)	26.0	(6.3)	29.5	(7.0)	100.0
3 to 4	19.1	(6.2)	32.1	(7.9)	13.9	(5.5)	34.9	(8.8)	100.0
5 to 6	23.0	(8.6)	41.8	(10.7)	15.0	(7.4)	20.2	(12.0)	100.0
7 or more	27.1	(6.1)	48.1	(7.3)	7.4	(3.5)	17.4	(6.0)	100.0

9. Platform and stall lengths

Note: The following estimates refer to operations on which Holsteins were the primary breed (n=454 for all housing types).

Stall-length measurements differed by housing type. Measurements for tie-stall and stanchion operations included only the actual surface (platform or bed) in back of the stanchion or rail where cows lie. Published recommendations suggest a 70-inch bed for first lactation and a 72-inch bed for mature cows (Anderson, 2008a).

Platform lengths for stalls on tie-stall operations were generally longer than on stanchion operations. Approximately 40 percent of tie-stall operations had platform lengths of 70.0 inches or more, while all stanchion operations had platform lengths of less than 70 inches. The majority of stanchion operations (60.3 percent) had platform lengths of 60.0 to 64.9 inches.

a. For tie-stall and stanchion operations, percentage of operations by average platform length and by housing type

	Percent Operations					
	Housing Type					
	Tie stall		Stanchion		All Operations	
Average Platform Length (Inches)	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 60.0	1.4	(0.8)	20.0	(7.8)	6.1	(2.2)
60.0 to 64.9	13.4	(4.1)	60.3	(9.4)	25.3	(4.5)
65.0 to 69.9	43.7	(5.9)	19.7	(7.1)	37.6	(4.9)
70.0 to 74.9	34.5	(5.3)	0.0	(--)	25.8	(4.1)
75.0 or more	7.0	(3.2)	0.0	(--)	5.2	(2.4)
Total	100.0		100.0		100.0	

Holsteins need approximately 120 inches (10 feet) of stall length to rise in freestalls without interference (Anderson, 2008b); 96 inches (8 feet) is usually recommended for freestalls that have an open front that does not restrict lunge space; 108 inches (9 feet) is recommended for closed front stalls that have a barrier restricting the lunge space (Cook and Nordlund, 2004). For this study, the distance from the rear curb to the front post where the loops are attached was measured (see Appendix III, p166, for diagram).

More than 4 of 10 freestall operations (44.1 percent) had a stall length of 86.0 to 91.9 inches. About one of five freestall operations had stall lengths of 82.0 to 85.9 inches. Less than 20 percent of freestall operations (15.3 percent) had stall lengths greater than the recommended 96 inches.

b. Percentage of freestall operations by average stall length

Average Stall Length (Inches)	**Percent Operations**	**Standard Error**
Less than 82.0	12.3	(3.8)
82.0 to 85.9	20.7	(3.9)
86.0 to 91.9	44.1	(5.0)
92.0 to 95.9	7.6	(2.3)
96.0 or more	15.3	(3.6)
Total	100.0	

10. Stall widths

Note: The following estimates refer to operations on which Holsteins were the primary breed (n=454 for all housing types).

Stalls should be wide enough for cows to lie down and get up easily but not so wide that cows can turn around in the stall. Narrow stalls increase perching time and decrease the amount of time cows lie down. Recommended stall widths for mature cows vary by weight but are generally 50 to 54 inches (Cook and Nordlund, 2004).

Tie-stall operations generally had wider stalls than operations with other housing types. Over three-fourths of tie-stall operations (76.4 percent) had stall widths of 46 inches or more compared with about one-half of stanchion operations (47.1 percent) and approximately one-third of freestall operations (32.1 percent).

Percentage of operations by average stall width and by housing type

	Percent Operations							
	Housing Type							
	Tie stall		Stanchion		Freestall		All Operations	
Average Stall Width (Inches)	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Less than 42.0	1.6	(0.9)	33.4	(10.0)	4.9	(1.7)	7.8	(2.0)
42.0 to 43.9	5.5	(2.3)	12.0	(7.0)	22.8	(3.6)	13.5	(2.1)
44.0 to 45.9	16.5	(4.0)	7.5	(4.4)	40.2	(4.1)	24.7	(2.6)
46.0 to 47.9	31.0	(5.5)	21.4	(7.6)	26.6	(4.0)	27.7	(3.1)
48.0 to 49.9	30.1	(5.3)	23.0	(9.9)	4.9	(2.6)	18.8	(2.9)
50.0 or more	15.3	(4.4)	2.7	(2.7)	0.6	(0.5)	7.5	(2.1)
Total	100.0		100.0		100.0		100.0	

11. Neck rails

Neck rails connect the freestall loops and are common features of freestalls. These rails, which are commonly constructed of pipe or cable, are used to provide cows a gauge of how far they can enter the stall. If neck rails are properly positioned, they allow cows to stand with all four feet in the stall and help ensure that manure and urine are deposited in the alleyway. If neck rails are placed too close to the rear curb or alleyway, cows may have difficulty rising without contacting the rails and may be more likely to stand with two feet in the stall (perching). Neck rails too far from the alleyway allow cows to stand fully in the stall, which can lead to more manure and urine being deposited in stalls rather than in the alleyway (Tucker et al., 2005; Fregonessi et al., 2009). Although restrictive neck rails help keep stalls clean, they may also lead to higher lameness scores (Bernardi et al., 2009).

The suggested height and distance from the rear curb for neck rails depend on the size of the cows housed. For adult cows weighing approximately 1,200 to 1,400 pounds, neck rails should be between 40 and 50 inches above the bed (BCMAF, 1994; Cook and Nordlund, 2004; Tucker et al., 2005). The recommended horizontal distance from curb to neck rail is generally 60 to 66 inches (BCMAF, 1994; Cook and Nordlund, 2004). When cows rise, incorrectly installed stationary neck rails can lead to neck injuries (Anderson, 2008b). Movable neck rails, which are usually supported from above, allow cows more freedom when using the stall and may decrease injuries.

Almost all freestall operations (98.2 percent) used neck rails. About 9 of 10 operations (90.5 percent) had stationary neck rails.

a. Percentage of freestall operations by type of neck rail

Type of Neck Rail	Percent Operations	Standard Error
Stationary	90.5	(1.8)
Moveable	7.7	(1.7)
None	1.8	(0.6)
Total	100.0	

Almost one-half of freestall operations that used neck rails placed neck rails at the recommended distance of 60.0 to 65.9 inches from the rear curb. Two-fifths of operations (41.3 percent) placed neck rails at 66.0 or more inches from the rear curb.

b. Percentage of freestall operations that used neck rails, by average distance from neck rail to curb

Average Distance (Inches)	**Percent Operations**	**Standard Error**
Less than 60.0	11.9	(2.5)
60.0 to 65.9	46.8	(4.1)
66.0 to 71.9	32.2	(4.0)
72.0 or more	9.1	(2.3)
Total	100.0	

More than three of four freestall operations that used neck rails (77.0 percent) located neck rails at the recommended height of 40.0 to 49.9 inches above the stall bed.

c. Percentage of freestall operations that used neck rails, by average distance from neck rail to bedding surface

Average Distance (Inches)	**Percent Operations**	**Standard Error**
Less than 40.0	20.6	(3.2)
40.0 to 45.9	47.6	(4.2)
46.0 to 49.9	29.4	(3.9)
50.0 or more	2.4	(0.9)
Total	100.0	

12. Brisket locators

Brisket locators (or brisket boards) are placed at the front of freestalls to keep cows from lying too far forward in the stall, making it difficult for cows to rise. Brisket locators properly position cows in their stalls and also reduce manure and urine contamination by keeping the rear of the cows close to the curb and alleyway. Brisket locators should be smooth, rounded, and not rise higher than 4 inches above the bedding (Cook and Nordlund, 2004). Research suggests that large wooden brisket locators reduce the time cows spend lying in stalls (Tucker et al., 2006). Stall features that are used to keep cows clean, such as brisket locators, may reduce cow comfort. The recommended distance from the rear curb to the brisket locator is 62 to 72 inches, depending on the weight of the cow being housed (ASABE, 2006).

Brisket locators were present on 59.3 percent of freestall operations. One-third of operations (33.4 percent) used a locator made of wood.

a. Percentage of freestall operations by type of brisket locator

Type of Brisket Locator	Percent Operations	Standard Error
Concrete	4.8	(1.6)
Wood	33.4	(3.9)
PVC or other plastic pipe	12.2	(2.6)
Other	8.9	(2.3)
None	40.7	(3.9)
Total	100.0	

Approximately one of four freestall operations that used brisket locators (22.8 percent) placed them less than 66.0 inches from the rear curb, while about 15 percent of operations placed them 72.0 inches or more from the rear curb.

b. Percentage of freestall operations that used brisket locators by average distance from curb to brisket locator

Average Distance (Inches)	**Percent Operations**	**Standard Error**
Less than 66.0	22.8	(4.3)
66.0 to 67.9	25.5	(4.9)
68.0 to 69.9	21.1	(4.6)
70.0 to 71.9	15.7	(3.9)
72.0 or more	14.9	(3.3)
Total	100.0	

13. Lunge space

Lunge space is the area in the front of a stall that allows cows to lunge and bob their heads in order to rise from the lying position. Although this area can be completely open, there is usually some barrier to keep cows from crawling too far forward. Research suggests that barriers should be 40 to 42 inches above the stall surface (Cook and Nordlund, 2004).

More than two of three operations (68.7 percent) had a barrier at the front of stalls. Wood was the barrier material used on 33.9 percent of operations. Approximately one-fourth of operations used “other” materials for front barriers, and the majority of these barriers were combinations of the listed materials as well as metal pipe.

Percentage of freestall operations by lunge barrier material

Lunge Barrier Material	Percent Operations	Standard Error
Concrete	6.6	(2.0)
Wood	33.9	(3.9)
Cable	2.6	(0.9)
Other	25.6	(3.4)
None	31.3	(3.8)
Total	100.0	

14. Curb measures

The curb separates the stall bed from the alleyway. The height of the curb is thought to be more important than its width, since curbs higher than 12.9 inches may lead to udder injuries and cause the cow to be reluctant to step up into the stall. The recommended height for curbs is 8 to 12 inches (BCMAF, 1994). Curb width is considered in the stall-length calculation; if it is excessively wide cows may get hock lesions from the abrasive action of the concrete on the hocks. The recommended curb width is 6 inches (BCMAF, 1994).

Curb height was at the recommended height of 8.0 to 12.9 inches on approximately three of four freestall operations (75.7 percent).

a. Percentage of freestall operations, by curb height

Curb Height (Inches)	**Percent Operations**	**Standard Error**
Less than 8.0	17.7	(3.3)
8.0 to 12.9	75.7	(4.0)
13.0 or more	6.6	(2.8)
Total	100.0	

Almost 70 percent of operations had curb widths of 6.0 to 8.9 inches.

b. Percentage of freestall operations, by curb width

Curb Width (Inches)	**Percent Operations**	**Standard Error**
Less than 6.0	21.6	(3.9)
6.0 to 8.9	68.0	(4.6)
9.0 or more	10.4	(3.1)
Total	100.0	

15. Gutter grates

Gutter grates are found on tie-stall and stanchion operations and have many functions. Grates provide a bridge from the alley to the stall for both cow and human movement. Additionally, grates keep cows' tails out of gutters. Grates are especially important when calves are born in stalls; without grates, calves might be born into the gutter, which might contaminate the calves with manure and urine.

Almost 6 of 10 operations with tie-stall or stanchion housing (55.7 percent) had at least some gutter grates. Approximately one of four operations had gutter grates on less than 50.0 percent of stalls. A higher percentage of tie-stall operations had gutter grates in 50.0 percent or more of stalls than stanchion operations (36.5 and 11.8 percent, respectively).

Percentage operations by percentage of stalls with gutter grates, and by housing type

	Percent Operations					
	Housing Type					
	Tie stall		Stanchion		All Operations	
Percent Stalls with Gutter Grates	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
0.0	40.6	(5.6)	55.6	(10.1)	44.3	(4.8)
0.1 to 49.9	22.9	(4.9)	32.6	(9.5)	25.3	(4.3)
50.0 or more	36.5	(5.4)	11.8	(6.5)	30.4	(4.5)
Total	100.0		100.0		100.0	

16. Cow trainers

Cow trainers should be located about 4 inches above the withers and are used to help keep the stall bed clean. When cows arch their backs to urinate or defecate, cow trainers prompt the cows to back up and deposit in the gutter instead of the stall bed. To be most effective, trainers must be adjusted for each cow. It appears that trainers need to be activated only 1 to 2 days per week to have the desired effect (Anderson, 2008a). Although trainers are supposed to assist in keeping stalls and cows cleaner, one study found that the presence of electric trainers was associated with dirty hind limbs and more cows with open wounds of the hock (Zurbrigg et al., 2005).

A higher percentage of tie-stall operations had electric cow trainers compared with stanchion operations (72.6 and 42.8 percent, respectively).

a. Percentage operations with cow trainers, by housing type

Percent Operations					
Housing Type					
Tie stall		Stanchion		All Operations	
Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
72.6	(4.8)	42.8	(9.7)	65.0	(4.3)

The horizontal distance from the trainer to the edge of the gutter should be approximately 48 inches (Anderson, 2008a). On approximately 45 percent of tie-stall operations, trainers were located 50.0 inches or more from the gutter edge, while on nearly the same percentage of stanchion operations, the trainer was located less than 46.0 inches from the gutter edge.

b. Percentage of operations by operation horizontal distance from trainer to gutter, and by housing type

	Percent Operations					
	Housing Type					
	Tie stall		Stanchion		All Operations	
Average Horizontal Distance (Inches)	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 46.0	17.0	(4.9)	41.9	(15.6)	21.2	(5.1)
46.0 to 49.9	37.5	(6.7)	30.8	(13.8)	36.3	(6.1)
50.0 to 53.9	23.0	(5.7)	18.2	(10.1)	22.2	(5.1)
54.0 or more	22.5	(5.5)	9.1	(8.7)	20.3	(4.8)
Total	100.0		100.0		100.0	

The height of a cow trainer should be directly related to the height of the cow, with the trainer being 4 inches above the back/wither area (Anderson, 2008a). Approximately one-fourth of all operations located the trainers less than 58.0 inches from the stall bed and almost two-fifths located trainers at 60.0 inches or more above the stall bed.

c. Percentage of operations by average distance from trainer to bed, and by housing type

	Percent Operations					
	Housing Type					
	Tie stall		Stanchion		All Operations	
Average Distance (Inches)	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Less than 58.0	26.6	(5.8)	36.4	(15.1)	28.2	(5.5)
58.0 to 59.9	35.4	(6.7)	26.6	(13.5)	33.9	(6.1)
60.0 or more	38.0	(6.7)	37.0	(14.4)	37.9	(6.0)
Total	100.0		100.0		100.0	

17. Water sources

Approximately 9 of 10 operations provided water troughs or tanks to cows in freestall or other multiple-animal area housing types, including dry lots.

Percentage of operations by water source and by housing type

	Percent Operations					
	Housing Type					
	Freestall		Other Multiple-animal Area		All Operations	
Water Source	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Individual cups or bowls	0.6	(0.4)	0.0	(--)	0.5	(0.3)
Troughs or tanks	91.2	(2.5)	91.6	(3.7)	91.3	(2.1)
Other	1.0	(1.0)	3.9	(2.8)	1.6	(1.0)
Combination of above	7.2	(2.3)	4.5	(2.4)	6.6	(1.9)
Total	100.0		100.0		100.0	

B. Cow Health

Note: Differences in this section were analyzed using STATA and the SUDAAN software. P values less than 0.05 were considered statistically significant (see Section III: Methodology, p 156).

1. Cow morbidity

During 2006, clinical mastitis, lameness, and infertility were the most common problems affecting cows on assessed operations (16.6, 16.0, and 14.9 percent of cows, respectively). A higher percentage of cows on tie-stall and freestall operations experienced clinical mastitis, infertility, or a displaced abomasum compared with cows in other housing types. Lameness affected the highest percentage of cows on freestall operations (18.4 percent) compared with cows in other housing types. With the exception of tie-stall operations, infertility was highest on freestall operations compared with other housing types.

Percentage of cows by health problems in 2006 and by housing type

	Percent Cows* Housing Type													
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Assessed Operations		All Dairy 2007 Operations	
Problem	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Clinical mastitis	18.6	(1.4)	14.0	(1.5)	17.9	(1.1)	10.5	(2.2)	10.3	(1.8)	16.6	(0.8)	16.5	(0.5)
Lameness	14.3	(1.4)	12.9	(2.5)	18.4	(1.2)	7.9	(1.9)	11.0	(3.1)	16.0	(0.8)	14.0	(0.4)
Respiratory problems	4.8	(1.1)	3.5	(1.5)	3.9	(0.3)	2.0	(0.3)	2.1	(0.4)	3.7	(0.3)	3.3	(0.1)
Retained placenta (more than 24 hours)	10.3	(0.8)	8.5	(1.4)	9.2	(0.5)	3.9	(0.8)	5.8	(1.3)	8.7	(0.4)	7.8	(0.2)
Infertility problems (not pregnant 150 days after calving)	14.1	(1.1)	8.6	(1.3)	16.4	(1.0)	11.0	(1.5)	11.5	(1.6)	14.9	(0.7)	12.9	(0.3)
Other reproductive problems (e.g., dystocia, metritis)	5.0	(0.7)	4.2	(1.3)	7.8	(1.0)	2.0	(0.5)	6.4	(1.2)	6.6	(0.7)	4.6	(0.3)
Diarrhea for more than 48 hours	4.7	(1.8)	5.2	(2.2)	1.9	(0.2)	2.0	(1.0)	1.5	(0.2)	2.4	(0.3)	2.5	(0.2)
Milk fever	8.0	(0.8)	7.8	(2.2)	5.1	(0.4)	3.1	(0.5)	2.7	(0.4)	5.3	(0.3)	4.9	(0.1)
Displaced abomasum	5.0	(0.4)	3.7	(0.7)	4.3	(0.3)	1.4	(0.3)	3.0	(0.6)	4.0	(0.2)	3.5	(0.1)
Neurological problems	0.6	(0.2)	0.2	(0.1)	0.3	(0.1)	0.1	(0.1)	0.6	(0.2)	0.3	(0.1)	0.3	(0.0)
Other health-related problems	0.7	(0.4)	0.8	(0.7)	1.5	(0.6)	1.0	(0.9)	0.3	(0.2)	1.2	(0.4)	0.6	(0.1)

*As a percentage of January 1, 2007, cow inventory.

2. Permanently removed cows

During 2006, udder or mastitis problems, lameness or injury, and reproductive problems each accounted for more than 4 percent of the cow inventory permanently removed on all assessed operations. A higher percentage of cows on tie-stall operations were sold as replacements to other dairies compared with cows in other housing types, except other multiple-animal areas. A higher percentage of cows were removed from tie-stall operations (27.8 percent) compared with cows on stanchion or freestall operations (18.5 and 24.0 percent, respectively). Freestall operations removed a higher percentage of cows than stanchion operations.

For operations that permanently removed cows in 2006, percentage of cows permanently removed, by reason and by housing type

	Percent Cows*													
	Housing Type													
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Assessed Operations		All Dairy 2007 Operations	
Reason	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Udder or mastitis problems	7.1	(0.6)	5.6	(0.9)	5.5	(0.4)	4.9	(1.1)	5.8	(1.3)	5.6	(0.3)	5.4	(0.1)
Lameness or injury	5.0	(0.6)	3.3	(0.6)	4.3	(0.3)	3.0	(0.7)	4.5	(1.3)	4.2	(0.3)	3.8	(0.1)
Reproductive problems	7.3	(0.7)	5.2	(0.7)	7.2	(0.5)	7.4	(1.8)	6.7	(1.3)	7.1	(0.4)	6.2	(0.2)
Poor production not related to above	2.7	(0.4)	2.3	(0.8)	3.2	(0.5)	3.5	(1.3)	5.5	(1.0)	3.3	(0.4)	3.8	(0.2)
Aggressiveness or belligerence	0.2	(0.1)	0.7	(0.3)	0.1	(0.0)	0.1	(0.1)	0.5	(0.4)	0.2	(0.0)	0.1	(0.0)
Other diseases	1.0	(0.2)	0.7	(0.4)	1.2	(0.2)	1.2	(0.6)	0.2	(0.2)	1.1	(0.1)	0.9	(0.1)
Sold as replacements to another dairy	3.7	(1.4)	0.1	(0.1)	0.9	(0.2)	0.4	(0.3)	2.8	(1.7)	1.4	(0.3)	1.4	(0.2)
Other	0.8	(0.3)	0.6	(0.4)	1.6	(0.6)	0.5	(0.2)	0.6	(0.4)	1.3	(0.4)	2.0	(0.3)
Total	27.8	(1.6)	18.5	(1.6)	24.0	(0.9)	21.0	(4.0)	26.6	(3.1)	24.2	(0.8)	23.6	(0.4)

*As a percentage of January 1, 2007, cow inventory.

3. Cow mortality

Deaths due to lameness or injury, mastitis, and calving problems each accounted for 1 percent or more of the cow inventory on all assessed operations. A lower percentage of cow deaths due to digestive problems (0.2 percent) occurred on tie-stall operations than on freestall or other multiple-animal areas (0.7 and 1.1 percent, respectively). Mastitis accounted for a higher percentage of cow deaths on freestall operations and operations with other multiple-animal area housing than on stanchion operations. Cow deaths due to calving problems were lowest for cows on stanchion operations compared with all other operations, with the exception of operations with other multiple-animal areas.

Percentage of cow deaths by cause and by housing type

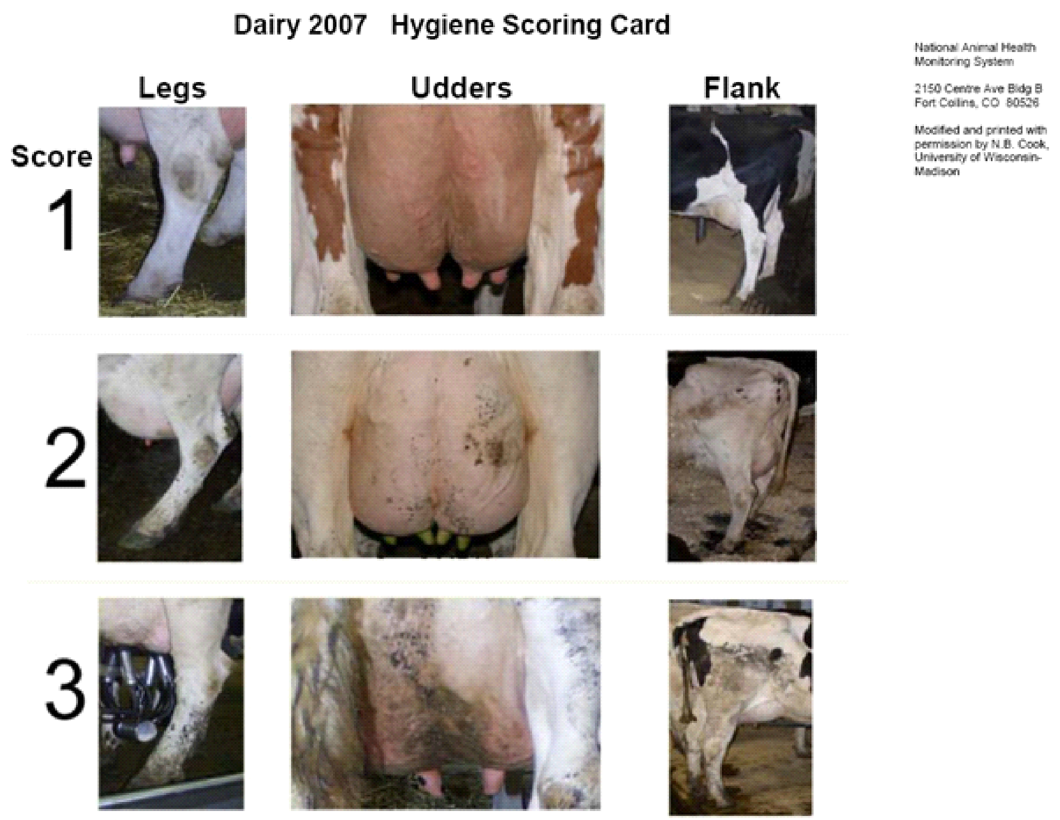
	Percent Cows*													
	Housing Type													
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Assessed Operations		All Dairy 2007 Operations	
Cause	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Scours, diarrhea, or other digestive problems	0.2	(0.1)	0.5	(0.3)	0.7	(0.1)	0.9	(0.4)	1.1	(0.4)	0.7	(0.1)	0.6	(0.0)
Respiratory problems	0.4	(0.2)	0.3	(0.2)	0.7	(0.1)	0.5	(0.1)	0.5	(0.1)	0.6	(0.1)	0.6	(0.0)
Poison	0.0	(--)	0.0	(--)	0.0	(--)	0.1	(0.1)	0.0	(--)	0.0	(0.0)	0.0	(0.0)
Lameness or injury	1.2	(0.2)	0.6	(0.3)	1.3	(0.1)	0.7	(0.2)	1.3	(0.2)	1.2	(0.1)	1.1	(0.0)
Lack of coordination or severe depression	0.1	(0.0)	0.3	(0.3)	0.1	(0.0)	0.0	(--)	0.0	(--)	0.1	(0.0)	0.0	(0.0)
Mastitis	0.7	(0.2)	0.5	(0.2)	1.2	(0.1)	0.7	(0.3)	1.4	(0.4)	1.1	(0.1)	0.9	(0.0)
Calving problems	1.4	(0.3)	0.3	(0.1)	1.0	(0.1)	0.9	(0.3)	0.6	(0.2)	1.0	(0.1)	0.9	(0.0)
Other known reasons	0.7	(0.2)	0.7	(0.3)	0.7	(0.1)	1.7	(0.7)	0.4	(0.2)	0.7	(0.1)	0.6	(0.0)
Unknown reasons	0.9	(0.2)	1.1	(0.5)	1.0	(0.1)	0.5	(0.2)	0.4	(0.1)	0.9	(0.1)	0.8	(0.1)
Total	5.6	(0.5)	4.3	(0.7)	6.7	(0.3)	6.0	(1.1)	5.7	(0.5)	6.3	(0.2)	5.7	(0.1)

*As a percentage of January 1, 2007, cow inventory.

C. Cow Assessments

1. Background/ method

Operations participating in Phase II (VMO component) of the Dairy 2007 study were given the opportunity to have up to 100 cows evaluated for hygiene of the udder, legs, and flanks. Hygiene was scored on a scale from 1 to 3, with 1 being no or very little manure and 3 being manure present in large quantities on the udder, legs, and flanks. Assessments were completed between March 5 and September 5, 2007. A training video was produced to assist evaluators in conducting the animal assessments. The following photographs of hygiene and hocks were provided to assist scorers in evaluating cows.



Hygiene is a critical component of producing quality milk. Multiple studies have shown a relationship between udder hygiene and somatic cell counts (Schriener and Ruegg, 2003; Reneau et al., 2005). Increased bacterial counts in milk have also been associated with poor udder hygiene (Elmoslemany et al., 2009). Hygiene is impacted by stall design and manure management. Cows on operations with properly designed and maintained freestalls and alleyways are more likely to have better hygiene than cows housed in improperly designed or maintained facilities.

Operations were also given the opportunity to have up to 100 cows scored for hock condition. Hocks were scored on a scale from 1 to 3, with 1 indicating hocks with no swelling or hair loss and 3 indicating hocks with evident swelling or a lesion through the hide. Each cow received two hock scores, one for each rear leg, and the higher of the hock scores was applied to the cow (i.e., if a cow had hair loss on one hock [score=2] and not the other [score=1] the cow received a score of 2). The following chart was used to evaluate hocks.


Cornell University Cooperative Extension

Hock Assessment Chart for Cattle

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Score = 1
No Swelling. No hair is missing.

Score = 2
No swelling. Bald area on the hock.

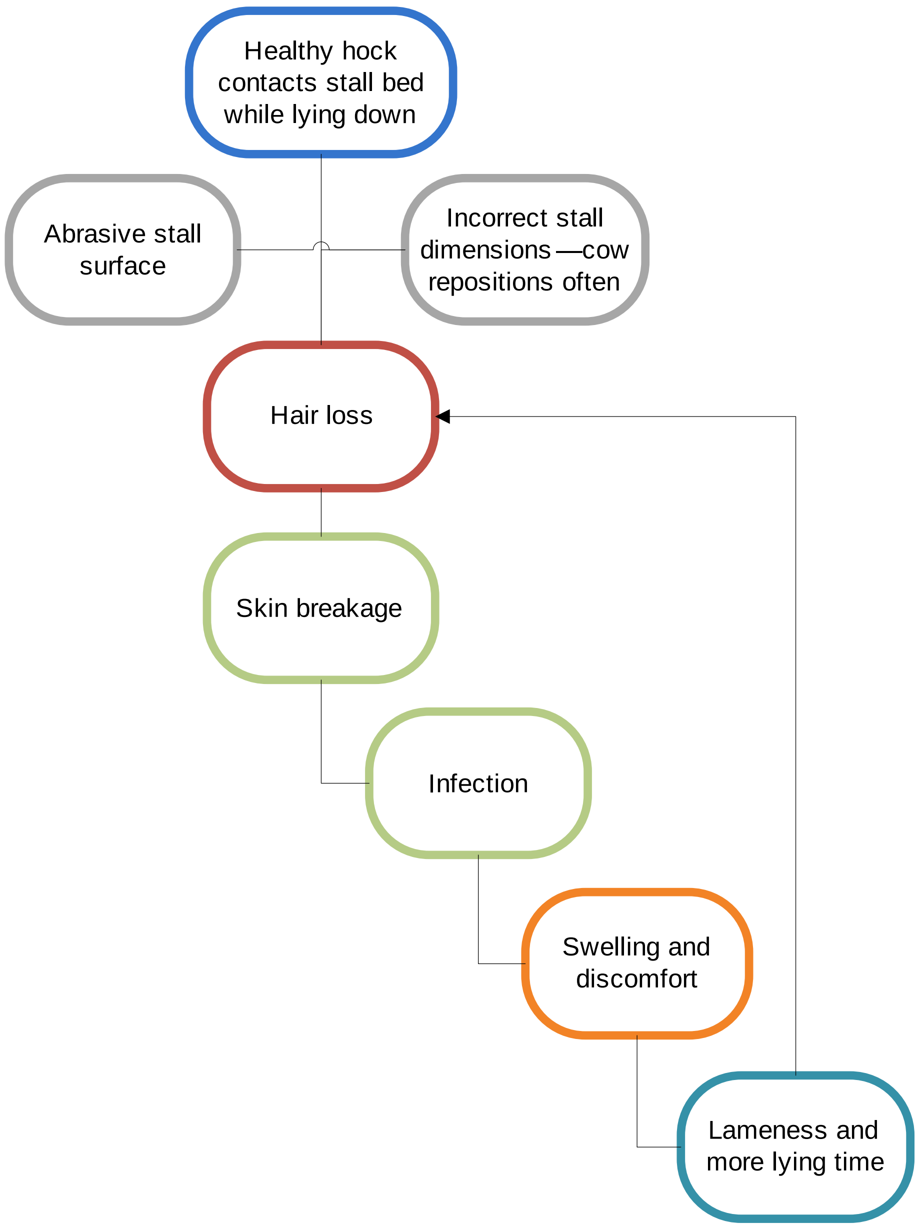
Score = 3
Swelling is evident or there is a lesion through the hide.

The normal, healthy hock is free from skin lesions and swelling. Ideally, the hair coat in that area is smooth and continuous with the rest of the leg.

Hock health is an important indicator of the abrasiveness of stall bedding and cow comfort. Injury is usually the result of prolonged exposure to an abrasive stall surface. Skin breakage provides an opportunity for infection to occur, which can lead to swelling, discomfort, and possibly lameness.

A consistent method of scoring hocks for swelling and hair loss allows you to assess the need to modify your stall management and can help you evaluate the effect of management changes.

The following chart outlines a hypothetical sequence of events that might lead to the development of hock lesions (Vokey, 2004). Most hock lesions are secondary to contact with abrasive surfaces. Continued exposure to abrasive surfaces leads to hair loss, skin abrasions, infection, and subsequent swelling and lameness.



Facility and management features associated with increased hock lesions include stall surface materials and stall design. Multiple studies have reported that rubber-filled mattresses are associated with more hock lesions compared with most other stall bases (Weary and Taszkun, 2000; Wechsler et al., 2000; Vokey et al., 2001; Fulwider et al., 2007). Short stall length may also contribute to more hock lesions (Weary and Taszkun, 2000).

2. Hygiene results

Note: Differences in this section were analyzed using STATA and SUDAAN software. P values less than 0.05 were considered statistically significant (see Section III: Methodology, p 156).

Hygiene scoring was performed on 477 operations. Freestall operations accounted for 282 of these operations and provided the majority (68.3 percent) of all cows scored. Approximately twice as many cows were scored on freestall, dry lot, and other multiple-animal area operations than on tie-stall or stanchion operations. These differences in animals scored among different housing types are directly related to herd size.

a. Number of operations assessed and number of cows assigned hygiene scores, by housing type

	Housing Type					
Parameter	Tie stall	Stanchion	Freestall	Dry lot	Other Multiple-animal Area	All Operations
Total number of operations assessed	102	27	282	30	36	477
Total number of cows scored	5,576	1,236	26,782	2,551	3,051	39,196
Average number of cows scored per operation	54.7	45.8	95.0	85.0	84.7	82.2

Among all housing types, 39.5 percent of cows had a hygiene score of 2 and 13.9 percent had a score of 3. Overall, there were no differences across housing types in the percentages of cows with hygiene scores of 1. A lower percentage of cows on freestall operations (10.0 percent) had a hygiene score of 3 compared with cows on tie-stall, stanchion, and dry lot operations (16.2, 21.4, and 22.3 percent, respectively).

b. Percentage of cows by hygiene score and by housing type

	Percent Cows											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	48.6	(2.9)	37.3	(5.6)	47.9	(2.3)	43.7	(6.1)	42.3	(6.5)	46.6	(1.7)
2	35.2	(1.7)	41.3	(4.5)	42.1	(1.9)	34.0	(3.3)	43.7	(6.8)	39.5	(1.3)
3	16.2	(1.6)	21.4	(2.8)	10.0	(1.1)	22.3	(4.5)	14.0	(3.8)	13.9	(0.9)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

Operations that used stall bases made of concrete or rubber mats had a higher percentage of cows with hygiene scores of 3 (16.5 and 18.0 percent, respectively) than operations that used dirt or mattresses (10.2 and 11.6 percent, respectively).

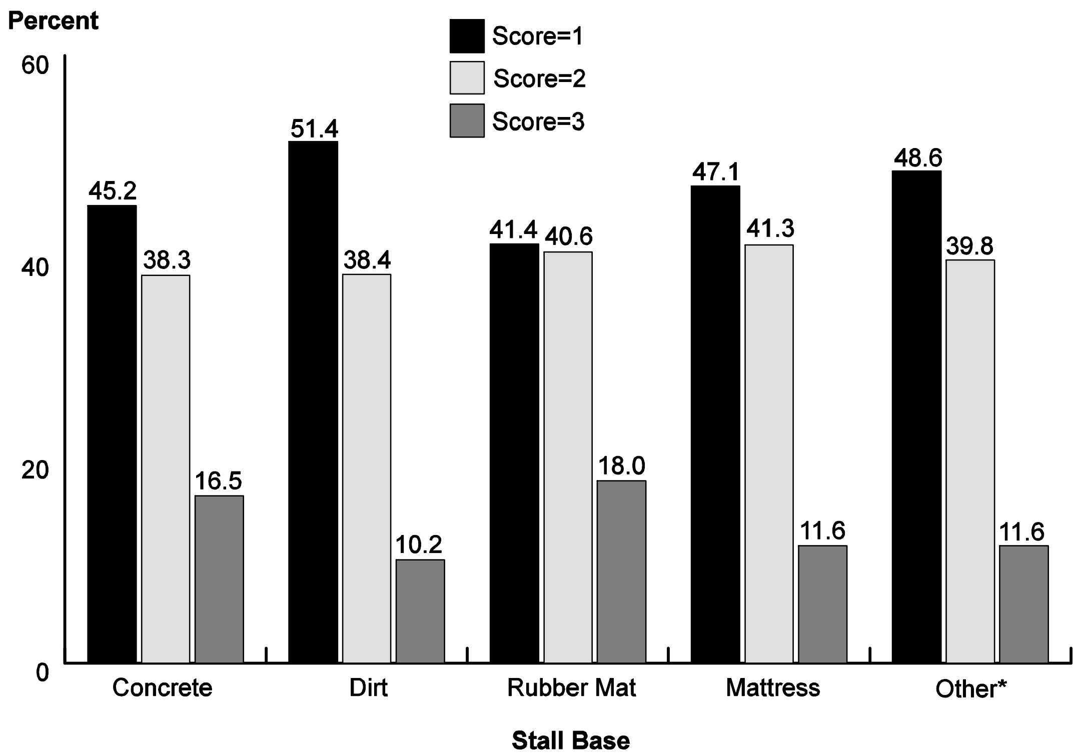
c. Percentage of cows by hygiene score and by type of stall base

	Percent Cows									
	Type of Stall Base									
	Concrete		Dirt		Rubber Mat		Mattress		Other*	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	45.2	(3.3)	51.4	(3.7)	41.4	(3.3)	47.1	(3.3)	48.6	(5.0)
2	38.3	(2.2)	38.4	(3.3)	40.6	(2.4)	41.3	(2.8)	39.8	(4.1)
3	16.5	(1.9)	10.2	(1.5)	18.0	(2.2)	11.6	(1.2)	11.6	(2.5)
Total	100.0		100.0		100.0		100.0		100.0	

*Includes waterbeds.

Photo courtesy of Dr. Jason Lombard

Percentage of Cows by Hygiene Score and by Stall Base



*Includes waterbeds.

Bedding type influenced hygiene scores. The lowest percentage of cows with a hygiene score of 3 were on operations that bedded stalls with coarse sand, composted manure, or dried manure (primarily freestall operations).

d. Percentage of cows by hygiene score and by bedding type

	Percent Cows															
	Bedding Type															
	Straw		Sawdust		Fine Sand		Coarse Sand		Composted Manure		Dried Manure		Other*		None	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	48.5	(2.8)	48.2	(3.4)	42.9	(4.7)	51.1	(6.0)	60.7	(8.2)	50.3	(10.3)	40.6	(4.4)	37.5	(6.7)
2	37.0	(2.0)	36.7	(2.5)	43.5	(3.6)	41.5	(5.3)	34.8	(6.8)	43.3	(10.6)	43.1	(3.1)	41.8	(3.5)
3	14.5	(1.6)	15.1	(1.8)	13.6	(2.8)	7.4	(1.6)	4.5	(2.3)	6.4	(2.2)	16.3	(2.2)	20.7	(4.2)
Total	100.0		100.0		100.0		100.0		100.0		100.0		100.0		100.0	

*Includes shredded newspaper.

Days since bedding was added/changed was not significantly associated with the percentage of cows by hygiene score.

e. Percentage of cows by hygiene score and by number of days since bedding was added/changed

	Percent Cows									
	Number of Days									
	Less than 1		1–2		3–4		5–6		7 or More	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	45.5	(7.1)	46.1	(3.5)	40.4	(5.6)	50.0	(5.4)	52.1	(4.1)
2	41.6	(4.9)	40.2	(2.8)	46.1	(4.7)	38.9	(3.9)	37.7	(2.9)
3	12.9	(3.0)	13.7	(2.0)	13.5	(3.1)	11.1	(3.2)	10.2	(1.8)
Total	100.0		100.0		100.0		100.0		100.0	

As bedding quantity/stall condition decreased, the percentage of cows with a hygiene score of 3 increased.

f. Percentage of cows by hygiene score and by bedding quantity/stall condition in majority of stalls

	Percent Cows									
	Bedding Quantity/Stall Condition									
	Base not Exposed, Bedding Level with Curb		Base not Exposed, Bedding Slightly Dished Out		Base Exposed (Less than 50 Percent)		Base Mostly Exposed (More than 50 Percent)		No Bedding Present*	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	51.3	(4.6)	50.4	(3.1)	41.2	(2.9)	45.5	(3.4)	39.3	(6.1)
2	40.4	(4.2)	37.6	(2.4)	43.2	(2.2)	37.6	(2.6)	40.5	(3.1)
3	8.3	(2.2)	12.0	(1.5)	15.6	(1.7)	16.9	(1.7)	20.2	(4.0)
Total	100.0		100.0		100.0		100.0		100.0	

*80.9 percent of operations on which no bedding was present were dry lot operations or operations with other multiple-animal areas.

Platform lengths for stalls on tie-stall and stanchion operations were not associated with hygiene scores.

g. For tie-stall and stanchion operations, percentage of cows by hygiene score and by average platform length

	Percent Cows									
	Average Platform Length (Inches)									
	Less than 60.0		60.0–64.9		65.0–69.9		70.0–74.9		75.0 or More	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	41.1	(7.3)	40.8	(7.2)	46.9	(4.1)	51.5	(3.5)	41.4	(14.1)
2	40.7	(5.4)	37.3	(5.3)	36.1	(2.1)	34.7	(2.2)	42.7	(10.1)
3	18.2	(5.8)	21.9	(3.2)	17.0	(2.7)	13.8	(1.7)	15.9	(4.5)
Total	100.0		100.0		100.0		100.0		100.0	

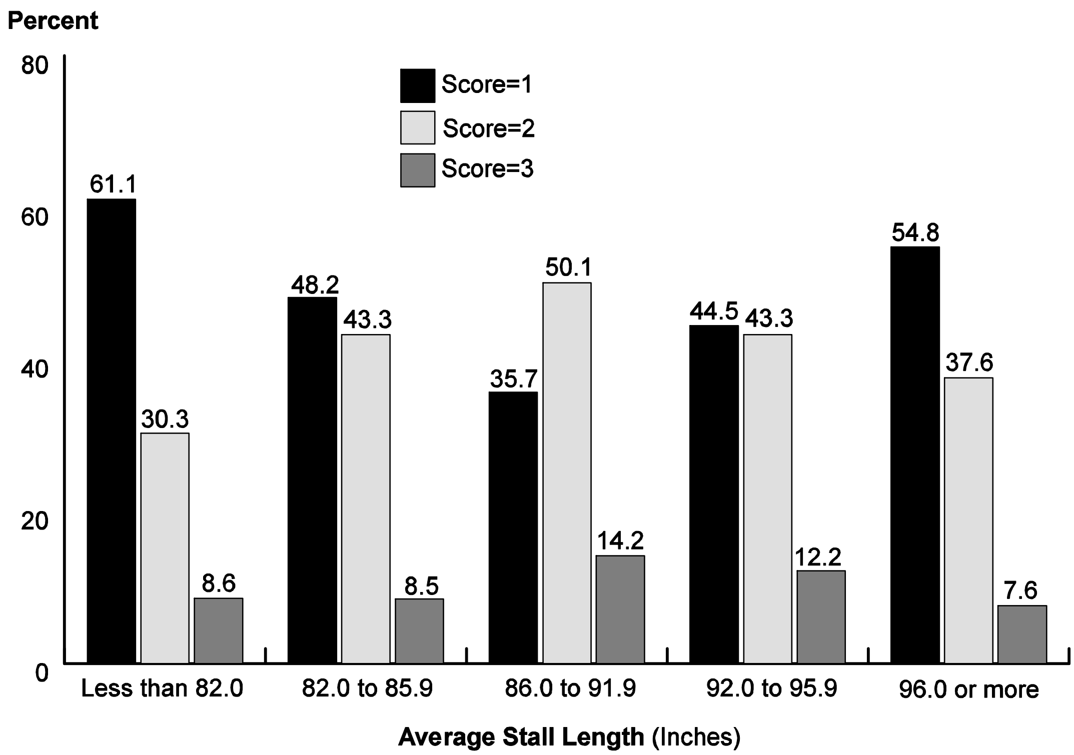

Photo courtesy of Dr. Jason Lombard

Freestall operations with stall lengths of less than 82.0 inches or 96.0 inches or more had a higher percentage of cows with a hygiene score of 1 (61.1 and 54.8 percent, respectively) compared with freestall operations with stall lengths of 86.0 to 91.9 inches (35.7 percent).

h. For freestall operations, percentage of cows by hygiene score and by average stall length

	Percent Cows									
	Average Stall Length (Inches)									
	Less than 82.0		**82.0–85.9**		**86.0–91.9**		**92.0–95.9**		**96.0 or More**	
Hygiene Score	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1	61.1	(7.6)	48.2	(6.0)	35.7	(3.7)	44.5	(6.9)	54.8	(7.6)
2	30.3	(5.5)	43.3	(5.2)	50.1	(3.2)	43.3	(5.1)	37.6	(6.9)
3	8.6	(4.6)	8.5	(2.3)	14.2	(2.6)	12.2	(2.3)	7.6	(1.7)
Total	100.0		100.0		100.0		100.0		100.0	

For Freestall Operations, Percentage of Cows by Hygiene Score and by Average Stall Length



The width of stalls did not have an impact on hygiene scores.

i. Percentage of cows by hygiene score and by average stall width

	Percent Cows Average Stall Width (Inches) Less than 42.0		42.0–43.9		44.0–45.9		46.0–47.9		48.0–49.9		50.0 or More	
Hygiene Score	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1	45.6	(6.6)	38.2	(5.9)	48.1	(4.5)	46.4	(3.6)	43.2	(5.0)	52.9	(6.3)
2	36.1	(3.6)	44.1	(4.8)	39.7	(3.4)	41.6	(2.8)	38.4	(3.7)	34.4	(3.0)
3	18.3	(3.9)	17.7	(4.4)	12.2	(2.4)	12.0	(1.6)	18.4	(2.3)	12.7	(4.0)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

A higher percentage of cows on operations with moveable neck rails had a hygiene score of 1 (74.8 percent) compared with cows on operations with stationary neck rails or no neck rails (43.7 and 40.8 percent, respectively).

j. For freestall operations, percentage of cows by hygiene score and by type of neck rail

	Percent Cows Type of Neck Rail Stationary		Moveable		None	
Hygiene Score	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1	43.7	(2.3)	74.8	(6.1)	40.8	(8.5)
2	45.2	(2.0)	20.3	(4.5)	45.7	(9.6)
3	11.1	(1.2)	4.9	(2.5)	13.5	(7.0)
Total	100.0		100.0		100.0	

The forward location of the neck rail was not associated with the percentage of cows by hygiene score.

k. For freestall operations, percentage of cows by hygiene score and by average distance from neck rail to curb

	Percent Cows							
	Average Distance (Inches)							
	Less than 60.0		60.0–65.9		66.0–71.9		72.0 or More	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	47.1	(8.1)	49.1	(3.2)	44.2	(4.0)	50.3	(6.6)
2	42.3	(6.5)	40.6	(2.6)	45.1	(3.4)	40.1	(6.1)
3	10.6	(3.4)	10.3	(1.8)	10.7	(1.7)	9.6	(1.9)
Total	100.0		100.0		100.0		100.0	

The distance of the neck rail above the bedding surface was not associated with the percentage of cows by hygiene score.

l. For freestall operations, percentage of cows by hygiene score and by average distance from neck rail to bedding surface

	Percent Cows							
	Average Distance (Inches)							
	Less than 40.0		40.0–45.9		46.0–49.9		50.0 or More	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	56.8	(5.0)	42.4	(3.1)	48.6	(4.6)	46.4	(10.0)
2	32.5	(3.8)	47.2	(2.7)	41.4	(3.5)	42.5	(7.9)
3	10.7	(3.3)	10.4	(1.2)	10.0	(2.0)	11.1	(4.1)
Total	100.0		100.0		100.0		100.0	

Operations with wood brisket locators had a higher percentage of cows with scores of 3 (12.3 percent) compared with operations that used "other" materials for brisket locators or did not use brisket locators.

m. For freestall operations, percentage of cows by hygiene score and by type of brisket locator

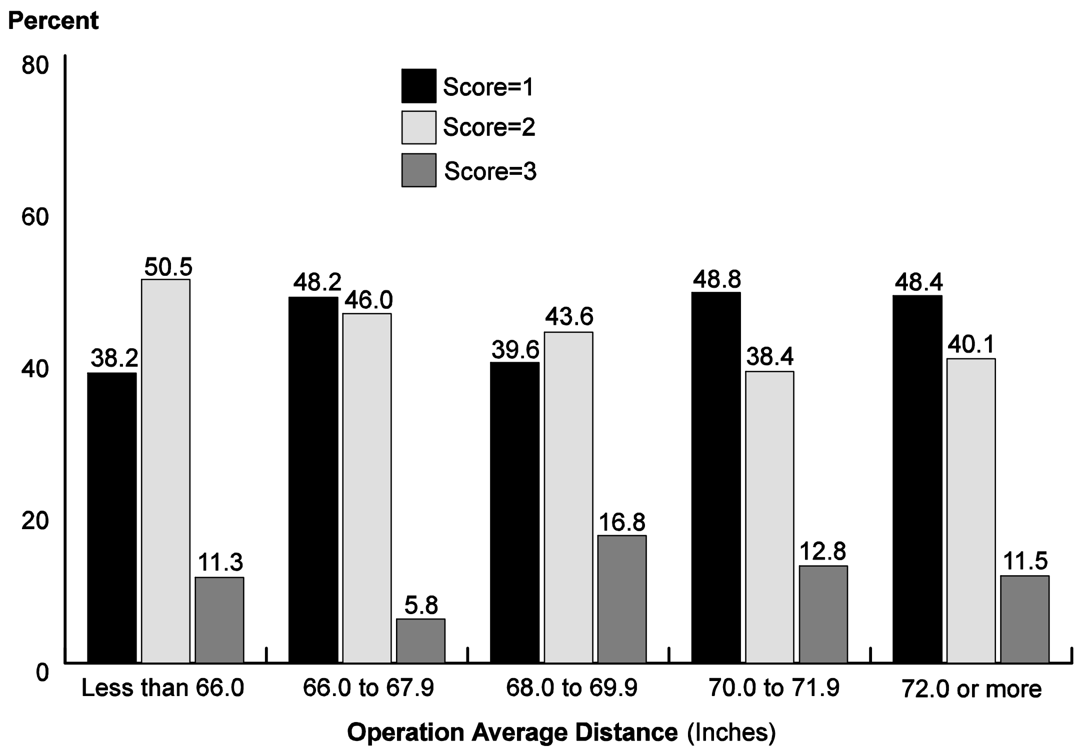
	Percent Cows									
	Type of Brisket Locator									
	Concrete		Wood		PVC or Other Plastic Pipe		Other		None	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	46.0	(11.1)	41.0	(3.4)	43.8	(6.3)	56.2	(6.7)	51.9	(3.9)
2	29.2	(7.1)	46.7	(2.9)	45.7	(5.6)	39.0	(5.7)	39.7	(3.1)
3	24.8	(11.5)	12.3	(1.8)	10.5	(2.8)	4.8	(1.1)	8.4	(1.3)
Total	100.0		100.0		100.0		100.0		100.0	

The percentage of cows with hygiene scores of 3 was significantly lower when the distance from the curb to the brisket locator was 66.0 to 67.9 inches than when the distance was less than 66.0 inches and 68.0 to 69.9 inches.

n. For freestall operations, percentage of cows by hygiene score and by operation average distance form curb to brisket locator

	Percent Cows									
	Operation Average Distance (Inches)									
	Less than 66.0		66.0–67.9		68.0–69.9		70.0–71.9		72.0 or More	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	38.2	(4.7)	48.2	(5.4)	39.6	(5.3)	48.8	(8.0)	48.4	(7.7)
2	50.5	(4.5)	46.0	(4.5)	43.6	(4.0)	38.4	(6.5)	40.1	(6.1)
3	11.3	(2.3)	5.8	(1.1)	16.8	(5.4)	12.8	(3.8)	11.5	(3.4)
Total	100.0		100.0		100.0		100.0		100.0	

For Freestall Operations, Percentage of Cows by Hygiene Score and by Operation Average Distance from Curb to Brisket Locator



The presence of a lunge barrier or type of barrier was not associated with hygiene scores.

o. For freestall operations, percentage of cows by hygiene score and by lunge barrier material

	Percent Cows									
	Lunge Barrier Material									
	Concrete		Wood		Cable		Other		None	
Hygiene Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	47.8	(9.1)	49.9	(3.6)	40.9	(7.9)	45.1	(5.0)	47.7	(4.2)
2	44.8	(7.5)	39.0	(2.8)	49.0	(7.0)	44.5	(4.4)	41.8	(3.2)
3	7.4	(1.8)	11.1	(1.8)	10.1	(3.2)	10.4	(2.7)	10.5	(1.8)
Total	100.0		100.0		100.0		100.0		100.0	

A lower percentage of cows were assigned a hygiene score of 1 on operations with curb heights of 13 inches or more (31.6 percent) compared with cows on operations with curb heights of 8.0 to 12.9 inches.

p. For freestall operations, percentage of cows by hygiene score and by curb height

	Percent Cows					
	Curb Height (Inches)					
	Less than 8.0		8.0–12.9		13.0 or More	
Hygiene Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	47.3	(5.7)	48.8	(2.7)	31.6	(5.6)
2	42.1	(5.0)	40.9	(2.1)	56.3	(5.0)
3	10.6	(3.0)	10.3	(1.3)	12.1	(2.4)
Total	100.0		100.0		100.0	

Curb width did not influence cow hygiene scores.

q. For freestall operations, percentage of cows by hygiene score and by curb width

	Percent Cows					
	Curb Width (Inches)					
	Less than 6.0		6.0–8.9		9.0 or More	
Hygiene Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	49.3	(5.8)	50.1	(3.4)	56.3	(7.5)
2	42.8	(5.2)	39.7	(2.7)	31.3	(4.3)
3	7.9	(1.8)	10. 2	(1.6)	12.4	(5.8)
Total	100.0		100.0		100.0	

Operations with any gutter grates had a higher percentage of cows assigned a hygiene score of 1 compared with operations without gutter grates. For operations on which 50.0 percent or more of stalls had gutter grates, a lower percentage of cows received a hygiene score of 3 compared with operations without gutter grates (12.8 and 21.4 percent of cows, respectively).

r. For tie-stall and stanchion operations, percentage of cows by hygiene score and by percentage of stalls with gutter grates

	Percent Cows					
	Percent Stalls with Gutter Grates					
	0.0		0.1–49.9		50.0 or More	
Hygiene Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	38.2	(4.7)	50.9	(4.1)	54.0	(3.6)
2	40.4	(3.2)	33.2	(2.2)	33.2	(2.2)
3	21.4	(2.4)	15.9	(2.7)	12.8	(2.1)
Total	100.0		100.0		100.0	

The use of cow trainers was associated with cleaner cows. A higher percentage of cows on operations with trainers had a hygiene score of 1 (50.3 percent) compared with cows on operations without trainers (37.6 percent).

Almost twice the percentage of cows had a hygiene score of 3 on operations that did not use cow trainers compared with cows on operations that did use cow trainers (23.6 and 14.1 percent, respectively).

s. Percentage of cows by hygiene score and by use of cow trainers

	Percent Cows			
	Cow Trainers			
	Yes		No	
Hygiene Score	**Percent**	**Std. Error**	**Percent**	**Std. Error**
1	50.3	(3.1)	37.6	(5.0)
2	35.6	(1.9)	38.8	(3.6)
3	14.1	(1.5)	23.6	(2.8)
Total	100.0		100.0	

Trainer location was not associated with hygiene scores. The distance from the trainer to the gutter or from the trainer to the stall bed was not associated with cleanliness.

t. For tie-stall and stanchion operations, percentage of cows by hygiene score and by average distance from trainer to gutter

	Percent Cows							
	Average Distance (Inches)							
	Less than 46.0		46.0–49.9		50.0–53.9		54.0 or More	
Hygiene Score	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1	52.6	(6.1)	55.0	(5.9)	47.9	(5.0)	42.5	(6.3)
2	32.1	(3.6)	33.8	(3.7)	38.4	(2.4)	39.4	(4.1)
3	15.3	(3.6)	11.2	(2.7)	13.7	(3.3)	18.1	(2.7)
Total	100.0		100.0		100.0		100.0	

u. For tie-stall and stanchion operations, percentage of cows by hygiene score and by average distance from trainer to bed

	Percent Cows					
	Average Distance (Inches)					
	Less than 58.0		**58.0–59.9**		**60.0 or More**	
Hygiene Score	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
1	54.0	(6.5)	45.5	(5.1)	51.3	(4.8)
2	33.8	(4.2)	39.6	(3.5)	33.9	(2.4)
3	12.2	(2.7)	14.9	(2.4)	14.8	(2.9)
Total	100.0		100.0		100.0	

No differences were observed in spring and summer in the percentage of cows by hygiene score.

v. Percentage of cows by hygiene score and by season

	Percent Cows			
	Season			
	Spring		**Summer**	
Hygiene Score	**Percent**	**Std. Error**	**Percent**	**Std. Error**
1	46.9	(2.2)	46.0	(2.5)
2	39.0	(1.7)	40.2	(1.9)
3	14.1	(1.1)	13.8	(1.4)
Total	100.0		100.0	

3. Hock results

Note: Differences in this section were analyzed using STATA and SUDAAN software. P values less than 0.05 were considered statistically significant (see Section III: Methodology, p 156).

Hock scoring was performed on 477 operations; freestall operations accounted for 282 of these operations, providing the majority of all cows scored (67.9 percent). Approximately twice as many cows were scored on freestall, dry lot, and other multiple-animal area operations than on tie-stall or stanchion operations. These differences in animals scored among different housing types are directly related to herd size.

a. Number of operations assessed and number of cows assigned hock scores, by housing type

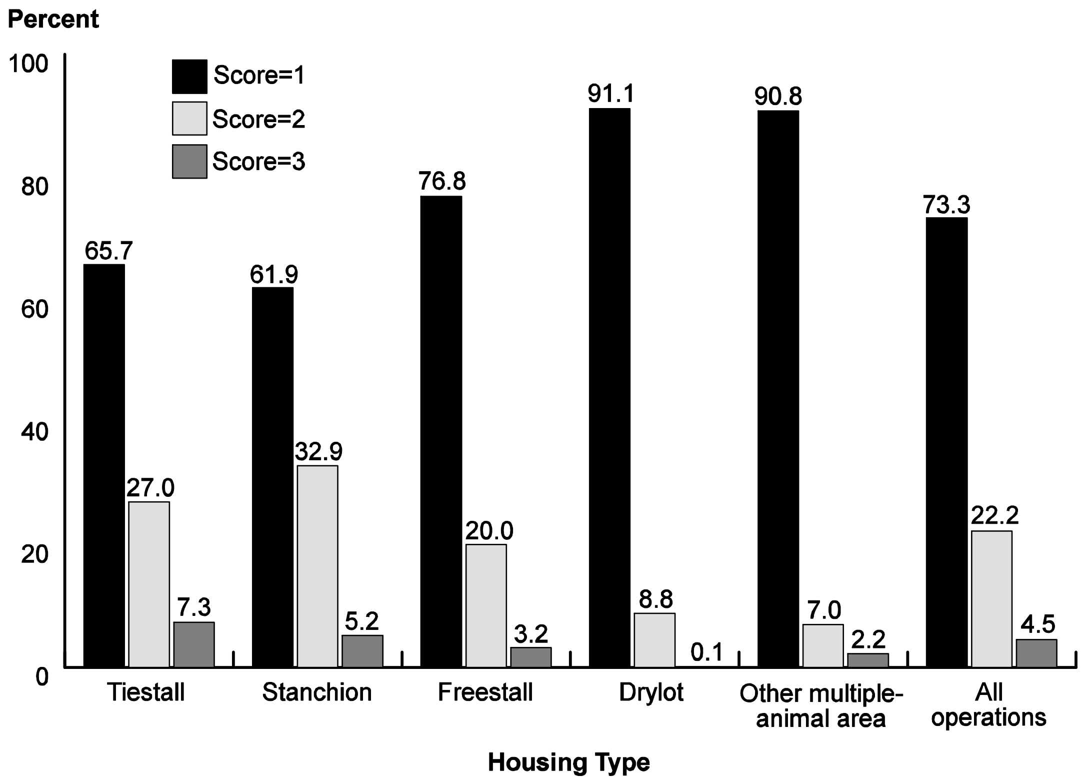
	Number Scored					
	Housing Type					
Parameter	Tie stall	Stanchion	Freestall	Dry lot	Other Multiple-animal Area	All Operations
Total number of operations assessed	102	27	282	30	38	477
Total number of cows scored	5,558	1,266	26,264	2,547	3,064	38,699
Average number of cows scored per operation	54.5	46.9	93.1	84.9	80.6	81.1

Operations with dry lots and other multiple-animal areas had the highest percentage of cows assigned a hock score of 1 (91.1 and 90.8 percent of cows, respectively). Approximately three of four cows on freestall operations (76.8 percent) were assigned a hock score of 1, while tie-stall and stanchion operations had the lowest percentage of cows with a score of 1 (65.7 and 61.9 percent, respectively). Dry-lot operations had a lower percentage of cows with hock scores of 3 compared with tie-stall, stanchion, and freestall operations.

b. Percentage of cows by hock score and by housing type

	Percent Cows											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	65.7	(2.6)	61.9	(5.2)	76.8	(1.9)	91.1	(3.4)	90.8	(3.1)	73.3	(1.4)
2	27.0	(2.2)	32.9	(5.5)	20.0	(1.7)	8.8	(3.4)	7.0	(2.0)	22.2	(1.2)
3	7.3	(1.0)	5.2	(1.1)	3.2	(0.4)	0.1	(0.1)	2.2	(1.4)	4.5	(0.4)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

Percentage of Cows by Hock Score and by Housing Type



Almost 9 of 10 cows (89.5 percent) on operations that used dirt as a stall base were assigned a hock score of 1. The lowest percentage of cows assigned a hock score of 1 were on operations that used concrete, rubber mats, or mattresses as a stall base (72.8, 65.9, and 60.6 percent, respectively). The lowest percentage of cows assigned a hock score of 3 (0.7 percent) were on operations that used dirt as a stall base, while the highest percentage of cows with a score of 3 were on operations that used concrete, rubber mats, or mattresses as a stall base (5.6, 7.2, and 5.0 percent, respectively).

c. Percentage of cows by hock score and by type of stall base

	Percent Cows									
	Type of Stall Base									
	Concrete		Dirt		Rubber Mat		Mattress		Other*	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	72.8	(2.8)	89.5	(2.0)	65.9	(3.0)	60.6	(3.3)	82.5	(2.6)
2	21.6	(2.5)	9.8	(1.9)	26.9	(2.3)	34.4	(3.2)	14.9	(2.2)
3	5.6	(0.9)	0.7	(0.2)	7.2	(1.0)	5.0	(0.9)	2.6	(0.7)
Total	100.0		100.0		100.0		100.0		100.0	

*Includes waterbeds.

A higher percentage of cows bedded with fine or coarse sand, composted or dried manure, or no bedding (used primarily by operations with freestalls, dry lots, or other multiple-animal areas) had hock scores of 1 compared with cows bedded with straw or sawdust (used primarily by tie-stall and stanchion operations). Similarly, a lower percentage of cows bedded in coarse sand and composted manure had hock scores of 3 compared with cows on straw, sawdust, or other bedding.

d. Percentage of cows by hock score and by type of bedding

	Percent Cows															
	Type of Bedding Type															
	Straw		Sawdust		Fine Sand		Coarse Sand		Composted Manure		Dried Manure		Other*		None	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	68.1	(2.6)	63.5	(2.5)	83.6	(4.1)	90.7	(2.4)	86.7	(5.8)	86.7	(5.0)	71.6	(4.3)	80.5	(4.8)
2	25.3	(2.3)	31.4	(2.4)	13.7	(3.3)	8.7	(2.3)	13.2	(5.8)	10.8	(4.1)	23.7	(4.1)	16.1	(3.8)
3	6.6	(1.0)	5.1	(0.8)	2.7	(1.0)	0.6	(0.2)	0.1	(0.1)	2.5	(1.5)	4.7	(0.9)	3.4	(1.5)
Total	100.0		100.0		100.0		100.0		100.0		100.0		100.0		100.0	

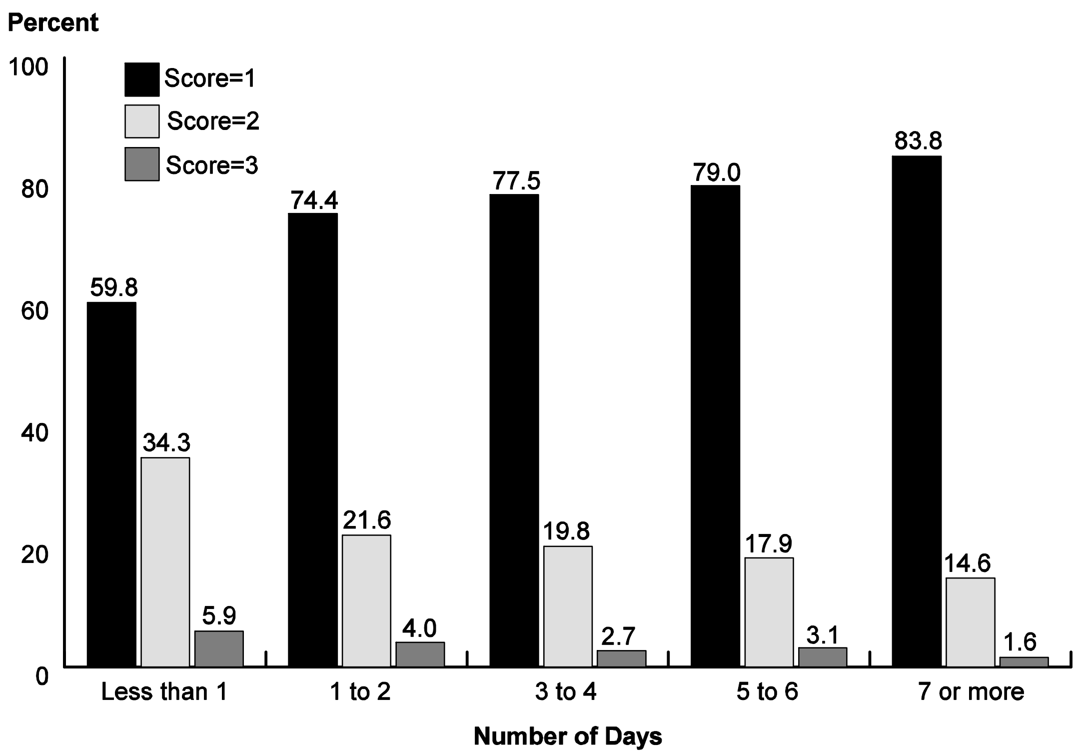
*Includes shredded newspaper.

As the number of days since bedding was added increased, the percentage of cows assigned a hock score of 1 increased. Housing type, bedding type, and bedding quantity likely influenced this relationship. The frequency and type of bedding and bedding quantity/stall condition were associated with housing type. Since operations with freestall or other multiple-animal areas typically had more days since bedding was added/changed, these results are in agreement with hock scores presented by housing type.

e. Percentage of cows by hock score and by number of days since bedding was added/changed

	Percent Cows									
	Number of Days									
	Less than 1		1 to 2		3 to 4		5 to 6		7 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	59.8	(6.9)	74.4	(3.2)	77.5	(4.4)	79.0	(4.5)	83.8	(2.4)
2	34.3	(5.8)	21.6	(2.7)	19.8	(3.8)	17.9	(3.7)	14.6	(2.1)
3	5.9	(1.8)	4.0	(0.9)	2.7	(0.8)	3.1	(0.9)	1.6	(0.6)
Total	100.0		100.0		100.0		100.0		100.0	

Percentage of Cows by Hock Score and by Number of Days Since Bedding was Added/Changed



The percentage of cows by hock scores was associated with bedding quantity. As bedding quantity decreased until the stall base was mostly exposed, a lower percentage of cows had hock scores of 1. In addition, a higher percentage of cows had hock scores of 1 when no bedding was present than when the stall base was exposed. Operations that did not use bedding were typically dry lot facilities on which cows lie on dirt.

f. Percentage of cows by hock score and by bedding quantity/stall condition in majority of stalls

	Percent Cows									
	Bedding Quantity/Stall Condition									
	Base not Exposed, Bedding Level with Curb		Base not Exposed, Bedding Slightly Dished Out		Base Exposed (Less than 50 Percent)		Base Mostly Exposed (More than 50 Percent)		No Bedding Present*	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	85.3	(2.8)	79.5	(2.4)	65.3	(2.6)	61.9	(3.5)	81.9	(4.2)
2	13.1	(2.5)	16.8	(1.9)	28.6	(2.4)	32.0	(3.2)	14.9	(3.3)
3	1.6	(0.6)	3.7	(0.8)	6.1	(0.8)	6.1	(1.1)	3.2	(1.3)
Total	100.0		100.0		100.0		100.0		100.0	

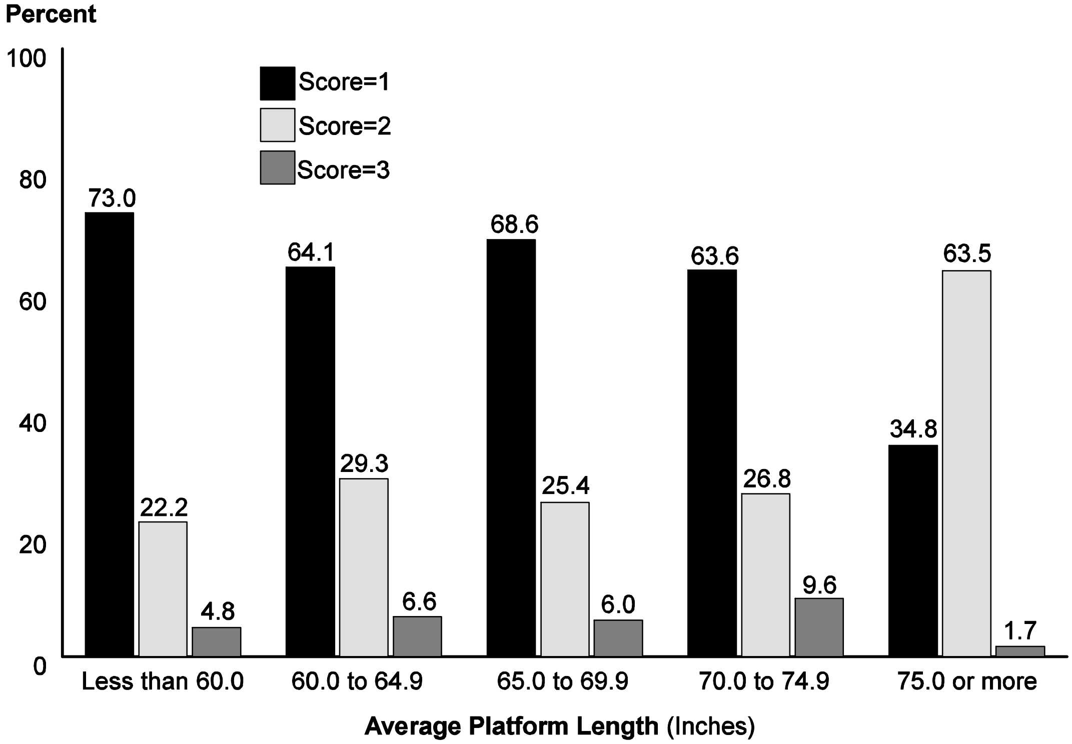
*80.9 percent of operations on which no bedding was present were dry lot operations or operations with other multiple-animal areas.

Platform lengths of 75.0 inches or more were associated with the lowest percentage of cows assigned a hock score of 1 (34.8 percent).

g. For tie-stall and stanchion operations, percentage of cows by hock score and by average platform length

	Percent Cows									
	Average Platform Length (Inches)									
	Less than 60.0		**60.0–64.9**		**65.0–69.9**		**70.0–74.9**		**75.0 or More**	
Hock Score	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1	73.0	(6.9)	64.1	(5.4)	68.6	(3.1)	63.6	(4.3)	34.8	(8.3)
2	22.2	(5.5)	29.3	(5.7)	25.4	(2.5)	26.8	(3.1)	63.5	(8.4)
3	4.8	(2.2)	6.6	(1.7)	6.0	(1.1)	9.6	(2.0)	1.7	(0.9)
Total	100.0		100.0		100.0		100.0		100.0	

For Tie-stall and Stanchion Operations, Percentage of Cows by Hock Score and by Average Platform Length



Stall length on freestall operations was not associated with specific hock scores.

h. For freestall operations, percentage of cows by hock score and by average stall length

	Percent Cows									
	Average Stall Length (Inches)									
	Less than 82.0		82.0–85.9		86.0–91.9		92.0–95.9		96.0 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	81.0	(7.2)	72.3	(4.1)	78.7	(2.8)	79.9	(4.5)	64.3	(7.6)
2	15.7	(6.2)	24.1	(3.7)	18.0	(2.3)	17.7	(4.2)	32.0	(7.6)
3	3.3	(1.3)	3.6	(0.9)	3.3	(0.8)	2.4	(0.7)	3.7	(1.2)
Total	100.0		100.0		100.0		100.0		100.0	

Stall width was not associated with hock scores.

i. Percentage of cows by hock score and by average stall width

	Percent Cows											
	Average Stall Width (Inches)											
	Less than 42.0		42.0–43.9		44.0–45.9		46.0–47.9		48.0–49.9		50.0 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	73.5	(4.9)	75.5	(5.4)	77.5	(3.4)	74.9	(2.9)	64.5	(4.4)	65.6	(6.8)
2	22.4	(4.4)	21.4	(5.1)	18.7	(2.7)	21.0	(2.4)	27.7	(4.3)	27.0	(5.5)
3	4.1	(1.4)	3.1	(0.9)	3.8	(0.9)	4.1	(0.8)	7.8	(1.6)	7.4	(2.5)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

Operations with stationary neck rails had a lower percentage of cows with hock scores of 1 (75.8 percent) compared with operations that had moveable neck rails or no neck rails (87.1 and 93.4 percent, respectively).

j. For freestall operations, percentage of cows by hock score and by type of neck rail

	Percent Cows					
	Type of Neck Rail					
	Stationary		Moveable		None	
Hock Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	75.8	(2.0)	87.1	(3.9)	93.4	(3.5)
2	20.7	(1.8)	12.0	(3.7)	6.6	(3.5)
3	3.5	(0.4)	0.9	(0.6)	0.0	(--)
Total	100.0		100.0		100.0	

Although there appeared to be a trend toward more hock lesions as the distance from neck rail to curb increased, no significant differences were found.

k. For freestall operations, percentage of cows by hock score and by average distance from neck rail to curb

	Percent Cows							
	Average Distance (Inches)							
	Less than 60.0		60.0–65.9		66.0–71.9		72.0 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	81.1	(4.3)	79.0	(2.5)	74.8	(3.8)	68.7	(6.2)
2	16.1	(3.6)	18.2	(2.4)	21.7	(3.1)	27.3	(5.5)
3	2.8	(0.9)	2.8	(0.5)	3.5	(0.8)	4.0	(0.9)
Total	100.0		100.0		100.0		100.0	

Neck rail height was not associated with hock scores.

l. For freestall operations, percentage of cows by hock score and by average distance from neck rail to bedding surface

	Percent Cows							
	Average Distance (Inches)							
	Less than 40.0		40.0–45.9		46.0–49.9		50.0 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	80.8	(4.1)	74.6	(2.9)	77.7	(3.2)	83.4	(5.2)
2	16.7	(3.6)	22.0	(2.6)	18.9	(2.7)	14.4	(4.2)
3	2.5	(0.6)	3.4	(0.6)	3.4	(0.9)	2.2	(1.1)
Total	100.0		100.0		100.0		100.0	

Operations that used PVC or other plastic pipe for brisket locators had a lower percentage of cows with hock scores of 1 and a higher percentage of cows with hock scores of 3 compared with operations that used locators made of wood, other materials, or did not have brisket locators.

m. For freestall operations, percentage of cows by hock score and by type of brisket locator

	Percent Cows									
	Type of Brisket Locator									
	Concrete		Wood		PVC or Other Plastic Pipe		Other		None	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	78.0	(10.4)	74.3	(3.3)	63.2	(4.6)	80.4	(3.7)	83.4	(2.9)
2	16.1	(6.9)	22.6	(3.2)	30.9	(4.1)	16.7	(3.4)	14.6	(2.5)
3	5.9	(3.8)	3.1	(0.6)	5.9	(1.1)	2.9	(0.7)	2.0	(0.5)
Total	100.0		100.0		100.0		100.0		100.0	

The distance from the curb to brisket locator was not associated with hock scores.

n. For freestall operations, percentage of cows by hock score and by average distance form curb to brisket locator

	Percent Cows									
	Average Distance (Inches)									
	Less than 66.0		66.0–67.9		68.0–69.9		70.0–71.9		72.0 or More	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	79.9	(3.0)	74.2	(6.2)	71.6	(6.5)	63.1	(5.2)	71.7	(5.2)
2	17.2	(2.8)	22.6	(6.1)	23.4	(5.1)	32.1	(4.8)	24.0	(4.3)
3	2.9	(0.6)	3.2	(0.8)	5.0	(2.1)	4.8	(1.0)	4.3	(1.3)
Total	100.0		100.0		100.0		100.0		100.0	

The type of lunge barrier material was not associated with hock scores.

o. For freestall operations, percentage of cows by hock score and by lunge barrier material

	Percent Cows									
	Lunge Barrier Material									
	Concrete		Wood		Cable		Other		None	
Hock Score	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
1	68.7	(7.2)	78.4	(2.8)	69.5	(10.4)	77.0	(3.8)	80.3	(3.0)
2	25.9	(5.7)	18.6	(2.5)	25.5	(8.6)	20.5	(3.7)	16.8	(2.5)
3	5.4	(1.8)	3.0	(0.7)	5.0	(1.8)	2.5	(0.6)	2.9	(0.7)
Total	100.0		100.0		100.0		100.0		100.0	

Curb height was not associated with hock scores.

p. For freestall operations, percentage of cows by hock score and by curb height

	Percent Cows					
	Curb Height (Inches)					
	Less than 8.0		**8.0–12.9**		**13.0 or More**	
Hock Score	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
1	84.1	(3.4)	77.9	(2.0)	77.8	(5.5)
2	14.2	(3.0)	18.8	(1.7)	19.8	(4.8)
3	1.7	(0.6)	3.3	(0.5)	2.4	(1.2)
Total	100.0		100.0		100.0	

Curb widths of less than 6.0 inches were associated with a lower percentage of cows assigned a hock score of 1 (70.4 percent), while widths of 9.0 inches or more were associated with the lowest percentage of cows assigned a score of 3 (0.7 percent).

q. For freestall operations, percentage of cows by hock score and by curb width

	Percent Cows					
	Curb Width (Inches)					
	Less than 6.0		**6.0–8.9**		**9.0 or More**	
Hock Score	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
1	70.4	(5.1)	84.7	(2.5)	86.3	(5.6)
2	25.3	(4.2)	13.0	(2.1)	13.0	(5.4)
3	4.3	(1.3)	2.3	(0.6)	0.7	(0.4)
Total	100.0		100.0		100.0	

The percentage of stalls with gutter grates was not associated with hock scores.

r. For tie-stall and stanchion operations, percentage of cows by hock score and by percentage of stalls with gutter grates

	Percent Cows					
	Percent Stalls with Gutter Grates					
	0.0		0.1–49.9		50.0 or More	
Hock Score	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1	61.9	(3.9)	72.0	(3.8)	63.6	(4.1)
2	30.9	(3.8)	21.2	(2.6)	30.0	(3.6)
3	7.2	(1.4)	6.8	(1.6)	6.4	(1.2)
Total	100.0		100.0		100.0	

The presence of cow trainers was not associated with hock scores.

s. For tie-stall and stanchion operations, percentage of cows by hock score and by use of cow trainers

	Percent Cows			
	Cow Trainers			
	Yes		No	
Hock Score	Percent	Std. Error	Percent	Std. Error
1	63.3	(2.8)	66.6	(4.3)
2	29.1	(2.4)	27.8	(4.3)
3	7.6	(1.1)	5.6	(1.2)
Total	100.0		100.0	

The distance from the trainer to the gutter was not associated with hock scores.

t. For tie-stall and stanchion operations, percentage of cows by hock score and by average distance from trainer to gutter

	Percent Cows							
	Average Distance (Inches)							
	Less than 46.0		**46.0–49.9**		**50.0–53.9**		**54.0 or More**	
Hock Score	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
1	66.9	(6.4)	67.6	(3.7)	58.2	(5.8)	57.3	(6.8)
2	25.2	(4.6)	27.1	(3.1)	32.8	(4.6)	32.6	(7.2)
3	7.9	(2.6)	5.3	(1.3)	9.0	(2.9)	10.1	(2.3)
Total	100.0		100.0		100.0		100.0	

The distance from the trainer to the stall bed was not associated with hock scores.

u. For tie-stall and stanchion operations, percentage of cows by hock score and by average distance from trainer to bed

	Percent Cows					
	Average Distance (Inches)					
	Less than 58.0		**58.0–59.9**		**60.0 or More**	
Hock Score	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
1	66.6	(5.7)	60.9	(5.2)	64.6	(3.5)
2	28.6	(5.6)	29.8	(4.0)	27.4	(2.9)
3	4.8	(1.5)	9.3	(2.4)	8.0	(1.5)
Total	100.0		100.0		100.0	

The season in which assessments were made did not impact hock scores.

v. Percentage of cows by hock score and by season

	Percent Cows			
	Season			
	Spring		Summer	
Hock Score	Percent	Std. Error	Percent	Std. Error
1	71.2	(1.9)	76.0	(2.0)
2	24.6	(1.8)	19.2	(1.5)
3	4.2	(0.5)	4.8	(0.7)
Total	100.0		100.0	

D. Comfort Assessments

Note: Data for all estimates in Section II were obtained from operations with 30 or more cows that completed the cow comfort assessment. Housing types in this section refer to the buildings or areas that housed the majority of fresh (recently calved) cows. For most operations, these housing areas also housed the majority of lactating cows.

Note: Differences in this section were analyzed using STATA and SUDAAN software. P values less than 0.05 were considered statistically significant (see Section III: Methodology, p 156).

Four comfort parameters were assessed: perching (standing with the front feet inside the stall), standing (with all feet inside the stall), lying, and the cow comfort index (the proportion of cows in contact with a stall that are lying down). Assessments were completed at a single point in time and conducted no earlier than 2 hours after milking and no later than 2 hours prior to the next milking, which removed the impact of major cattle movements from the assessments.

1. Cows assessed

Comfort parameters were evaluated on 485 operations, and the pens and areas evaluated housed 52,490 cows. The majority of operations (290) and cows (39,014) assessed were on freestall operations.

a. Number of operations and cows assessed for comfort, by housing type

	Housing Type					
Parameter	Tie Stall	Stanchion	Freestall	Dry lot	Other Multiple-animal Area	All Operations
Total number of operations assessed	101	27	290	30	37	485
Total number of cows assessed	5,783	1,234	39,014	2,828	3,631	52,490
Average number of cows assessed per operation/pen	57.3	45.7	134.5	94.3	98.1	108.2

For the majority of operations (72.2 percent) the pen being assessed housed cows of all lactation stages.

b. Percentage of operations by type of cow being assessed and by housing type

	Percent Operations							
	Housing Type							
	Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Cows Assessed	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Early lactation (1 to 90 days in milk)	12.6	(2.3)	23.5	(8.4)	9.8	(4.6)	13.4	(2.0)
Midlactation (91 to 180 days in milk)	7.3	(1.7)	4.6	(3.0)	13.3	(5.3)	7.7	(1.5)
Late lactation (more than 180 days in milk)	4.5	(1.6)	0.9	(0.9)	5.1	(3.5)	4.1	(1.4)
All lactation stages	72.4	(3.1)	71.0	(9.5)	71.6	(7.5)	72.2	(2.7)
Other	3.2	(1.2)	0.0	(--)	0.2	(0.2)	2.6	(0.9)
Total	100.0		100.0		100.0		100.0	

About 4 of 10 freestall operations (42.6 percent) and all operations (40.4 percent) were at 95.0 percent or more of the maximum number of cows ever housed in the pen or area.

Approximately 50 to 60 percent of operations with dry lot and other multiple-animal areas were at less than 85 percent of the maximum number of cows ever housed in the pen or area.

c. Percentage of operations by percentage of maximum number of cows ever housed in the pen or area, and by housing type

	Percent Operations							
	Housing Type							
	Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Percent Maximum Number of Cows	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Less than 85.0	27.6	(3.9)	59.0	(13.6)	48.8	(9.8)	32.9	(3.6)
85.0 to 94.9	29.8	(3.7)	10.2	(4.6)	18.6	(8.3)	26.7	(3.1)
95.0 or more	42.6	(4.0)	30.8	(13.4)	32.6	(8.8)	40.4	(3.5)
Total	100.0		100.0		100.0		100.0	

2. Season and temperature

Increases in temperature (i.e., heat stress) have been associated with decreases in duration of lying in dairy cows (Zähner et al., 2004). The implementation of heat abatement methods, such as shade, fans, and misters, can decrease heat stress in cattle, which can occur in any region of the United States during summer.

Although assessments of most housing types were split about equally between spring and summer, the majority of stanchion operations (74.7 percent) were assessed during spring.

a. Percentage of operations by season of assessment and by housing type

	Percent Operations											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Season	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Spring	51.7	(5.5)	74.7	(8.1)	54.4	(4.0)	42.6	(12.7)	39.0	(9.2)	54.6	(2.9)
Summer	48.3	(5.5)	25.3	(8.1)	45.6	(4.0)	57.4	(12.7)	61.0	(9.2)	45.4	(2.9)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

The operation average temperature at the time of assessment was higher for dry lot operations than stanchion operations, possibly because the the two types of operations might have been assessed in different seasons.

b. Operation average temperature at time of assessment, by housing type

Operation Average Temperature (°F)											
Housing Type											
Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error	Avg.	Std. Error
65.3	(1.3)	60.6	(2.8)	65.1	(1.2)	70.5	(2.9)	64.9	(2.4)	64.8	(0.8)

The majority of all operations were assessed when the temperature was between 60 and 80 degrees; however, the majority of stanchion operations were assessed between 50 and 70 degrees, and more than 4 of 10 dry lot operations (44.0 percent) were assessed when the temperature was 80 degrees or higher.

c. Percentage of operations by temperature at the time of assessment and by housing type

	Percent Operations											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Temperature (°F)	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Less than 50	11.1	(3.8)	17.4	(8.5)	16.6	(3.3)	11.0	(5.3)	11.8	(5.1)	14.0	(2.2)
50 to 59	15.6	(3.8)	23.4	(8.6)	10.2	(2.1)	9.7	(5.8)	18.7	(8.1)	14.6	(2.1)
60 to 69	25.6	(5.0)	29.3	(10.1)	25.4	(3.7)	16.3	(7.3)	19.9	(8.4)	25.4	(2.8)
70 to 79	39.9	(5.4)	13.2	(5.9)	28.0	(3.7)	19.0	(9.0)	31.9	(9.1)	30.6	(2.8)
80 or above	7.8	(2.8)	16.7	(7.1)	19.8	(3.3)	44.0	(14.2)	17.7	(6.1)	15.4	(2.1)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

3. Timing

Since movement of cows around the time of milking can impact cow comfort assessments (Cook et al., 2005), assessors were advised to perform assessments no earlier than 2 hours after milking and no later than 2 hours prior to the next milking.

The operation average time since the last milking was more than 2 hours for all housing types. The operation average time until the next milking was well above 2 hours for all housing types, ranging from 5.1 hours for freestall operations to 6.2 hours for multiple-animal area and tie-stall operations. The time until next feeding ranged from 4.0 hours on stanchion operations to 8.3 hours on freestall operations.

a. Operation average time of assessment in relation to feeding and milking, by housing type

	Operation Average Time (Hours)											
	Housing Type											
	Tie stall		**Stanchion**		**Freestall**		**Dry lot**		**Other Multiple-animal Area**		**All Operations**	
Hours…	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Since last milking	5.0	(0.3)	5.6	(0.7)	5.1	(0.2)	4.9	(0.6)	4.6	(0.6)	5.1	(0.2)
Until next milking	6.2	(0.3)	5.6	(0.6)	5.1	(0.2)	5.8	(0.5)	6.2	(0.6)	5.7	(0.2)
Since last feeding	4.2	(0.4)	3.2	(0.6)	4.3	(0.3)	5.1	(1.8)	6.8	(1.6)	4.3	(0.2)
Until next feeding	5.2	(0.6)	4.0	(0.7)	8.3	(0.6)	7.3	(0.7)	7.3	(1.1)	6.4	(0.3)

Approximately 90 percent of operations were assessed 2.0 hours or more after the last milking.

b. Percentage of operations by number of hours *since last milking* that assessment was conducted and by housing type

	Percent Operations											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Number of Hours	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Fewer than 2.0	11.6	(3.7)	10.6	(7.8)	5.3	(1.5)	1.5	(1.6)	2.2	(2.2)	8.2	(1.9)
2.0 to 3.9	21.9	(4.9)	19.5	(7.8)	29.7	(4.1)	47.2	(14.4)	38.5	(9.3)	26.6	(2.8)
4.0 to 5.9	29.5	(5.1)	27.1	(8.4)	29.9	(3.8)	25.5	(11.8)	35.6	(9.0)	29.4	(2.8)
6.0 or more	37.0	(5.4)	42.8	(10.7)	35.1	(3.9)	25.8	(9.0)	23.7	(8.7)	35.8	(3.0)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

Only 6.0 percent of all operations were assessed fewer than 2.0 hours before the next milking.

c. Percentage of operations by number of hours *until next milking* that assessment was conducted and by housing type

	Percent Operations											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Number of Hours	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Fewer than 2.0	4.4	(2.0)	6.8	(4.7)	7.0	(1.6)	7.2	(4.5)	8.5	(7.9)	6.0	(1.2)
2.0 to 3.9	16.9	(4.3)	13.5	(8.1)	21.0	(3.2)	16.1	(6.5)	9.2	(6.1)	17.6	(2.3)
4.0 to 5.9	17.6	(3.9)	37.3	(10.4)	32.9	(3.8)	14.4	(7.9)	26.6	(8.1)	26.2	(2.6)
6.0 or more	61.1	(5.4)	42.4	(10.6)	39.1	(4.3)	62.3	(11.8)	55.7	(10.1)	50.2	(3.1)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

The delivery of feed also influences cow movement and can impact cow assessments. Although there were guidelines for doing the assessment relative to milking, no restrictions were placed relative to feeding.

Approximately 25 percent of assessments were conducted in each of the time periods listed in the following table.

d. Percentage of operations by number of hours *since last feeding* that assessment was conducted and by housing type

	Percent Operations											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Number of Hours	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Fewer than 2.0	24.3	(4.6)	37.0	(9.8)	21.7	(3.9)	22.9	(11.0)	15.5	(6.7)	24.5	(2.9)
2.0 to 3.9	27.0	(5.1)	27.2	(8.9)	27.6	(4.0)	30.2	(13.0)	34.9	(9.0)	27.8	(2.8)
4.0 to 5.9	27.7	(5.2)	25.8	(8.7)	29.3	(3.6)	18.7	(8.6)	17.8	(7.2)	27.1	(2.8)
6.0 or more	21.0	(4.7)	10.0	(5.6)	21.4	(3.0)	28.2	(14.5)	31.8	(10.7)	20.6	(2.6)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

More than 4 of 10 operations (44.0 percent) were assessed 6.0 or more hours until the next feeding.

e. Percentage of operations by number of hours *until next feeding* that assessment was conducted and by housing type

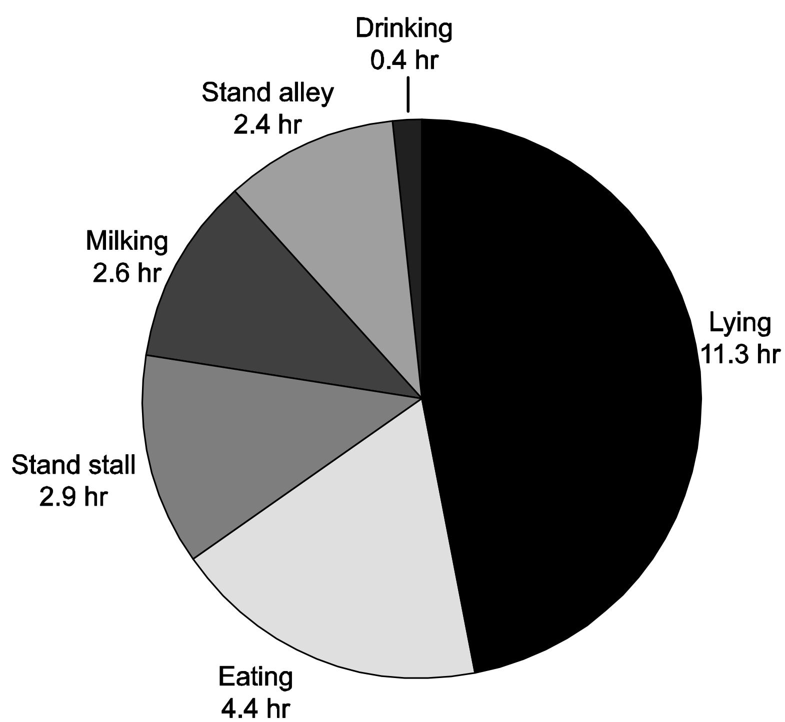
	Percent Operations											
	Housing Type											
	Tie stall		Stanchion		Freestall		Dry lot		Other Multiple-animal Area		All Operations	
Number of Hours	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Fewer than 2.0	25.7	(5.1)	30.7	(10.2)	15.7	(3.4)	5.4	(3.5)	20.9	(10.6)	21.4	(2.8)
2.0 to 3.9	22.0	(4.5)	16.2	(7.1)	12.5	(2.3)	6.2	(2.9)	0.4	(0.3)	15.9	(2.2)
4.0 to 5.9	14.1	(4.0)	33.0	(10.5)	18.7	(3.1)	13.5	(6.4)	22.3	(8.0)	18.7	(2.5)
6.0 or more	38.2	(5.5)	20.1	(9.1)	53.1	(4.2)	74.9	(8.7)	56.4	(10.4)	44.0	(3.2)
Total	100.0		100.0		100.0		100.0		100.0		100.0	

4. Comfort parameters—perching, standing, lying, and cow comfort index

Note: All estimates in this section were derived from operations with freestalls, which included some operations that reported having freestalls in other multiple-animal areas.

Cows have multiple activities during the day including eating, milking, socializing, and lying. A video of 208 cows in 17 freestall operations was analyzed to determine time budgets for cows. The single largest amount of time was spent lying in a stall (11.3 hours; range 2.8 to 17.6 hours). On average, cows ate for an average of 4.4 hours per day (range 1.4 to 8.1 hours). Cows spent an average of almost 3 hours a day standing in a stall (range 0.3 to 13.0 hours) [Cook, 2010].

Dairy Cow Time Budget



Multiple measures have been evaluated to determine how well facilities are designed based on cow use. The goal of research regarding these measures is to be able to make an assessment at a single point in time that reflects activity throughout the day. In this report, the following four measures are considered:

1. Percentage of cows in the pen that are perching.
2. Percentage of cows standing with all four feet in the stall.
3. Percentage of cows lying in the stall.
4. Cow comfort index (CCI).

Perching is the term used to describe cows standing with both front feet in a stall. Perching occurs when cows enter and exit a stall, but prolonged perching suggests problems with management. Associations found in the analysis of these data showed that increased perching was associated with decreased bedding quantity, increased temperature, shorter stall lengths, decreased time since feeding, and more cows per stall (Lombard et al., 2010). Although the distance of the neck rail to the rear curb has been associated with perching (Tucker et al., 2005; Bernardi et al., 2009; Fregonesi et al., 2009), no such association was found in this study.

The CCI is the number of cows lying in a stall divided by the number of cows in contact (i.e., perching, standing, or lying) with a stall. Overton et al. (2003) suggested that a target CCI should be around 85 percent of cows lying in a stall when measured 1 hour after milking, which coincides with peak lying activity.

Increased perching has been associated with shorter stalls (Tucker et al., 2004; Lombard et al., 2010), narrow stalls (Tucker et al., 2004), more restrictive neck rail placement (Tucker et al., 2005; Fregonesi et al., 2009), decreased stocking density (Hill et al., 2009), and higher ambient temperatures (Overton et al., 2002; Zähner et al., 2004). Shorter distances from the rear curb to the neck rail are associated with increased perching, while longer distances may lead to more standing fully in the stall (Tucker et al., 2005; Fregonesi et al., 2009; Lombard et al., 2010). When the neck rail is removed and cows are allowed to stand fully in the stall, gait scores are improved (Bernardi et al., 2009). Increased standing in stalls has been associated with stall base and bedding types, with cows spending more time standing on rubber mats or mattresses (Tucker et al., 2003; Cook et al., 2004). Increased lying behavior has been associated with sand bedding compared with organic bedding types and during cooler months (Lombard et al., 2010), although cows without prior experience lying on sand spend less time lying (Manninen et al., 2002; Tucker et al., 2003; Norring et al., 2010)..

The CCI has been the most popular index used to evaluate the comfort of dairy cows. However, no studies have found an association between CCI and lying times. The reciprocal of CCI (1-CCI), or stall standing index, was significantly associated with stall standing times when conducted 2 hours prior to milking and may be an indicator of increased lameness (Cook et al., 2005).

A higher percentage of cows were observed perching and standing with all four feet in stalls on freestall operations (8.5 and 10.0 percent, respectively) than on operations using other multiple-animal areas (3.7 and 0.8 percent, respectively). Although on operations with other multiple-animal areas the percentage of cows lying was much lower than in freestall operations (8.1 and 39.6 percent, respectively), the CCI was not different. This finding suggests that the numbers of cows lying in stalls as a percentage of those touching a stall were not different in the two housing types. Cows in other multiple-animal area housing had additional bedding choices.

a. Percentage of cows by comfort parameter and by housing type

	Percent Cows					
	Housing Type					
	Freestall		Other Multiple-animal Area		All Operations	
Parameter	Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
Perching	8.5	(0.7)	3.7	(1.3)	8.3	(0.7)
Standing	10.0	(1.1)	0.8	(0.8)	9.6	(1.1)
Lying	39.6	(1.7)	8.1	(3.5)	38.3	(1.7)
CCI	68.2	(2.0)	64.2	(9.8)	68.1	(2.0)

Stall-base type did not have a significant impact on any comfort parameter.

b. Percentage of cows by comfort parameter and by type of stall base

	Percent Cows									
	Type of Stall Base									
	Concrete		Dirt		Rubber Mat		Mattress		Other	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	8.5	(1.1)	9.4	(1.6)	6.9	(1.5)	5.9	(0.6)	9.6	(1.6)
Standing	7.9	(1.9)	6.6	(1.3)	18.7	(5.5)	10.8	(1.4)	10.3	(3.3)
Lying	35.2	(3.3)	39.8	(3.2)	27.2	(5.5)	42.9	(3.2)	40.9	(3.6)
CCI	68.2	(3.6)	71.3	(3.8)	51.6	(7.7)	72.0	(2.4)	67.3	(4.4)

Photo courtesy of Dr. Jason Lombard

The percentages of cows perching were similar across all bedding types. Standing in stalls was observed for a lower percentage of cows when straw, coarse sand, composted manure, or no bedding was used compared with most other bedding types. A higher percentage of cows were lying when in stalls bedded with coarse sand (48.0 percent) compared with cows in stalls bedded with straw, composted or dried manure, or "other" bedding types (33.6, 30.2, 28.5, and 30.8 percent, respectively). With the exception of composted manure, the CCI was highest for operations that bedded with coarse sand compared with all other bedding types.

c. Percentage of cows by comfort parameter and by bedding type

	Percent Cows													
	Bedding Type													
	Straw		Sawdust		Fine Sand		Coarse Sand		Composted Manure		Dried Manure		Other*	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	8.4	(1.5)	7.2	(0.7)	9.0	(1.2)	7.5	(0.8)	9.4	(2.8)	15.6	(7.6)	5.9	(0.9)
Standing	6.6	(1.4)	14.9	(2.6)	10.7	(2.8)	5.1	(1.4)	2.9	(1.1)	14.1	(4.4)	10.4	(2.4)
Lying	33.6	(4.6)	42.1	(2.8)	39.3	(3.6)	48.0	(3.6)	30.2	(6.8)	28.5	(6.7)	30.8	(4.1)
CCI	69.0	(3.6)	65.6	(3.4)	66.6	(4.4)	79.2	(2.0)	71.1	(3.6)	49.0	(12.4)	65.4	(4.7)

*Includes shredded newspaper.

Days since bedding was changed was not associated with perching, standing, or CCI. A higher percentage of cows on operations that had changed bedding 1 to 2 days before the assessment were lying (46.8 percent) compared with cows on operations on which bedding was changed 7 or more days before the assessment (34.5 percent). Increased frequency of bedding changes was not always associated with an increased percentage of cows lying or increased CCI.

d. Percentage of cows by comfort parameter and by number of days since bedding was added/changed

	Percent Cows									
	Number of Days									
	Less than 1		1 to 2		3 to 4		5 to 6		7 or More	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	5.9	(3.1)	8.8	(0.8)	7.6	(1.8)	7.3	(1.1)	9.4	(1.7)
Standing	10.3	(3.0)	10.0	(1.8)	6.5	(1.3)	9.6	(4.2)	10.7	(2.4)
Lying	28.0	(11.9)	46.8	(2.8)	38.3	(3.6)	38.4	(4.8)	34.5	(2.9)
CCI	63.5	(10.6)	71.3	(2.2)	73.1	(3.9)	69.5	(6.6)	63.2	(4.9)

The percentage of cows perching in stalls was higher when the stall base was not exposed, bedding level with curb or base not exposed, bedding slightly dished out (8.2 and 10.2 percent, of cows, respectively) than when the stall base was less than 50 percent exposed (6.0 percent). Bedding quantity/stall condition was not associated with standing or lying parameters. The CCI was higher when bedding was level with the curb (74.2 percent) than when bedding was slightly dished out or more than 50 percent of the base was exposed (63.7 and 66.2 percent, respectively).

e. Percentage of cows by comfort parameter and by bedding quantity/stall condition in the majority of stalls

	Percent Cows							
	Bedding Quantity/Stall Condition							
	Base not Exposed, Bedding Level with Curb		**Base not Exposed, Bedding Slightly Dished Out**		**Base Exposed** (Less than 50 Percent)		**Base Mostly Exposed** (More than 50 Percent)	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	8.2	(0.6)	10.2	(1.6)	6.0	(0.7)	6.6	(1.0)
Standing	7.3	(1.4)	10.3	(2.0)	11.0	(2.8)	11.8	(2.5)
Lying	44.7	(2.7)	35.9	(2.8)	36.0	(3.4)	36.0	(5.7)
CCI	74.2	(2.1)	63.7	(3.9)	67.9	(4.5)	66.2	(3.5)

Stall length was not associated with any comfort parameter.

f. Percentage of cows by comfort parameter and by average stall length

	Percent Cows									
	Average Stall Length (Inches)									
	Less than 82.0		82.0–85.9		86.0–91.9		92.0–95.9		96.0 or More	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	7.8	(1.5)	9.6	(1.2)	7.7	(1.0)	7.8	(1.0)	6.3	(1.4)
Standing	6.8	(1.8)	7.4	(1.5)	11.6	(2.6)	14.4	(6.4)	12.1	(2.8)
Lying	29.6	(5.8)	45.5	(3.7)	38.4	(2.5)	40.3	(7.0)	47.3	(3.8)
CCI	66.9	(4.4)	72.8	(3.3)	66.5	(3.5)	64.5	(10.7)	72.0	(3.8)

Photo courtesy of Dr. Jason Lombard

There were no differences in the percentage of cows perching or standing in stalls based on stall width. The percentage of cows lying was higher on operations with stall widths of 50.0 inches or more (58.6 percent) compared with the percentage of cows on operations in which stall widths were less than 50.0 inches. Although a linear trend was not observed, the CCI was higher for stall widths of 50.0 inches or more compared with stall widths of 44.0 to 45.9 inches and 48.0 to 49.9 inches.

g. Percentage of cows by comfort parameter and by average stall width

	Percent Cows											
	Average Stall Width (Inches)											
	Less than 42.0		**42.0–43.9**		**44.0–45.9**		**46.0–47.9**		**48.0–49.9**		**50.0 or More**	
Parameter	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Perching	7.8	(1.1)	7.8	(0.8)	9.4	(1.5)	7.1	(1.0)	7.2	(1.4)	11.2	(1.5)
Standing	7.4	(2.0)	7.7	(1.7)	12.3	(1.9)	9.6	(2.6)	6.7	(2.2)	9.0	(1.6)
Lying	35.9	(7.0)	39.1	(3.2)	40.2	(2.4)	35.7	(4.0)	25.9	(4.8)	58.6	(7.2)
CCI	70.2	(2.3)	71.7	(2.7)	65.0	(3.8)	68.1	(4.3)	65.1	(4.5)	74.4	(1.0)

The type or presence of a neck rail did not impact the percentage of cows perching or the CCI. A lower percentage of cows were standing in the stall when no neck rail was present (4.0 percent) compared with either the presence of a stationary or moveable neck rail (9.7 and 11.9 percent, respectively). Similarly, a lower percentage of cows were lying when no neck rail was present compared with operations with stationary or moveable neck rails.

h. Percentage of cows by comfort parameter and by neck rail type

	Percent Cows					
	Neck Rail Type					
	Stationary		Moveable		None	
Parameter	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Perching	7.8	(0.5)	13.7	(4.3)	5.5	(1.3)
Standing	9.7	(1.2)	11.9	(2.9)	4.0	(1.2)
Lying	38.3	(1.8)	36.2	(7.1)	19.6	(4.1)
CCI	68.7	(2.0)	58.6	(8.1)	67.4	(5.1)

There were no differences in comfort parameters based on neck rail distance from the curb.

i. Percentage of cows by comfort parameter and by average distance from neck rail to curb

	Percent Cows							
	Average Distance (Inches)							
	Less Than 60.0		60–65.9		66.0–71.9		72.0 or More	
Parameter	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Perching	6.5	(0.8)	8.7	(0.7)	9.1	(1.8)	6.2	(1.1)
Standing	11.6	(4.1)	9.0	(1.7)	9.8	(1.4)	11.1	(2.9)
Lying	40.4	(6.0)	35.5	(2.3)	42.6	(3.2)	38.4	(5.9)
CCI	69.1	(5.6)	66.8	(2.8)	69.3	(3.7)	68.8	(4.9)

Neck rail height was not associated with any of the reported comfort parameters.

j. Percentage of cows by comfort parameter and by average distance from neck rail to bedding surface

	Percent Cows							
	Average Distance (Inches)							
	Less than 40		**40.0–45.9**		**46.0–49.9**		**50.0 or More**	
Parameter	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Perching	7.4	(0.8)	8.2	(0.6)	9.8	(2.2)	6.0	(1.5)
Standing	9.2	(1.9)	8.9	(1.5)	11.9	(2.5)	10.6	(5.1)
Lying	34.9	(4.4)	39.7	(2.3)	41.3	(3.3)	27.5	(9.1)
CCI	67.8	(3.6)	70.0	(2.5)	65.6	(4.7)	62.4	(8.6)

The presence of a brisket locator or the locator material did not affect the percentage of cows that were perching, standing, or the CCI. However, operations that did not have a brisket locator had a lower percentage of cows lying (32.6 percent) compared with operations that had brisket locators made of wood (41.9 percent) or PVC or other plastic pipe (46.4 percent).

k. Percentage of cows by comfort parameter and by type of brisket locator

	Percent Cows									
	Type of Brisket Locator									
	Concrete		**Wood**		**PVC or Other Plastic Pipe**		**Other**		**None**	
Parameter	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Perching	7.2	(1.8)	8.2	(0.7)	6.3	(1.2)	7.6	(1.0)	9.2	(1.4)
Standing	12.3	(5.8)	9.9	(1.7)	13.8	(4.4)	8.5	(2.5)	8.4	(1.6)
Lying	38.7	(6.3)	41.9	(2.6)	46.4	(3.5)	42.8	(5.5)	32.6	(2.9)
CCI	66.5	(7.9)	69.9	(2.8)	69.7	(5.6)	72.7	(4.9)	64.9	(3.6)

The percentage of cows perching, standing, or lying was not different based on the distance of the brisket locator from the rear curb.

Operations with a distance of 66.0 to 67.9 inches from curb to brisket locator had the highest CCI (79.2 percent)

l. Percentage of cows by comfort parameter and by average distance from curb to brisket locator

	Percent Cows									
	Average Distance (Inches)									
	Less than 66.0		**66.0–67.9**		**68.0–69.9**		**70.0–71.9**		**72.0 or More**	
Parameter	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Perching	8.3	(1.1)	6.3	(0.7)	8.8	(1.4)	8.0	(1.4)	7.2	(1.2)
Standing	10.2	(3.6)	6.8	(1.4)	10.0	(2.5)	10.4	(2.3)	16.3	(5.0)
Lying	36.4	(4.8)	50.2	(3.5)	44.5	(3.8)	39.8	(3.4)	40.0	(4.6)
CCI	66.3	(6.0)	79.2	(2.5)	70.3	(3.0)	68.4	(2.7)	62.9	(7.1)

The presence of a lunge barrier or its material did not affect the percentage of cows standing or the CCI. Operations with a cable lunge barrier had the lowest percentage of cows perching (3.5 percent). Operations with a wood lunge barrier had a lower percentage of cows lying (30.8 percent) compared with “other” lunge barriers or no lunge barriers (43.4 and 41.8 percent, respectively).

m. Percentage of cows by comfort parameter and by lunge barrier material

	Percent Cows									
	Lunge Barrier Material									
	Concrete		**Wood**		**Cable**		**Other**		**None**	
Parameter	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Perching	9.8	(2.4)	8.2	(0.8)	3.5	(1.0)	8.6	(1.9)	8.5	(0.9)
Standing	6.0	(2.8)	7.6	(1.2)	8.9	(2.6)	11.8	(2.5)	10.5	(2.1)
Lying	32.2	(5.2)	30.8	(2.9)	37.6	(11.6)	43.4	(3.5)	41.8	(2.3)
CCI	67.1	(4.6)	66.1	(2.7)	75.2	(8.5)	68.1	(4.7)	68.7	(3.0)

Curb heights of 13.0 inches or more were associated with a lower percentage of cows perching (4.8 percent) and lying (25.5 percent) compared with curb heights of 8.0 to 12.9 inches. Curb height was not associated with the percentage of cows standing in stalls or with the CCI.

n. Percentage of cows by comfort parameter and by curb height

	Percent Cows					
	Curb Height (Inches)					
	Less than 8.0		8.0–12.9		13.0 or More	
Parameter	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Perching	6.7	(0.9)	8.8	(0.8)	4.8	(1.2)
Standing	7.8	(2.0)	10.1	(1.3)	10.1	(3.7)
Lying	33.7	(4.3)	39.3	(2.0)	25.5	(5.6)
CCI	69.9	(4.1)	67.5	(2.3)	63.1	(7.3)

Photo courtesy of Dr. Jason Lombard

Curb width was not associated with any of the measured comfort parameters.

o. Percentage of cows by comfort parameter and by curb width

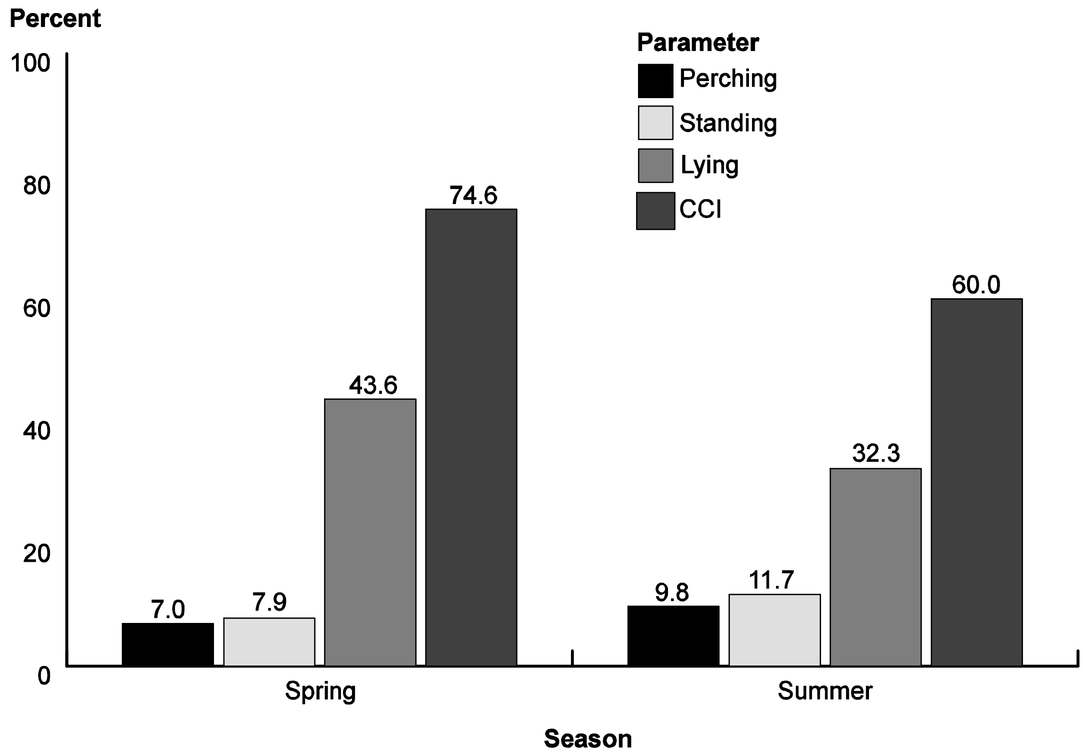
	Percent Cows					
	Curb Width (Inches)					
	Less than 6.0		6.0–8.9		9.0 or More	
Parameter	Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
Perching	8.1	(1.1)	7.9	(0.8)	14.0	(5.2)
Standing	7.8	(1.7)	10.1	(1.7)	9.0	(3.4)
Lying	43.3	(4.3)	36.4	(2.5)	39.0	(5.4)
CCI	73.1	(3.1)	66.9	(2.7)	63.0	(10.6)

Season had a significant impact on the percentage of cows perching, lying, and on the CCI. The percentage of cows perching was lower in spring than in summer, while the percentage of cows lying and the CCI were higher in spring than in summer.

p. Percentage of cows by comfort parameter and by season

	Percent Cows			
	Season			
	Spring		Summer	
Parameter	Percent	Std. Error	Percent	Std. Error
Perching	7.0	(0.6)	9.8	(1.2)
Standing	7.9	(0.9)	11.7	(2.1)
Lying	43.6	(2.2)	32.3	(2.4)
CCI	74.6	(1.5)	60.0	(3.6)

Percentage of Cows by Comfort Parameter and by Season



Section III: Methodology

A. Needs Assessment

NAHMS develops study objectives by exploring existing literature and by contacting stakeholders about their informational needs and priorities during a needs-assessment phase. The objective of the needs assessment for the NAHMS Dairy 2007 study was to conduct a national survey to collect information from U.S. dairy producers and other dairy specialists about what they perceived to be the most important dairy health and productivity issues. A driving force of the needs assessment was the desire of NAHMS researchers to receive as much input as possible from a variety of producers, industry experts and representatives, veterinarians, extension specialists, universities, and dairy organizations.

Focus group teleconferences and meetings were held to help determine the focus of the study.

Teleconference, March 30, 2006
National Johne's Working Group

Louisville, KY, April 2, 2006
National Johne's Working Group
National Institute for Animal Agriculture

Louisville, KY, April 3, 2006
National Milk Producers Federation
Animal Health Committee

Teleconference, December 15, 2006
Bovine Alliance on Management and Nutrition

In addition, a needs-assessment survey was designed to ascertain the top-three management issues, diseases/disorders, and producer incentives from producers, veterinarians, extension personnel, university researchers, and allied industry groups. The survey, created in SurveyMonkey, was available online from early February through late April 2006.The survey was promoted via electronic newsletters, magazines, and Web sites. Organizations/ magazines promoting the study included "Dairy Herd Management–Dairy Alert," "Dairy Today," "Hoard's Dairyman," NMC, "Journal of the American Veterinary Medical Association," and the American Association of Bovine Practitioners. Email messages were also sent to cooperative members of the National Milk Producers Federation as well as State and Federal personnel. A total of 313 people completed the survey. Universities/extensions accounted for 23 percent of respondents, producers accounted for 22 percent, and veterinarians/consultants accounted for another 20 percent.

Fort Collins, CO, May 18, 2006
CEAH Focus Group meeting

Draft objectives for the Dairy 2007 study, using input from teleconferences, face-to-face meetings, and the online survey, were drafted prior to the focus group meeting. Attendees included producers, veterinarians, and university/extension and government personnel. The day-long meeting culminated in the formulation of eight objectives for the study:

1. Describe trends in dairy cattle health and management practices,

2. Evaluate management factors related to cow comfort and removal rates,
3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices,
4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVD),
5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens,
6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis* (Johne's disease),
7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices, and
8. Determine the prevalence of specific food safety pathogens and describe antimicrobial resistance patterns.

B. Sampling and Estimation

1. State selection

The preliminary selection of States to be included in the study was done in February 2006, using the National Agricultural Statistics Service (NASS) January 27, 2006, Cattle Report. A goal for NAHMS national studies is to include States that account for at least 70 percent of the animals and producer population in the United States. The initial review of States identified 16 major States representing 82.0 percent of the milk cow inventory and 79.3 percent of the operations with milk cows (dairy herds). The States were: California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Washington, and Wisconsin.

A memo identifying these 16 States was provided in March 2006 to the USDA-APHIS-VS-CEAH Director and, in turn, the VS Regional Directors. Each Regional Director sought input from the respective States about being included or excluded from the study. Virginia expressed interest in participating and was included, bringing the total number of States to 17.

2. Operation selection

The list sampling frame was provided by NASS. Within each State a stratified random sample was selected. The size indicator was the number of milk cows for each operation. NASS selected a sample of dairy producers in each State for making the January 1 cattle estimates. The list-based sample from the January 2006 survey was used as the screening sample. Among those producers reporting 1 or more milk cows on January 1, 2006, a total of 3,554 operations were selected in the sample for contact in January 2007 during Phase I. Operations with 30 or more dairy cows that had participated in Phase I were invited to participate in data collection for Phase II. A total of 1,077 operations agreed to be contacted by Veterinary Medical Officers (VMOs) to determine whether to complete Phase II.

3. Population inferences

a. Phase I: General Dairy Management Report

Inferences cover the population of dairy producers with at least 1 milk cow in the 17 participating States. As of January 1, 2007, these States accounted for 82.5 percent (7,536,000 head) of milk cows and 79.5 percent (59,640) of operations with milk cows in the United States. (See Appendix II for respective data on individual States.) All respondent data were statistically weighted to reflect the population from which they were selected. The inverse of the probability of selection for each operation was the initial selection weight. This selection weight was adjusted for nonresponse within each State and size group to allow for inferences back to the original population from which the sample was selected.

b. Phase II: VS Initial and Second Visits

For operations eligible for Phase II data collection (those with 30 or more dairy cows), weights were adjusted to account for operations that did not want to continue to Phase II. In addition, weights were adjusted for nonresponse to the questionnaire in each visit. The 17-State target population of operations with 30 or more dairy cows represented 82.5 percent of dairy cows and 84.7 percent of dairy operations (Appendix II).

C. Data Collection

1. Phase I: General Dairy Management Report

From January 1 to 31, 2007, NASS enumerators administered the General Dairy Management Report questionnaire. The interview took slightly more than 1 hour.

2. Phase II: VS Initial Visit

From February 26 to April 30, 2007, Federal and State Veterinary Medical Officers (VMOs) and/or Animal Health Technicians (AHTs) collected data from producers during an interview that lasted approximately 2 hours.

3. Phase II: VS Second Visit

From May 1 to August 31, 2007, Federal and State VMOs and/or AHTs collected data from producers during an interview that lasted approximately 2 hours.

D. Data Analysis

1. Validation

a. Phase I: Validation—General Dairy Management Report

Initial data entry and validation for the General Dairy Management Report were performed in individual NASS State offices. Data were entered into a SAS data set. NAHMS national staff performed additional data validation on the entire data set after data from all States were combined.

b. Phase II: Validation—VS Initial and Second Visit Questionnaires

After completing the VS Initial and Second Visit questionnaires, data collectors sent them to their respective State NAHMS Coordinators, who reviewed the questionnaire responses for accuracy and sent them to NAHMS. Data entry and validation were completed by NAHMS staff using SAS.

E. Sample Evaluation

The purpose of this section is to provide various performance measurement parameters. Historically, the term “response rate” has been used as a catchall parameter, but there are many ways to define and calculate response rates. Therefore, the following tables present an evaluation based upon a number of measurement parameters, which are defined with an “x” in categories that contribute to the measurement.

1. Phase I: General Dairy Management Report

A total of 3,554 operations were selected for the survey. Of these operations, 3,304 (93.0 percent) were contacted. There were 2,519 operations that provided usable inventory information (70.9 percent of the total selected and 76.2 percent of those contacted). In addition, there were 2,194 operations (61.7 percent) that provided “complete” information for the questionnaire. Of operations that provided complete information and were eligible to participate in Phase II of the study (2,067 operations), 1,077 (52.1 percent) consented to be contacted for consideration/ discussion about further participation.

Responses for Phase I: General Dairy Management Report

			Measurement Parameter		
Response Category	**Number Operations**	**Percent Operations**	**Contacts**	**Usable[1]**	**Complete[2]**
Survey complete and VMO consent	1,077	30.3	x	x	x
Survey complete, refused VMO consent	990	27.9	x	x	x
Survey complete, ineligible[3] for VMO	127	3.6	x	x	x
No dairy cows on January 1, 2007	214	6.0	x	x	
Out of business	111	3.1	x	x	
Out of scope	6	0.2			
Refusal of GDMR	785	22.1	x		
Office hold (NASS elected not to contact)	126	3.5			
Inaccessible	118	3.3			
Total	3,554	100.0	3,304	2,519	2,194
Percent of total operations			93.0	70.9	61.7
Percent of total operations weighted[4]			94.0	74.1	59.6

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—fewer than 30 head of milk cows on January 1, 2007.
[4]Weighted response—the rate was calculated using the initial selection weights.

2. Phase II: VS Initial Visit

There were 1,077 operations that agreed to be contacted by a VMO during Phase I. Of these 1,077 operations, 582 (54.0 percent) agreed to continue in Phase II of the study and completed the VS Initial Visit questionnaire; 380 (35.3 percent) refused to participate. Approximately 10 percent of the 1,077 operations were not contacted, and 0.4 percent were ineligible because they had no dairy cows at the time they were contacted.

Responses for Phase II: VS Initial Visit

			Measurement Parameter		
Response Category	Number Operations	Percent Operations	Contacts	Usable[1]	Complete[2]
Survey complete	582	54.0	x	x	x
Survey refused	380	35.3	x		
Not contacted	111	10.3			
Ineligible[3]	4	0.4	x	x	
Total	1,077	100.0	966	586	582
Percent of total operations			89.7	54.4	54.0
Percent of total operations weighted[4]			87.5	50.8	50.4

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—no dairy cows at time of interview, which occurred from February 26 through April 30, 2007
[4]Weighted response—the rate was calculated using the turnover weights.

3. Phase II: VS Second Visit

Of the 582 operations that completed the VS Initial Visit Questionnaire, 519 (including one operation that did not complete the VS Initial Visit on time) completed the VS Second Visit questionnaire; 47 (8.1 percent) refused to participate. Approximately 3 percent of the 583 operations were not contacted, and 0.3 percent were ineligible because they had no dairy cows at the time of the VS Second Visit.

Responses for Phase II: VS Second Visit

			Measurement Parameter		
Response Category	Number Operations	Percent Operations	Contacts	Usable[1]	Complete[2]
Survey complete	519	89.0	x	x	x
Survey refused	47	8.1	x		
Not contacted	15	2.6			
Ineligible[3]	2	0.3	x	x	
Total	583	100.0	568	521	519
Percent of total operations			97.4	89.4	89.0
Percent of total operations weighted[4]			98.1	90.6	90.3

[1]Usable operation—respondent provided answers to inventory questions for the operation (either zero or positive number on hand).
[2]Survey complete operation—respondent provided answers to all or nearly all questions.
[3]Ineligible—no dairy cows at time of interview, which occurred from May 1 through August 31, 2007.
[4]Weighted response—the rate was calculated using the turnover weights.

Appendix I: Sample Profile

Responding Operations

a. Number of responding operations by herd size

Herd Size (Number of Cows)	**Phase I: General Dairy Management Report**	**Phase II: VS Initial Visit**	**Phase II: VS Second Visit**	**Cow Comfort Assessment**
Fewer than 100	1,028	233	211	187
100 to 499	691	215	188	179
500 or more	475	134	120	119
Total	2,194	582	519	485

b. Number of responding operations by region

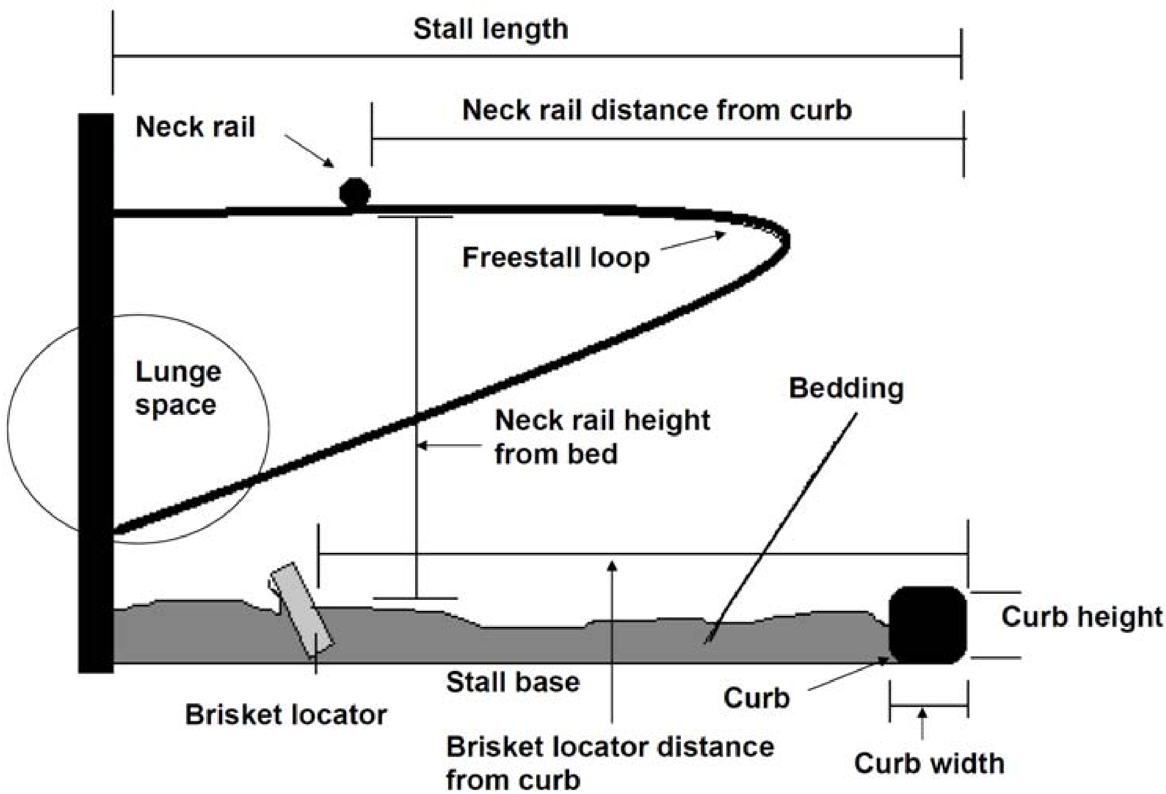
Region	**Phase I: General Dairy Management Report**	**Phase II: VS Initial Visit**	**Phase II: VS Second Visit**	**Cow Comfort Assessment**
West	426	108	93	81
East	1,768	474	426	404
Total	2,194	582	519	485

Appendix II: U.S. Milk Cow Population and Operations

Number of milk cows on January 1, 2007*							
		Number of Milk Cows, January 1, 2007 (Thousand Head)		Number of Operations 2006		Average Herd Size	
Region	State	Milk Cows on Operations with 1 or More Head	Milk Cows on Operations with 30 or More Head	Operations with 1 or More Head	Operations with 30 or More Head	Operations with 1 or More head	Operations with 30 or More Head
West	California	1,790	1,788.2	2,200	1,920	813.6	931.4
	Idaho	502	501.0	800	620	627.5	808.1
	New Mexico	360	358.9	450	180	800.0	1,993.9
	Texas	347	344.2	1,300	660	266.9	521.5
	Washington	235	234.3	790	540	297.5	433.9
	Total	3,234	3,226.6	5,540	3,920	583.8	823.1
East	Indiana	166	154.4	2,100	1,150	79.0	134.3
	Iowa	210	203.7	2,400	1,870	87.5	108.9
	Kentucky	93	86.5	2,000	1,180	46.5	73.3
	Michigan	327	320.5	2,700	1,910	121.1	167.8
	Minnesota	455	441.3	5,400	4,800	84.3	91.9
	Missouri	114	108.3	2,600	1,400	43.8	77.4
	New York	628	612.3	6,400	5,100	98.1	120.1
	Ohio	274	252.1	4,300	2,400	63.7	105.0
	Pennsylvania	550	536.3	8,700	7,000	63.2	76.6
	Vermont	140	137.2	1,300	1,100	107.7	124.7
	Virginia	100	97.0	1,300	820	76.9	118.3
	Wisconsin	1,245	1,213.9	14,900	12,800	83.6	94.8
	Total	4,302	4,163.5	54,100	41,530	79.5	100.3
Total (17 States)		7,536	7,390.1	59,640	45,450	126.4	162.6
Percent of U.S.		82.5	82.5	79.5	84.7		
Total U.S. (50 States)		9,132.0	8,958.5	74,980	53,680	121.8	166.9

*Source: NASS Cattle report, February 1, 2008, and NASS Farms, Land in Farms, and Livestock Operations 2007 Summary report, February 1, 2008. An operation is any place having one or more head of milk cows, excluding cows used to nurse calves, on hand at any time during the year.

Appendix III: Typical Freestall Components and Dimensions



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Animal and
Plant Health
Inspection Service

Veterinary
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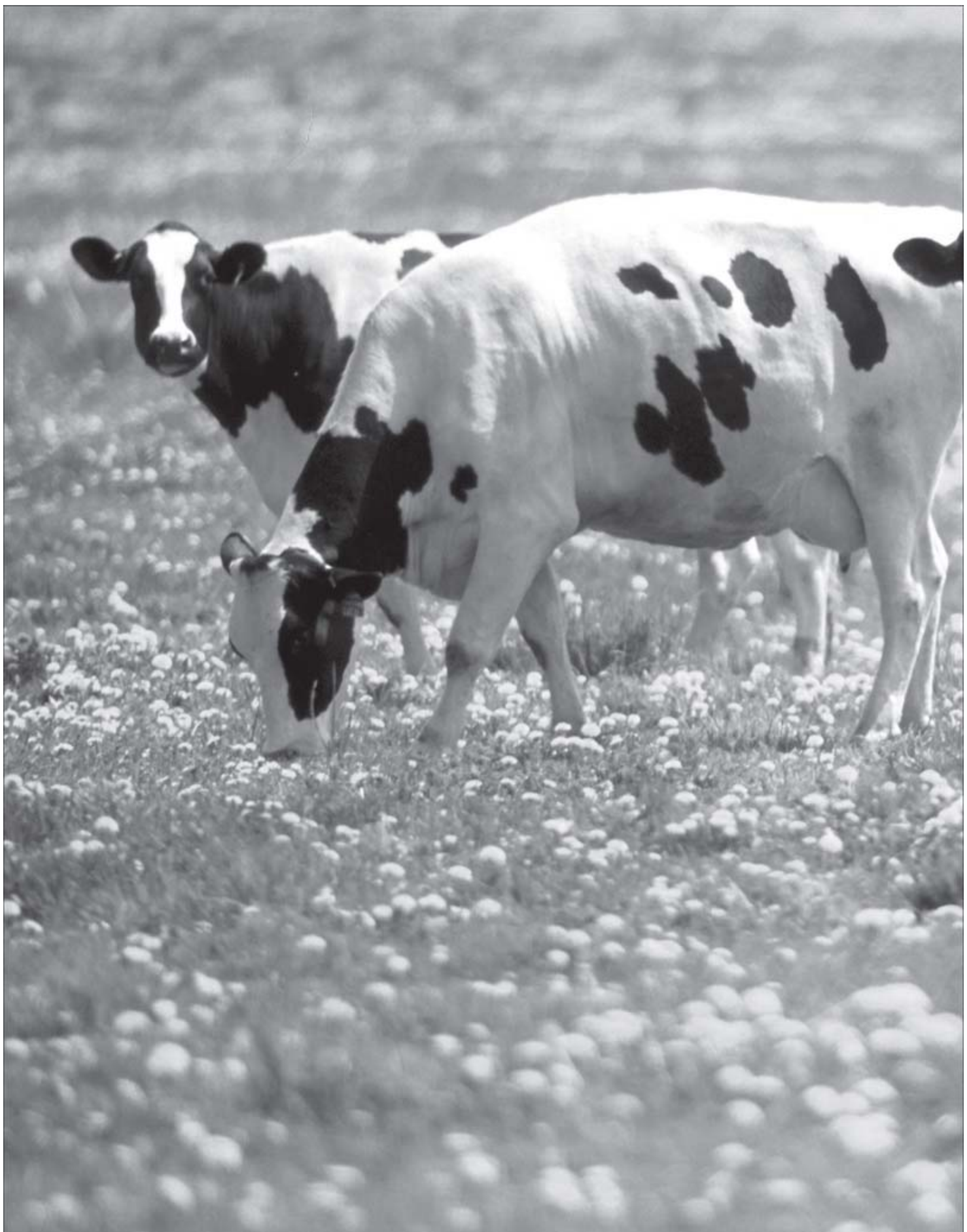
National
Animal Health
Monitoring
System

March 2011

Dairy 2007

Salmonella, Listeria, and *Campylobacter* on U.S. Dairy Operations, 1996–2007



USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
(970) 494-7000
Email: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Selected Highlights

This report provides an in-depth look at the prevalence of food safety pathogens on U.S. dairy operations from 1996 to 2007, as identified from three National Animal Health Monitoring System studies: Dairy 1996, Dairy 2002, and Dairy 2007. Estimates in this report from bulk-tank milk testing are reported as population estimates. Estimates based on fecal culture represent a convenience sample and are not population estimates.

Here are a few highlights from the report:

In 2007, the percentage of operations on which a milk filter tested positive for *Salmonella* (24.7 percent) was more than double the percentage of operations on which a bulk-tank milk sample tested positive (10.8 percent). Likewise, the percentage of operations on which a milk filter tested positive for any *Listeria* (28.3 percent) was more than three times the percentage of operations on which a bulk-tank milk sample tested positive for any *Listeria* (9.0 percent). Milk filters were not tested in 2002 or 1996.

The percentage of operations on which bulk-tank milk tested positive for *Salmonella* by RT-PCR was similar in 2002 and 2007 (11.9 and 10.8 percent, respectively). In addition, the percentage of operations on which bulk-tank milk tested positive for *Listeria monocytogenes* was similar in 2002 and 2007 (3.8 and 3.7 percent, respectively). Bulk-tank milk was not tested in 1996.

The percentage of operations positive for *Salmonella* via fecal culture increased from 1996 to 2007. In 1996, 20.0 percent of operations had any *Salmonella*-positive cows compared with 30.9 percent of operations in 2002 and 39.7 percent in 2007. In 1996 and 2007, the percentage of cows positive for *Salmonella* was 5.4 and 13.8 percent, respectively.

During the Dairy 1996, 2002, and 2007 studies, a higher percentage of operations with 500 or more cows were *Salmonella* positive than operations with fewer than 100 cows.

The percentage of *Salmonella* isolates resistant to at least one antimicrobial decreased from 2002 to 2007 (17.7 and 3.4 percent, respectively). Similarly, for any specific antimicrobial to which resistance was observed, a lower percentage of isolates were resistant in 2007 than in 2002.

In the Dairy 1996, 2002, and 2007 studies, nearly all operations had at least one cow that was shedding *Campylobacter* (100, 97.9, and 92.6 percent of operations, respectively).

In 2002 and 2007, less than 5 percent of *C. jejuni* isolates were resistant to any single antimicrobial tested, with the exception of tetracycline. In 2007, 62.4 percent of *C. jejuni* isolates were resistant to tetracycline compared with 47.5 percent in 2002.

Acknowledgments

This report has been prepared from material received and analyzed by the U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS) via three national studies of health management and animal health on U.S. dairy operations conducted in 1996, 2002, and 2007.

The Dairy 1996, Dairy 2002, and Dairy 2007 studies were cooperative efforts between State and Federal animal health officials, statisticians, university researchers, and extension personnel. We want to thank the National Agricultural Statistics Service (NASS) enumerators, State and Federal veterinary medical officers (VMOs), and animal health technicians (AHTs) who visited the farms and collected the data. Their hard work and dedication to the National Animal Health Monitoring System (NAHMS) are invaluable. The roles of the producers, Area Veterinarians in Charge (AVIC), NAHMS Coordinators, VMOs, AHTs, and NASS enumerators were critical in providing quality data for all dairy reports. Recognition also goes to the personnel at the Centers for Epidemiology and Animal Health (CEAH) for their efforts in generating and distributing valuable reports from NAHMS dairy studies.

Additional biological sampling and testing were afforded by the generous contributions of collaborators for the dairy studies, including

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- USDA–ARS, Russell Research Center;
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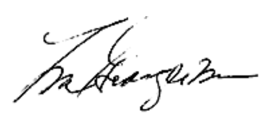
- BIOCOR Animal Health;
- Colorado State University, College of Veterinary Medicine and Biomedical Sciences;
- Cornell University Animal Health Diagnostic Laboratory;
- IDEXX Laboratories;
- Quality Milk Production Services;
- Tetracore, Inc.;
- TREK Diagnostic Systems;
- University of British Columbia, Canada, Animal Welfare Program;
- University of California - Davis;
- University of Pennsylvania, New Bolton Center;
- University of Wisconsin, Madison; and
- Wisconsin Veterinary Diagnostic Laboratory.

All participants are to be commended, particularly the producers whose voluntary efforts made the dairy studies possible.



Larry M. Granger
Director
Centers for Epidemiology and Animal Health

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Contacts for further information:
Questions or comments on data analysis: Dr. Jason Lombard (970) 494–7000
Information on reprints or other reports: Ms. Abby Fienhold (970) 494–7000
Email: NAHMS@aphis.usda.gov

Feedback
Feedback, comments, and suggestions regarding the Dairy 2007 study reports are welcome. Please forward correspondence via email to: NAHMS@aphis.usda.gov, or you may submit feedback via online survey at: http://nahms.aphis.usda.gov (Click on “FEEDBACK on NAHMS reports.”)

Table of Contents

Introduction

There are more than 250 known diseases caused by bacteria, fungi, viruses, and parasites transmitted through food to humans. Foodborne pathogens or toxins enter the body through the gastrointestinal tract where the first symptoms of illness often appear. As a result, nausea, vomiting, abdominal cramps, and diarrhea are common symptoms in many foodborne diseases. The majority of foodborne illnesses are mild and cause symptoms for only 1 to 2 days; however, some cases are more serious, resulting in severe illness or death (CDC, 2005).

While the food supply in the United States is one of the safest in the world, the Centers for Disease Control and Prevention (CDC) estimates that each year 76 million people in the United States get sick from foodborne pathogens, of which 325,000 are hospitalized and 5,000 die (Mead et al., 1999). The most commonly recognized foodborne infections caused by bacteria are due to *Campylobacter*, *Salmonella*, and *Escherichia coli (E. coli)* O157:H7 (CDC, 2005). The Foodborne Diseases Active Surveillance Network (FoodNet) of CDC's Emerging Infections Program collects data in 10 U.S. States on diseases caused by enteric pathogens transmitted commonly through food. In 2008, FoodNet reported that the incidence per 100,000 people for *Salmonella, Campylobacter*, *E. coli* O157:H7, and *Listeria* remained unchanged for the preceding 3 years (CDC, 2009). Preventing illness and death associated with foodborne pathogens remains a major public health challenge.

In addition to the effect on human health, foodborne illnesses have an economic impact. The health-related cost of foodborne illness in the United States is estimated to be approximately $152 billion annually (Scharff, 2010).

Many organisms capable of causing foodborne illness are present in the intestines of healthy animals raised for food. As a result, food can be contaminated as it is produced. For example, meat and poultry carcasses can be contaminated if they come in contact with small amounts of intestinal contents during slaughter. Similarly, fresh fruits and vegetables can be contaminated if they are washed or irrigated with water contaminated with animal manure or human sewage (Doyle and Erickson, 2008; Hanning et al., 2009). Other foods of animal origin, such as raw eggs, unpasteurized milk, and raw shellfish might also be contaminated. In general, commingling products from many individual animals—such as bulk raw milk, pooled raw eggs, or ground beef—presents an increased risk of contamination; a pathogen present in any one animal can contaminate products from multiple animals.

There are several reasons that food safety is of concern to the dairy industry. Raw milk can contain *Salmonella*, *Campylobacter*, or *Listeria,* all of which can cause human disease; however, outbreaks of disease in humans caused by milk products have primarily been due to the consumption of unpasteurized milk or cheeses made from unpasteurized milk. In addition, cull dairy cows account for about 17 percent of the ground beef available for national consumption (Troutt and Osburn, 1997) and may be a potential source of human exposure to foodborne pathogens if the meat from these animals is contaminated with fecal material during slaughter or processing.

This report compares the prevalence and antimicrobial resistance of *Salmonella, Campylobacter*, and *Listeria* on U.S. dairy operations as reported in the NAHMS Dairy 1996, Dairy 2002, and Dairy 2007 studies. These pathogens were selected because data relating to them could be compared across study years; only results that could be compared with Dairy 2007 results were included. For example, results from the composite fecal sample testing for *Salmonella* conducted during Dairy 2007 are not reported here because composite fecal *Salmonella* samples were not collected and tested during the Dairy 1996 and Dairy 2002 studies.

Further information on NAHMS studies and reports is available online at:
http://nahms.aphis.usda.gov

For questions about this report or additional copies, please contact:
USDA–APHIS–VS–CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000

NAHMS Dairy Studies

The National Animal Health Monitoring System (NAHMS) is a nonregulatory division of the U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS). NAHMS is designed to help meet the Nation's animal-health information needs and has collected data on dairy health and management practices through four previous studies.

The NAHMS 1991-92 National Dairy Heifer Evaluation Project (NDHEP) provided the dairy industry's first national information on the health and management of dairy heifers in the United States. Just months after the study's first results were released in 1993, cases of acute bovine viral diarrhea (BVD) surfaced in the United States following a 1993 outbreak in Canada. NDHEP information on producer vaccination and biosecurity practices helped officials address the risk of disease spread and target educational efforts on vaccination protocols. An outbreak of human illness was reported in 1993 in the Pacific Northwest, this time related to *Escherichia coli* 0157:H7. NDHEP data on the bacteria's prevalence in dairy cattle helped officials define public risks as well as research needs. This baseline picture of the industry also helped identify additional research and educational efforts in various production areas, such as feed management and weaning age.

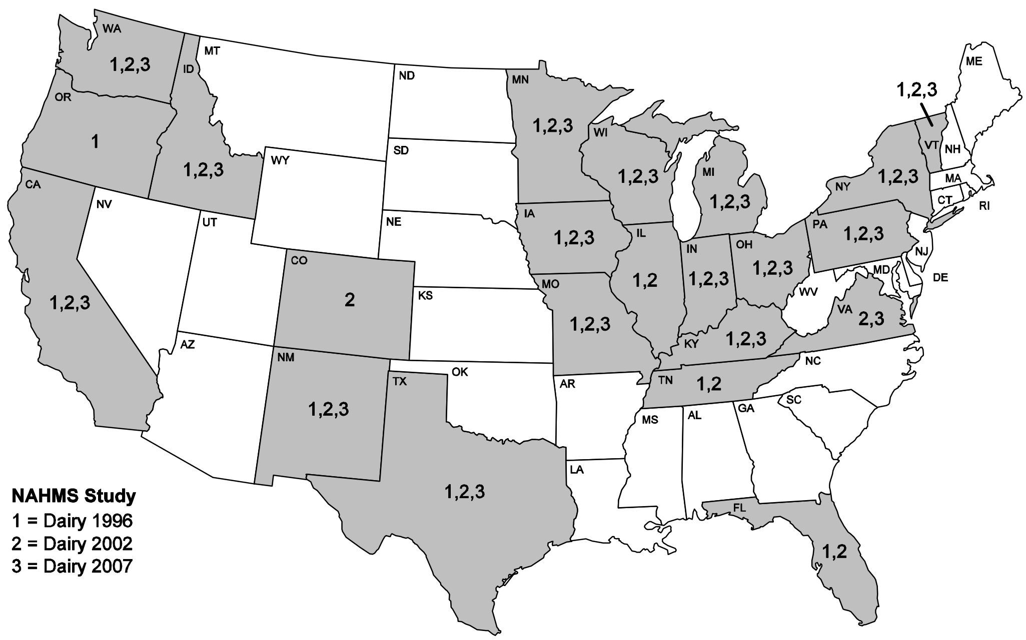
Information from the NAHMS Dairy 1996 study helped the U.S. dairy industry identify educational needs and prioritize research efforts on such timely topics as antibiotic usage and Johne's disease, as well as digital dermatitis, bovine leukosis virus, and potential foodborne pathogens, including *E. coli*, *Salmonella*, and *Campylobacter.*

A major focus of the Dairy 2002 study was to describe management strategies that prevent and reduce Johne's disease and to determine management factors associated with *Mycoplasma* and *Listeria* in bulk-tank milk. Additionally, levels of participation in quality assurance programs, the incidence of digital dermatitis, a profile of animal waste handling systems used on U.S. dairy operations, and industry changes since the NDHEP in 1991 and Dairy 1996 were examined.

One of the objectives of the Dairy 2007 study was calf health, including colostrum management and passive transfer of immunity. Additional study topics included an evaluation of cow comfort and the analysis of hygiene and hock scores. Additionally, diseases of concern such as BVD, Johne's disease, and contagious mastitis were evaluated. The Dairy 2007 study also took and in-depth look at reproductive practices.

An objective for all three studies, Dairy 1996, Dairy 2002, and Dairy 2007, was to determine the prevalence of specific food safety pathogens and to describe antimicrobial resistance patterns on U.S. dairy operations.

States Participating in NAHMS 1996, 2002, and 2007 Dairy Studies



Study Objectives and Related Outputs

1. Describe trends in dairy cattle health and management practices
- Part II: Changes in the U.S. Dairy Cattle Industry, 1991–2007, March 2008
- Part V: Changes in Dairy Cattle Health and Management Practices in the United States, 1996–2007, July 2009

2. Evaluate management factors related to cow comfort and removal rates
- Facility Characteristics and Cow Comfort on U.S. Dairy Operations, 2007, Interpretive Report, October 2010

3. Describe dairy calf health and nutrition from birth to weaning and evaluate heifer disease prevention practices
- Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
- Off-Site Heifer Raising on U.S. Dairy Operations, 2007, info sheet, November 2007
- Colostrum Feeding and Management on U.S. Dairy Operations, 1991–2007, info sheet, March 2008
- Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, February 2009
- Calving Intervention on U.S. Dairy Operations, 2007, info sheet, February 2009
- Heifer Calf Health and Management Practices on U.S. Dairy Operations, 2007, Interpretive Report, February 2010
- Passive Transfer in Dairy Heifer Calves, 1991–2007, info sheet, March 2010

4. Estimate the prevalence of herds infected with bovine viral diarrhea virus (BVDV)
- Bovine Viral Diarrhea (BVD) Management Practices and Detection in Bulk Tank Milk in the United States, 2007, info sheet, October 2008

5. Describe current milking procedures and estimate the prevalence of contagious mastitis pathogens
- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
- Milking Procedures on U.S. Dairy Operations, 2007, info sheet, October 2008
- Prevalence of Contagious Mastitis Pathogens on U.S. Dairy Operations, 2007, info sheet, October 2008

6. Estimate the herd-level prevalence and associated costs of *Mycobacterium avium* subspecies *paratuberculosis*
- Johne’s Disease on U.S. Dairies, 1991–2007, info sheet, April 2008

7. Describe current biosecurity practices and determine producer motivation for implementing or not implementing biosecurity practices
- Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, October 2007
- Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, September 2008
- Biosecurity Practices on U.S. Dairy operations, 1991–2007, Interpretive Report, May 2010

8. Determine the prevalence of specific food-safety pathogens and describe antimicrobial resistance patterns

- Antibiotic Use on U.S. Dairy Operations, 2002 and 2007, info sheet, October 2008
- Prevalence of *Salmonella* and *Listeria* in Bulk Tank Milk and In-line Filters on U.S. Dairies, 2007, info sheet, July 2009
- *Salmonella* and *Campylobacter* on U.S. Dairy Operations, 2002–07, info sheet, July 2009
- ***Salmonella, Listeria,* and *Campylobacter* on U.S. Dairy Operations, 2007, Interpretive Report, March 2011**
- Prevalence of *Coxiella burnetii* on U.S. Dairy Operations, 2007, technical brief, March 2011
- Prevalence of *Clostridium difficile* on U.S. Dairy Operations, 2007, technical brief, April 2011

Additional information sheets

- Dairy Cattle Identification Practices in the United States, 2007, info sheet, November 2007
- Bovine Leukosis Virus (BLV) on U.S. Dairy Operations, 2007, info sheet, October 2008
- Reproduction Practices on U.S. Dairy Operations, 2007, info sheet, February 2009
- Injection Practices on U.S. Dairy Operations, 2007, info sheet, February 2009
- Methicillin-Resistant *Staphylococcus aureus* (MRSA) Isolation from Bulk Tank Milk in the United States, 2007,technical brief, March 2011

Terms Used in This Report

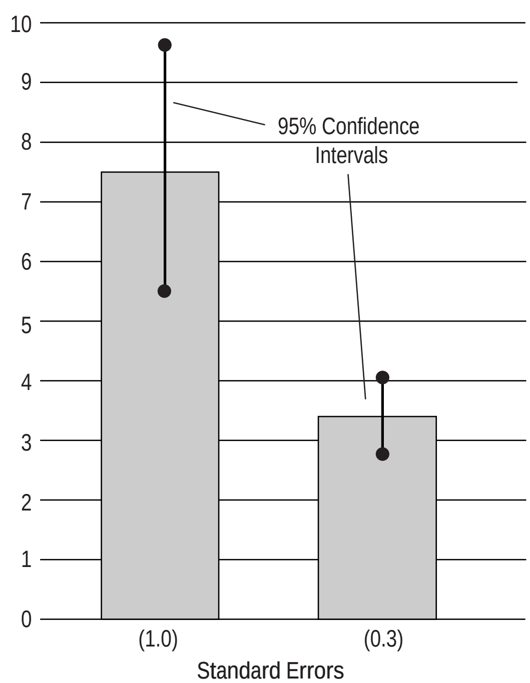
Herd size: Herd size is based on January 1 dairy cow inventory for each study year. Small herds are those with fewer than 100 head; medium herds are those with 100 to 499 head; and large herds are those with 500 or more head.

Population estimates: The estimates in this report for bulk-tank milk and milk filter sampling make inference to all of the operations with dairy cows in the target population. Data from the operations responding to the survey are weighted to reflect their probability of selection during sampling and to account for survey nonresponse.

Precision of population estimates: Population estimates in this report are provided with a measure of precision called the standard error. A 95-percent confidence interval can be created with bounds equal to the estimate plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean 95 out of 100 times. In the example to the right, an estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). The second estimate of 3.4 shows a standard error of 0.3 and results in limits of 2.8 and 4.0. Alternatively, the 90-percent confidence interval would be created by multiplying the standard error by 1.65 instead of 2. Most estimates in this report are rounded to the nearest tenth. If rounded to 0, the standard error was reported (0.0). References to population estimates being higher or lower than other estimates are based on the 95-percent confidence intervals not overlapping. The estimates in this report without standard errors are not considered populatin estimates.

Regions:
West: California, Colorado, Idaho, New Mexico, Oregon, Texas, Washington
East: Florida, Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio, Pennsylvania, New York, Tennessee, Vermont, Virginia, Wisconsin

Examples of a 95% Confidence Interval



Section I: Population Estimates

A. *Salmonella* Detection in Bulk-tank Milk and Milk Filters

1. Background

Salmonellae are gram-negative bacteria that can cause gastrointestinal infection in animals and humans. *Salmonella* causes an estimated 1.4 million human illnesses and over 500 deaths annually in the United States (Mead et al., 1999). Clinical signs of salmonellosis in humans include diarrhea, fever, and abdominal cramps 12 to 72 hours after infection. Clinical signs usually last 4 to 7 days, and most people recover without treatment (CDC, 2008a). In the elderly, infants, and immunocompromised individuals, *Salmonella* infection may spread from the intestines to the bloodstream and cause more severe, sometimes life-threatening, infections. Economic losses associated with human *Salmonella* infections have attracted increasing attention in a number of countries. Salmonellosis is estimated to cost the United States $14.6 billion annually (Scharff, 2010).

In dairy cows, *Salmonella* infection can result in mortality of adult cows, higher treatment costs, increased cull rates, higher labor costs, and lower milk production. Calf mortality and morbidity also add to the total cost of disease. Clinical signs of salmonellosis in adult cattle include depression, dehydration, diarrhea, fever (106–108°F), anorexia, vaginal discharge, abortion, and decreased milk production. The effects of infection can range from no clinical signs to endotoxemia and death. Calves with clinical *Salmonella* infections can present with diarrhea, fever, lethargy, and an inability to rise. Infected calves can also become septic and die (Smith, 2002). Evidence indicates that calves are more likely to experience mortality than cows (Cummings et al., 2009b), and preweaned calves are more likely to be affected by clinical salmonellosis compared with other cattle (Cummings et al., 2009a). Cattle can shed *Salmonella* in their feces without showing clinical signs.

Dairy operations represent a potential source of *Salmonella* infection for humans. *Salmonella* species can colonize the gastrointestinal tracts of cattle and other animals. Humans can become infected with *Salmonella* through fecal contamination of food products or water. Several outbreaks of salmonellosis have been linked to beef and dairy products (CDC, 2003, 2006a, 2006b; Van Duynhoven et al., 2009). Another source of human infection, primarily affecting farm families, employees, and visitors, is direct contact with ill animals (Holmberg et al., 1984; Troutt and Osburn, 1997). Cull dairy cows contribute about 17 percent of the ground beef available for national consumption (Troutt and Osburn, 1997) and can be a potential source of human exposure to *Salmonella* when the meat is contaminated with fecal material during slaughter. Pasteurization is very effective against *Salmonella* organisms, and foodborne outbreaks associated with this pathogen in pasteurized milk or dairy products are very rare.

Testing for *Salmonella* in milk is not a routine practice by milk producers. Bacteriological analysis of raw milk is typically limited to tests for bacteria (i.e., standard plate count and coliform count) or for specific mastitis-causing bacteria (Jayarao et al., 2001). *Salmonella* serotyping allows for monitoring changes in the causative organisms. A change in a herd's serotype profile could indicate a new source of infection. Antimicrobial susceptibility testing is important for determining effective therapy and for guiding prudent antibiotic use.

Salmonella contamination in bulk-tank milk is believed to result from fecal contamination attributable to poor hygiene during the milking process rather than from intramammary infection with *Salmonella*, which is rare (Van Kessel et al., 2004; Jayarao et al., 2006). Standard hygiene practices during milking reduce but do not eliminate the risk of milk contamination. Pasteurization decreases the number of pathogenic organisms, decreases transmission of pathogens, and improves the safety of milk more than other measures, including certification of raw milk (Potter et al., 1984). Interstate sale of raw milk is banned in the United States by the Food and Drug Administration, but intrastate sales are allowable on a State-by-State basis, depending upon each State's regulation. Consumption of raw bulk-tank milk is a common practice among farm families (Jayarao et al., 2006). Among the nonfarming population, a growing number of consumers claim that raw milk is healthier, and they choose raw milk over pasteurized milk (Bren, 2004; Jayarao et al., 2006). Pasteurizing raw milk is an important public health tool for preventing foodborne disease. Because of pasteurization, contamination of dairy products currently accounts for a small percentage of foodborne illness in the United States. However, it is clear that consuming raw milk and products made with raw milk present a risk of foodborne illness to humans.

2. Sampling and testing overview

Bulk-tank milk samples were collected and tested for the presence of *Salmonella* during the Dairy 2002 and Dairy 2007 studies. Bulk-tank milk was not tested for *Salmonella* in Dairy 1996. In 2002 and 2007, one bulk-tank milk sample was collected per operation using aseptic techniques. In addition, a milk filter was collected from each operation in 2007.

For Dairy 2002, both culture and real-time polymerase chain reaction (RT-PCR) were used to detect *Salmonella* in bulk-tank milk samples, while only PCR was used in Dairy 2007. Culture was performed on PCR-positive samples from Dairy 2007 so that serotyping could be done. In 2002, culture results for bulk-tank milk were available from 852 dairy operations, and RT-PCR results were available from 838 operations. In the Dairy 2007 study, test results from bulk-tank milk or milk filters were available from 538 dairy operations: 517 from bulk-tank milk and milk filters, 19 from bulk-tank milk only, and 2 from milk filters only.

For more information on sampling and diagnostic testing methods, see Section III, p 48.

3. Prevalence

In 2007, the percentage of operations on which a milk filter tested positive for *Salmonella* (24.7 percent) was more than double the percentage of operations on which a bulk-tank milk sample tested positive (10.8 percent).

a. Percentage of operations on which a bulk-tank milk and/or a milk-filter sample tested positive for *Salmonella* in Dairy 2007, by testing method

Testing Method					
Bulk-tank Milk RT-PCR		Milk Filter RT-PCR		Bulk-tank Milk or Milk Filter RT-PCR	
Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
10.8	(1.8)	24.7	(2.4)	28.1	(2.6)

The percentage of operations on which bulk-tank milk tested positive for *Salmonella* by RT-PCR was similar in 2002 and 2007 (11.9 and 10.8 percent of operations, respectively). The percentage of operations on which a bulk-tank milk sample tested positive for *Salmonella* by RT-PCR was similar across herd sizes in 2002 and 2007.

b. Percentage of operations on which a bulk-tank milk sample tested positive for *Salmonella* by RT-PCR, by herd size

	Herd Size (Number of Cows)							
	Small (Fewer than 100)		Medium (100–499)		Large (500 or More)		All Operations	
Study	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Dairy 2002	12.4	(2.2)	10.2	(2.1)	13.9	(3.1)	11.9	(1.7)
Dairy 2007	8.1	(2.3)	16.2	(3.2)	19.6	(4.6)	10.8	(1.8)

In 2002 and 2007, there was no regional difference in the percentage of operations on which a bulk-tank milk sample tested positive for *Salmonella* by RT-PCR.

c. Percentage of operations on which a bulk-tank milk sample tested positive for *Salmonella* by RT-PCR, by region

	Region			
	East		West	
Study	Percent	Std. Error	Percent	Std. Error
Dairy 2002	11.9	(1.8)	11.5	(3.8)
Dairy 2007	10.7	(2.0)	12.7	(3.1)

4. Serotypes

Eight *Salmonella* serotypes were found in bulk-tank milk in 2002. *S.* Montevideo was found in bulk-tank milk on seven operations in 2002. In 2007, 14 and 22 *Salmonella* serotypes were found in bulk-tank milk and milk filters, respectively. *S.* Cerro was identified in the highest number of both sample types.

a. Number of operations on which the following *Salmonella* serotypes were identified, by sample type used for identification

	Sample Type		
	Dairy 2002	Dairy 2007	
	Bulk-tank Milk	Bulk-tank Milk	Milk Filters
Serotype	Number Operations (852 Sampled)	Number Operations (536 Sampled)	Number Operations (519 Sampled)
Cerro	3	8	27
Kentucky	0	5	16
Muenster	2	5	10
Newport	4	1	9
Anatum*	1	4	8
Montevideo	7	2	7
Meleagridis	2	1	6
Mbandaka	0	3	5
Typhimurium*	0	1	4
Dublin	1	2	3
Senftenberg	0	1	2
Give*	0	0	2
Untypable	3	0	2
Agona	0	1	1
Infantis	0	1	1
Schwarzengrund	0	1	1
Derby	0	0	1
Muenchen	0	0	1
Reading	0	0	1
Saintpaul	0	0	1
Soerenga	0	0	1
Thompson	0	0	1

*Includes variant species (e.g., Typhimurium var. 5-, formerly Typhimurium var. Copenhagen).

B. *Listeria* Detection in Bulk-tank Milk

1. Background

Listeria species are gram-positive bacteria that can cause serious infections in humans. *Listeria monocytogenes* is the most important *Listeria* species in terms of public health risk and frequency of appearance in foodstuffs.

L. monocytogenes is widespread in the environment. The main source of infection for ruminants is spoiled silage, but cattle may also ingest the organism by fecal-oral transmission. Adult cattle observed with clinical disease (listeriosis) most often have encephalitis, a nervous system disorder. Signs of disease in cattle include facial paralysis, depression, circling, and abortion.

Although the occurrence of human listeriosis is generally infrequent, it often leads to serious illness. Listeriosis in humans can be accompanied by fever, muscle aches, nausea, and diarrhea. If infection spreads to the nervous system, symptoms such as headache, stiff neck, loss of balance, or convulsions can occur. Infections during pregnancy can lead to miscarriage or stillbirth. Pregnant women, the elderly, and those with immunosuppression are most susceptible to listeriosis. In the United States, the annual cost of illness in humans due to *L. monocytogenes* is estimated at $8.8 billion (Scharff, 2010). Estimates indicate that approximately 2,500 listeriosis cases in humans occur each year in the United States, with nearly all cases attributed to a food source (Mead et al., 1999). Approximately 92 percent of individuals with illness caused by *L. monocytogenes* listeriosis are hospitalized (20 percent of these cases are fatal), making *L. monocytogenes* responsible for the highest hospitalization rate among foodborne pathogens (Mead et al., 1999).

It is not possible to remove all *Listeria* organisms from the environment. *L. monocytogenes* is found in soil and water, which can lead to contamination of fruits, vegetables, and other foods typically eaten raw. *Listeria* is killed by pasteurization and cooking but is relatively cold tolerant. *L. monocytogenes* survives refrigeration temperatures and can grow under these conditions, an unusual characteristic among foodborne pathogens (Walker et al., 1990). With regard to milk and dairy products, listeriosis is most often associated with products made from unpasteurized milk. Because of its ability to grow under refrigeration, contamination of cold cuts or other ready-to-eat foods after processing is a concern and has been associated with human illness.

Pasteurizing raw milk is an important public health tool for foodborne disease prevention. Because of pasteurization, contamination of dairy products currently accounts for a small percentage of foodborne illness in the United States. However, it is clear that consuming raw milk and products made with raw milk present a risk of foodborne illness to humans.

2. Sampling and testing overview

Bulk-tank milk samples were collected and tested for the presence of *Listeria* as part of the Dairy 2002 and Dairy 2007 studies. Bulk-tank milk was not tested for *Listeria* in Dairy 1996. In 2002 and 2007, one bulk-tank milk sample was collected per participating operation using aseptic techniques. In addition, in 2007 a milk filter was collected from each operation.

Culture methods were used to identify *Listeria* in bulk-tank milk samples in 2002 and 2007. In 2002, PCR was used as a component of the process to confirm isolates as *Listeria*. Results for bulk-tank milk testing for *Listeria* were available from 851 operations for Dairy 2002 and from 538 operations for Dairy 2007. In 2007, bulk-tank milk or milk-filter results were available from 538 dairy operations: 517 from bulk-tank milk and milk filters, 19 from bulk-tank milk only, and 2 from milk filters only.

For more information on sampling and diagnostic testing methods, see Section III, p 48.

Photo of *Listeria* courtesy of CDC.

3. Prevalence

The percentage of operations on which a bulk-tank milk sample tested positive for *L. monocytogenes* was similar in 2002 and 2007 (3.8 and 3.7 percent, respectively). In Dairy 2007, the percentage of operations on which a milk filter tested positive for any *Listeria* species (28.3 percent) was more than three times the percentage of operations on which a bulk-tank milk sample tested positive for any *Listeria* species (9.0 percent).

a. Percentage of operations on which a bulk-tank milk and/or a milk filter sample tested positive for *Listeria*, by sample type

	Dairy 2002		Dairy 2007			
	L. monocytogenes		Any *Listeria*		*L. monocytogenes*	
Sample Type	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Bulk-tank milk	3.8	(0.7)	9.0	(1.9)	3.7	(1.2)
Milk filter	NA		28.3	(2.9)	5.1	(1.2)
Bulk-tank milk or milk filter	NA		32.1	(2.9)	7.1	(1.5)

The percentage of operations on which a bulk-tank milk sample tested positive for *L. monocytogenes* was similar across herd sizes in 2002 and 2007.

b. Percentage of operations on which a bulk-tank milk sample tested positive for *L. monocytogenes*, by herd size

	Herd Size (Number of Cows)							
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)		**All Operations**	
Study	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Dairy 2002	3.0	(0.9)	5.4	(1.2)	7.8	(2.4)	3.8	(0.7)
Dairy 2007	2.3	(1.4)	7.5	(2.5)	4.0	(1.7)	3.7	(1.2)

There were no regional differences in 2002 and 2007 in the percentage of operations on which a bulk-tank milk sample tested positive for *L. monocytogenes*.

c. Percentage of operations on which a bulk-tank milk sample tested positive for *L. monocytogenes*, by region

	Region			
	East		West	
Study	Percent	Std. Error	Percent	Std. Error
Dairy 2002	3.9	(0.8)	2.9	(1.4)
Dairy 2007	3.3	(1.2)	8.3	(4.2)

Section II: Pathogen Detection in Feces

A. *Salmonella*

1. Sampling and testing overview

NAHMS has examined *Salmonella* occurrence using individual fecal samples from dairy cows in three separate studies: Dairy 1996, Dairy 2002, and Dairy 2007. Typically, NAHMS studies generate population-based estimates, and appropriate sample sizes are used to arrive at such estimates. Field resources, laboratory capacity, and the expense of culturing samples make it difficult to provide a national estimate of *Salmonella* prevalence based on fecal culturing of individual animals. Therefore, for the *Salmonella* estimates in this section, all three NAHMS dairy studies used a sample of approximately 100 operations, which is not an optimal sample size for providing national estimates of prevalence. Despite this limitation, the NAHMS studies provide valuable information on *Salmonella* occurrence and antimicrobial susceptibility patterns on U.S. dairies and represent the only national examination of *Salmonella* on dairy operations in the United States. Other research studies have examined *Salmonella* occurrence in dairy cattle but have been limited to specific regions of the United States.

At the time of sampling, records were kept as to whether each cow was sick, healthy (from the milking string), scheduled for culling (within 7 days of leaving the operation), or dry (dry cows were sampled only in Dairy 1996 and Dairy 2002). Dry cows were grouped with healthy cows in the following estimates. Dairy 1996 compared the prevalence of *Salmonella* in milk cows on-farm to that of cows on-farm that were scheduled for culling within the next 7 days and to cull cows at markets.

Dairy 2007 evaluated strategies for detecting *Salmonella* using fecal samples from individual cows, fecal samples pooled from five cows, and composite fecal samples from the dairy environment. To allow for comparison across the three studies, results presented in this report are primarily limited to healthy cows. An operation was classified as infected if one or more fecal samples were culture positive for *Salmonella*. The following table presents an overview of the sampling procedures used for the three dairy studies.

For more information on sampling and diagnostic testing methods, see Section III, p 48.

***Salmonella* fecal sampling methods, by study**

Study	Number of Operations Sampled*	Sampling Period	Number of Samples per Operation	Notes
Dairy 1996	91 dairy operations/ 19 States	Feb. 26 to July 10, 1996	40 or 50, depending on herd size, plus all cows scheduled for culling	All samples were taken rectally from individual cows. There were no specific targets as to the number of sick, dry, or milking string cows, other than the sample was to be representative of the cows on hand on the day of the visit. Cow type was noted at the time of collection. **Dairies with 30–99 cows**: Operations were visited once. Up to 40 fecal samples were collected, which included samples from all cows scheduled for culling present on the day of the visit. **Dairies with 100 or more cows:** Operations were visited three times. During one visit, 50 cows (from milking string, dry, or sick) were sampled along with up to 20 cows scheduled for culling in the next 7 days. On 2 other visits, up to 20 samples were taken from cows scheduled for culling in the next 7 days.
	97 cull cow markets/ 20 States	Feb. 26 to July 10, 1996	25	Twenty-five fresh fecal samples per market—either by rectal retrieval from individual cows or from pen floors if restraining facilities were not available.
Dairy 2002	97 dairy operations/ 21 States	Mar. 27 to Sept. 25, 2002	40	The goal was to collect 40 individual fecal samples during a single visit, all via rectal retrieval. If the herd had fewer than 40 cows, all cows were sampled. There were no specific targets for number of sick, dry, or milking string cows to be sampled, but cow type was noted at the time of collection.
Dairy 2007	121 dairy operations/ 17 States	Feb. 28 to Aug. 30, 2007	35	The goal was to collect 35 individual fecal samples during a single visit, all via rectal retrieval. Up to five sick cows and up to five cows scheduled for culling (within 7 days of leaving the operation) were sampled, with the remainder (up to 35) being from cows with saleable milk.
	260 dairy operations/ 17 States	Feb. 28 to Aug. 30, 2007	6	Manure/slurry (composite fecal) samples from six different adult cow areas where manure accumulates were taken (area samples). Each area sample was composed of about 4 oz of manure/slurry from each of six sites within the area. Areas recommended for sampling included common alleyways, common pens, exits from parlors, floors of holding pens, flush water, gutter cleaner, lagoons or manure pits, and manure spreaders.

*Operations with 30 or more dairy cows.

2. Prevalence

The table below presents both herd- and animal-level *Salmonella* prevalence estimates from the three NAHMS dairy studies. For purposes of comparison, estimates are limited to healthy cows because these sample numbers remained relatively consistent across the three studies. Culture methods were similar for the three NAHMS dairy studies. In 2007, the percentage of *Salmonella*-positive operations was almost double that in 1996, and the percentage of *Salmonella*-positive cows more than doubled over the same time period. Differences in types of operations sampled by region and herd size might account for some of the differences among the three studies; however, it is possible that *Salmonella* is becoming more common on U.S. dairies.

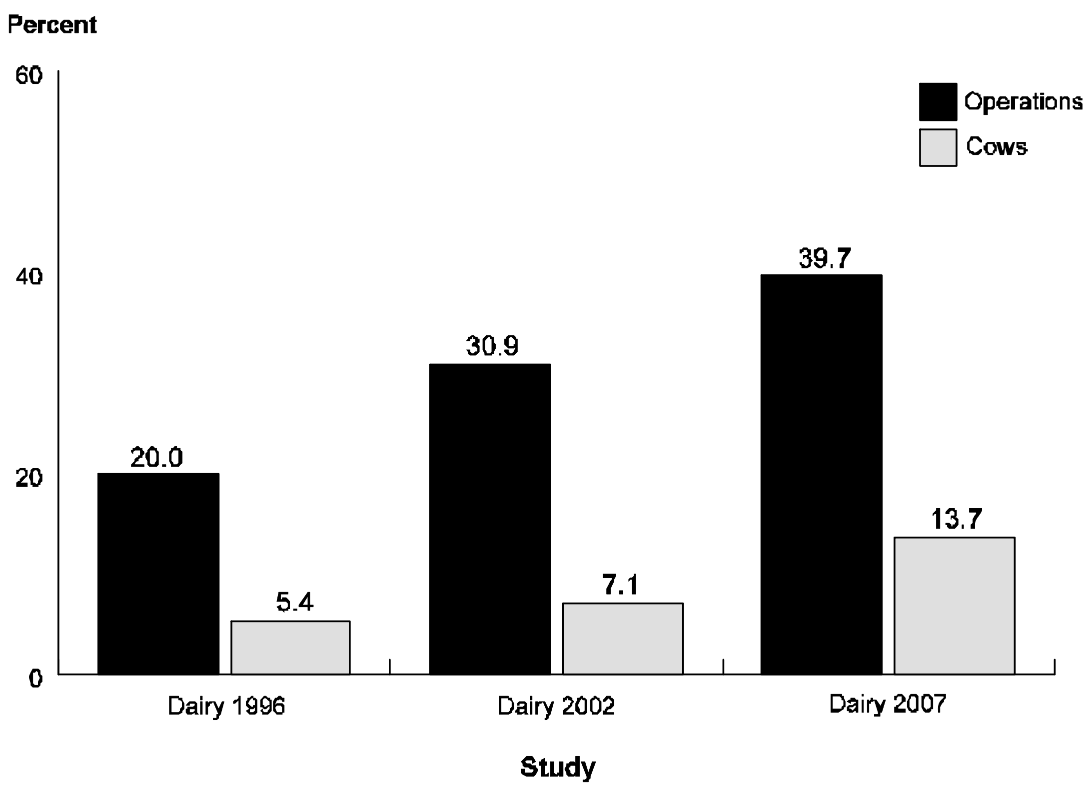
a. Percentage of operations and percentage of cows fecal-culture positive for *Salmonella*[1]

Study	Operations[2]	Cows
Dairy 1996	20.0 (18/90)	5.4 (194/3,585)
Dairy 2002	30.9 (30/97)	7.1 (259/3,645)
Dairy 2007	39.7 (48/121)	13.7 (523/3,804)

[1]Only cows healthy at the time of collection are included.
[2]Operations with at least one culture-positive cow were considered positive.

Photo courtesy of Judy Rodriguez

Percentage of Operations and Percentage of Cows Fecal-culture Positive for *Salmonella*



In several previous studies, operations with 100 or more dairy cows have been more likely than operations with fewer than 100 cows to be *Salmonella* positive (Warnick et al., 2001; Wells et al., 2001; Huston et al., 2002; Fossler et al., 2004; Blau et al., 2005; Davison et al., 2006; Cummings et al., 2009a). This finding was true in all three NAHMS dairy studies: the percentage of large operations culture positive for *Salmonella* was at least double that of small operations.

b. Percentage of operations[1] fecal-culture positive for *Salmonella*, by herd size[2]

	Herd Size (Number of Cows)		
Study	**Small** (Fewer than 100)	**Medium** (100–499)	**Large** (500 or More)
Dairy 1996	4.8 (2/42)	29.0 (9/31)	41.2 (7/17)
Dairy 2002	18.2 (6/33)	28.2 (11/39)	52.0 (13/25)
Dairy 2007	24.3 (9/37)	44.7 (21/47)	48.7 (18/37)

[1]Operations with at least one culture-positive cow were considered positive.
[2]Only cows healthy at the time of collection are included.

Salmonella has been found more commonly during summer months than winter months (Evans and Davies, 1996; Wells et al., 2001; Fossler et al., 2005b), although this finding has not been as consistently observed as the herd size differences described previously. In all three NAHMS studies, a higher percentage of operations sampled during summer (June–September) were positive compared with operations sampled during spring (February–May).

c. Percentage of operations[1] fecal-culture positive for *Salmonella*, by season[2]

	Season	
Study	**Spring** (February–May)	**Summer** (June–September)
Dairy 1996	16.2 (12/74)	37.5 (6/16)
Dairy 2002	23.5 (12/51)	39.1 (18/46)
Dairy 2007	29.6 (16/54)	47.8 (32/67)

[1]Operations with at least one culture-positive cow were considered positive.
[2]Only cows healthy at the time of collection are included.

There were no consistent trends in the percentage of *Salmonella*-positive operations by region. In 1996 and 2002, a higher percentage of operations in the West region than in the East region were *Salmonella* positive. In contrast, in 2007 a higher percentage of operations in the East region than in the West region were *Salmonella* positive (43.6 and 20.0 percent, respectively). It is difficult to draw any conclusions with regard to regional differences while ignoring herd size differences. As shown in table on the next page, during Dairy 1996 and Dairy 2002 there were fewer participating operations with 500 or more cows in the East region than there were in Dairy 2007. Thus, any apparent trends with regard to regional differences are likely due to herd sizes within each region.

d. Percentage of operations[1] fecal-culture positive for *Salmonella*, by region[2]

	Region	
Study	**East**	**West**
Dairy 1996	13.8 (9/65)	36.0 (9/25)
Dairy 2002	26.1 (18/69)	42.9 (12/28)
Dairy 2007	43.6 (44/101)	20.0 (4/20)

[1]Operations with at least one culture-positive cow were considered positive.
[2]Only cows healthy at the time of collection are included.

For the West region in 1996 and 2002, a higher percentage of operations with 500 or more cows were *Salmonella* positive compared with operations with fewer than 500 cows. For the East region in 2007, a higher percentage of operations with 500 or more cows were *Salmonella* positive compared with operations with fewer than 500 cows (65.2 and 37.2 percent, respectively). In the West region in 2007, there was little difference by herd size in the percentage of *Salmonella*-positive operations, which was also true in the East region in 1996 and 2002, although there were relatively few participating operations with 500 or more cows in the East region in 1996 and 2002.

e. Percentage of operations[1] fecal-culture positive for *Salmonella*, by herd size and by region[2]

	Dairy 1996		Dairy 2002		Dairy 2007	
	Region					
Herd size (Number of Cows)	**East**	**West**	**East**	**West**	**East**	**West**
Fewer than 500	13.3 (8/60)	23.1 (3/13)	25.8 (16/62)	10.0 (1/10)	37.2 (29/78)	16.7 (1/6)
500 or more	20.0 (1/5)	50.0 (6/12)	28.6 (2/7)	61.1 (11/18)	65.2 (15/23)	21.4 (3/14)

[1]Operations with at least one culture-positive cow were considered positive.
[2]Only cows healthy at the time of collection are included.

In all three dairy studies, a lower percentage of healthy cows were *Salmonella* positive on small operations than on medium and large operations. Large operations had the highest percentage of *Salmonella*-positive cows in 1996 and 2002.

f. Percentage of healthy cows fecal-culture positive for *Salmonella*, by herd size

	Herd Size (Number of Cows)					
	Small (Fewer than 100)		**Medium** (100–499)		**Large** (500 or More)	
Study						
Dairy 1996	0.6	(9/1,494)	6.3	(81/1,292)	13.0	(104/799)
Dairy 2002	1.8	(21/1,152)	7.7	(118/1,535)	12.5	(120/958)
Dairy 2007	5.5	(66/1,209)	17.9	(270/1,508)	17.2	(187/1,087)

In 1996 and 2002, a higher percentage of healthy cows were positive for *Salmonella* in the West region than in the East region. In contrast, in 2007 a higher percentage of cows were positive for *Salmonella* in the East region than in the West region; however, a much smaller number of cows were sampled in the West region than in the East region in 2007 (580 and 3,224, respectively).

g. Percentage of healthy cows fecal-culture positive for *Salmonella*, by region

	Region	
Study	**East**	**West**
Dairy 1996	1.6 (39/2,429)	13.4 (155/1,156)
Dairy 2002	5.3 (136/2,569)	11.4 (123/1,076)
Dairy 2007	15.5 (499/3,224)	4.1 (24/580)

One of the goals of the Dairy 1996 study was to evaluate whether cows scheduled for culling were more likely to be *Salmonella* positive than other cows on the operation. Aside from cows scheduled for culling, other cows sampled were to be representative of all cows on the operation on the day of sampling, including sick cows, dry cows, and cows in the milking string. It was noted at the time of sampling whether a cow was sick, dry, from the milking string, or scheduled for culling, but there were no requirements for sampling a specified number of sick cows. Likewise, for Dairy 2002 there were no requirements for sampling different types of cows, but it was noted at the time of sampling whether a cow was sick, scheduled for culling within 7 days, dry, or from the milking string. In contrast, in the Dairy 2007 study there were specific instructions to collect samples from up to 5 sick cows and up to 5 cows scheduled for culling, with the remainder of samples—up to 35—taken from cows with saleable milk.

The following results should be interpreted with these sampling differences in mind. For all three NAHMS studies, a higher percentage of cows designated as sick on the day of the visit were culture positive for *Salmonella* compared with cows designated as healthy. These results are supported by a previous study which collected samples from preweaned calves, sick cows, cows scheduled to be culled, periparturient cows (within 14 days of calving), and healthy cows and found that sick cows had the highest odds of being *Salmonella* positive (Fossler, 2005a). It is possible that the primary cause of illness in the sick cattle was salmonellosis, or that battling another illness or condition may make the animals more susceptible to secondary infections with *Salmonella*.

In 1996, a higher percentage of cows scheduled for culling were culture positive for *Salmonella* compared with healthy cows. In Dairy 2007, there was no difference in *Salmonella* prevalence between cows scheduled for culling and healthy cows.

h. Percentage of cows fecal-culture positive for *Salmonella*, by cow status

Cow Status	Dairy 1996		Dairy 2002		Dairy 2007	
Healthy	5.4	(194/3,585)	7.1	(259/3,645)	13.7	(523/3,804)
Sick	7.3	(4/55)	30.8	(8/26)	18.2	(40/220)
Scheduled for culling	18.1	(121/668)	0.0	(0/17)	12.6	(17/135)
All	7.4	(319/4,308)	7.2	(267/3,688)	13.9	(580/4,159)

Longitudinal studies with repeated sampling suggest that *Salmonella* can be found on almost all dairy operations. A study in which 110 dairies were sampled 5 times over the course of 1 year found 92.7 percent of operations to be culture positive for *Salmonella* (Fossler et al., 2004). In that study, between 31 and 55 percent of farms were positive on a per-visit basis and 25.0 percent of dairies accounted for 75 percent of the *Salmonella*-positive samples, implying that a relatively small percentage of dairy operations account for a majority of *Salmonella*-positive cattle.

Each of the three NAHMS dairy studies sampled operations at a single point in time, and the majority of operations were negative when tested for *Salmonella.* On many of the operations that tested positive for *Salmonella,* less than 10 percent of the cows sampled tested positive. Among culture-positive operations in 1996, 2002, and 2007, the median within-herd prevalence was 6.4, 10.3, and 21.9 percent, respectively. Among culture-positive operations in 1996, 2002, and 2007, the 75th percentile for within-herd prevalence was 40.0, 34.6, and 60.0 percent, respectively.

In each of the NAHMS dairy studies, approximately 10 percent of the sampled operations accounted for 75 percent or more of the positive samples from healthy cows. In 1996, 4 of the 90 operations accounted for 77.8 percent of the positive samples from healthy cows; in 2002, 9 of the 97 operations accounted for 74.5 percent of the positive samples from healthy cows; and in 2007, 16 of the 121 operations accounted for 74.6 percent of the positive samples from healthy cows.

i. Number of operations by within-herd prevalence of *Salmonella**

Within-herd Prevalence	Dairy 1996	Dairy 2002	Dairy 2007
0.0	72	67	73
0.1 to 10.0	11	16	20
10.1 to 20.0	1	2	4
20.1 to 30.0	1	3	4
30.1 to 40.0	1	3	3
40.1 to 50.0	0	1	2
50.1 to 60.0	0	3	4
60.1 to 70.0	1	0	2
70.1 to 80.0	0	0	1
80.1 to 90.0	3	1	4
90.1 to 100.0	0	1	4
Total	90	97	121

*Only cows healthy at the time of collection were included.

3. Serotypes

The following table shows the number of operations on which each serotype was identified from at least one cow (i.e., herd-level results). Cerro and Kentucky were the most common serotypes isolated from operations in Dairy 2007. *S.* Montevideo, one of the most common serotypes identified in the 1996, 2002, and 2007 NAHMS studies, has been among the top 10 identified from humans every year from 1996 through 2006 (CDC, 2008b).

a. Number of operations on which the following *Salmonella* serotypes were identified[1]

Serotype[2]	Dairy 1996 Number of Operations (90 Sampled)	Dairy 2002 Number of Operations (97 Sampled)	Dairy 2007 Number of Operations (121 Sampled)
Cerro	2	2	14
Kentucky	3	8	14
Muenster	2	3	8
Meleagridis	4	5	6
Montevideo	5	8	6
Untypable	1	5	6
Typhimurium[3]	2	3	4
Mbandaka	4	5	3
Anatum[3]	3	2	2
Agona	1	3	2
Bovismorbificans	1	0	2
Newport	0	5	2
Senftenberg	1	4	2
Derby	0	0	1
Fresno	0	0	1
Infantis	0	0	1
Muenchen	3	0	1
Saintpaul	0	0	1
Thompson	0	1	1
Give	2	2	0
Barranquilla	0	1	0
Cubana	0	1	0
Hartford	0	1	0
Livingstone	0	1	0
Newington	1	1	0
Ohio	0	1	0
Oranienburg	0	1	0
Reading	0	1	0
San Diego	0	1	0
Tennessee	0	1	0
Uganda	0	1	0
Worthington	2	0	0
Enteritidis	1	0	0
Menhaden	1	0	0
New Brunswick	1	0	0
Albany	1	0	0
Havana	1	0	0
Niakhar	1	0	0
Dublin	1	0	0

[1]Only cows healthy at the time of collection are included.
[2]Listed in order by rank for Dairy 2007 study.
[3]Includes variant species (e.g., Typhimurium var. 5-, formerly Typhimurium var. Copenhagen).

The top 10 serotypes identified from *Salmonella* isolates for each of the three NAHMS dairy studies are listed in the following table. Serotypes not among the top 10 were grouped into the “other” category. Three serotypes—Meleagridis, Montevideo, and Kentucky—ranked in the top five serotypes indentified in 1996, 2002, and 2007. The top 10 account for 81.1, 82.7, and 94.6 percent of total isolates in 1996, 2002, and 2007, respectively.

b. Number of *Salmonella* isolates from healthy cows, by serotype

Dairy 1996		Dairy 2002		Dairy 2007	
Serotype	No. Isolates (n=228)	Serotype	No. Isolates (n=283)	Serotype	No. Isolates (n=556)
Montevideo	49	Meleagridis	71	Cerro	157
Kentucky	29	Montevideo	34	Kentucky	130
Menhaden	27	Typhimurium*	29	Montevideo	66
Cerro	17	Kentucky	28	Mbandaka	47
Meleagridis	16	Agona	21	Meleagridis	40
Mbandaka	12	Mbandaka	12	Derby	27
Anatum	11	Ohio	12	Muenster	18
New Brunswick	9	Senftenberg	11	Anatum	17
Muenster	8	Cerro	8	Senftenberg	13
Albany	7	Newport	8	Newport	11
Other	43	Other	49	Other	30

*Includes variant species (e.g., Typhimurium var. 5-, formerly Typhimurium var. Copenhagen).

4. Comparison of serotypes isolated from cattle and humans

The following tables (a. through c.) compare *Salmonella* serotypes identified from cattle and humans in 1996, 2002, and 2007. Serotype data on healthy cows were taken from the respective NAHMS studies. Data on clinically ill cows originated from diagnostic samples submitted to the National Veterinary Services Laboratories (NVSL). Serotype data on humans were provided by the CDC through the Public Health Laboratory Information System. Salmonellosis is on the CDC's list of Nationally Notifiable Infectious Diseases.

The two most common serotypes identified in humans were *S.* Typhimurium and *S.* Enteritidis in 1996, 2002, and 2007. Sources of individual cases of salmonellosis in humans are often not identified, and the role of livestock in human cases of salmonellosis is unknown. There are many avenues other than food of animal origin, such as produce, by which people can get sick. Poultry is generally considered the most common source of salmonellosis in humans from *S.* Enteritidis. Hogs were the most common source of *S.* Typhimurium isolates among clinical animal submissions to NVSL in the most recent report in 2006. *S.* Montevideo was the only serotype that ranked among the 10 most common serotypes found in healthy cows, clinically ill cows, and humans in 1996, 2002, and 2007. However, *S.* Montevideo was a relatively uncommon serotype in humans, making up only 2 to 3 percent of isolates identified from humans in 1996, 2002, and 2007. *S.* Typhimurium was among the two most common serotypes identified in clinically ill cattle and humans in all 3 years but was uncommon among healthy cows. A recent study in which dairy herds were monitored for approximately 1 year for clinical signs of salmonellosis found *S.* Newport and *S*. Typhimurium to be the most common serotypes identified (Cummings, 2009b), which coincides with the NVSL results on clinically ill cattle. *S*. Typhimurium and *S*. Newport were among the four most common serotypes identified from humans in all 3 years. Clinically affected cattle may pose a greater threat to public health than healthy cattle (Cummings et al., 2009b) However, these serotype data alone do not provide sufficient evidence of transmission of *Salmonella* from cattle to humans.

a. Number of *Salmonella* isolates from healthy dairy cows, clinically affected cattle, and humans in 1996, by serotype

Healthy Cows (NAHMS)		Clinical Cattle (NVSL)[1 2]		Humans (CDC)[2]	
Serotype	**No. Isolates** (n=228)	**Serotype**	**No. Isolates** (n=4,183)	**Serotype**	**No. Isolates** (n=39,035)
Montevideo	49	Typhimurium[3]	1,081	Enteritidis	9,570
Kentucky	29	Montevideo	589	Typhimurium[3]	9,501
Menhaden	27	Cerro	239	Heidelberg	1,998
Cerro	17	Kentucky	230	Newport	1,985
Meleagridis	16	Anatum	228	Montevideo	1,227
Mbandaka	12	Dublin	213	Javiana	749
Anatum	11	Muenster	201	Oranienburg	690
New Brunswick	9	Meleagridis	172	Hadar	658
Muenster	8	Menhaden	118	Agona	606
Albany	7	Give	118	Muenchen	595
Other	43	Other	994	Other	11,456

[1]Serotypes are from beef and dairy sources. NVSL typically receives diagnostic samples from clinically ill cattle, but they may not be exclusively from ill cattle.
[2]From the *Salmonella* Annual Summaries published by the CDC at http://www.cdc.gov/ncidod/dbmd/phlisdata/*Salmonella*.htm
[3]Includes variant species (e.g., Typhimurium var. 5-, formerly Typhimurium var. Copenhagen).

b. Number of *Salmonella* isolates from healthy dairy cows, clinically affected cattle, and humans in 2002, by serotype

Healthy Cows (NAHMS)		Clinical Cattle (NVSL)[1 2]		Humans (CDC)[2]	
Serotype	**No. Isolates** (n=283)	**Serotype**	**No. Isolates** (n=2,674)	**Serotype**	**No. Isolates** (n=32,308)
Meleagridis	71	Newport	769	Typhimurium[3]	7,062
Montevideo	34	Typhimurium[3]	583	Enteritidis	5,116
Typhimurium[3]	29	Dublin	136	Newport	4,204
Kentucky	28	Agona	124	Heidelberg	1,957
Agona	21	Montevideo	115	Javiana	1,188
Mbandaka	12	Uganda	91	Montevideo	717
Ohio	12	Anatum	89	Muenchen	591
Senftenberg	11	Muenster	87	Oranienburg	585
Cerro	8	Kentucky	70	Saintpaul	535
Newport	8	Mbandaka	54	Infantis	463
Other	49	Other	556	Other	9,890

[1]Serotypes are from beef and dairy sources. NVSL typically receives diagnostic samples from clinically ill cattle, but they may not be exclusively from ill cattle.
[2]From the *Salmonella* Annual Summaries published by the CDC at
http://www.cdc.gov/ncidod/dbmd/phlisdata/*Salmonella*.htm
[3]Includes variant species (e.g., Typhimurium var. 5-, formerly Typhimurium var. Copenhagen).

c. Number of *Salmonella* isolates from healthy dairy cows, clinically affected cattle, and humans in 2007, by serotype

Healthy Cows (NAHMS)		Clinical Cattle (NVSL)[1 2]		Humans (CDC)[2]	
Serotype	**No. Isolates** (n=556)	**Serotype**	**No. Isolates** (n=3,770)	**Serotype**	**No. Isolates** (n=40,666)
Cerro	157	Newport	436	Typhimurium[3]	6,872
Kentucky	130	Typhimurium[3]	425	Enteritidis	6,740
Montevideo	66	Orion var. 15+,34+	365	Newport	3,373
Mbandaka	47	Dublin	335	Heidelberg	1,495
Meleagridis	40	Montevideo	293	Javiana	1,433
Derby	27	Agona	239	I 4,[5],12:i-	1,200
Muenster	18	Anatum	210	Montevideo	1,061
Anatum	17	Kentucky	164	Muenchen	753
Senftenberg	13	Muenster	163	Oranienburg	719
Newport	11	Cerro	155	Mississippi	604
Other	30	Other	985	Other	16,416

[1]Serotypes are from beef and dairy sources. NVSL typically receives diagnostic samples from clinically ill cattle, but they may not be exclusively from ill cattle.
[2]From the *Salmonella* Annual Summaries published by the CDC at http://www.cdc.gov/ncidod/dbmd/phlisdata/*Salmonella*.htm
[3]Includes variant species (e.g., Typhimurium var. 5-, formerly Typhimurium var. Copenhagen).

5. Antimicrobial susceptibility

Salmonella isolates from healthy cows showed relatively little resistance to antimicrobial agents in 1996, 2002, and 2007. Of all *Salmonella* isolates found in healthy cows and tested for antimicrobial susceptibility in 1996, 2002, and 2007, 92.3, 82.3, and 96.6 percent, respectively, were susceptible to all antimicrobials tested. In each of the studies, no more than 5 percent of *Salmonella* isolates from healthy cows were resistant to two or more antimicrobials.

a. Percentage of *Salmonella* isolates by number of antimicrobials in which antimicrobial resistance[1] was observed[2]

Study (n=Number of Isolates)	Susceptible to All Antimicrobials	Resistant to a Single Antimicrobial	Resistant to Two or More Antimicrobials	Total
Dairy 1996 (n=220)	92.3	3.6	4.1	100.0
Dairy 2002 (n=283)	82.3	12.7	5.0	100.0
Dairy 2007 (n=556)	96.6	0.7	2.7	100.0

[1]Intermediate isolates were classified as susceptible.
[2]Only cows healthy at the time of sample collection are included.

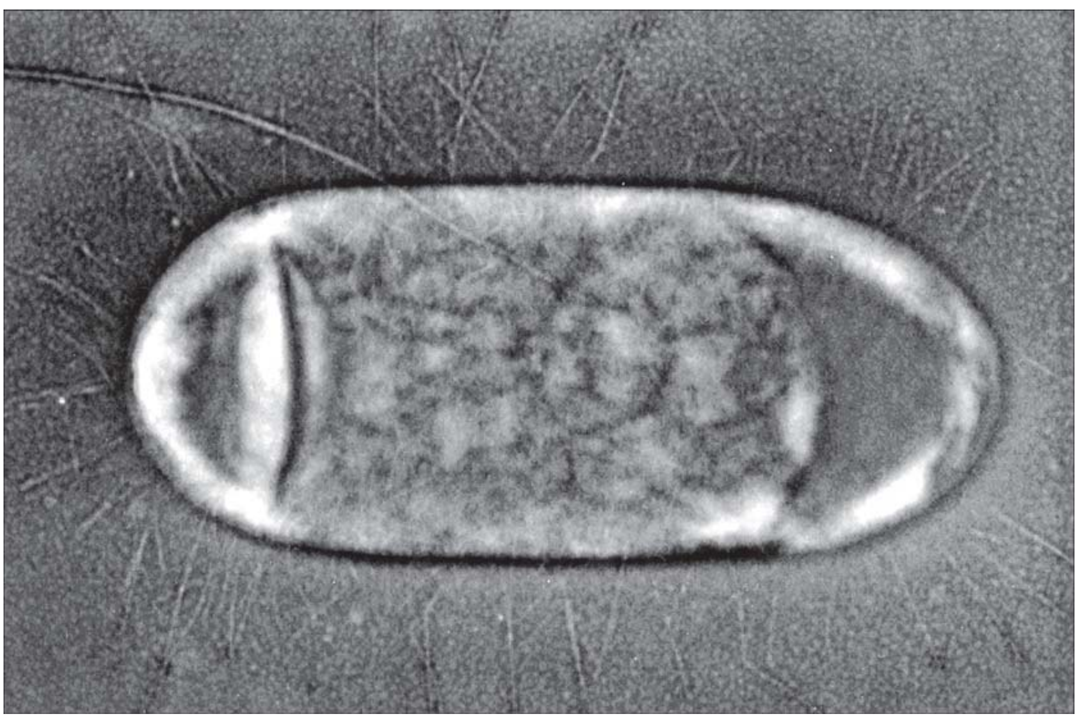


Photo of *S.* Typhimurium courtesy of Agriculture Research Service

Resistance to amikacin, ciprofloxacin, nalidixic acid, and trimethoprim-sulfamethoxazole was not observed in any of the three dairy studies. Resistance to ceftriaxone was observed in Dairy 2002 and Dairy 2007, but it was observed in only one isolate in Dairy 2007. *Salmonella* resistance to ceftriaxone is of interest because it is commonly used to treat severe *Salmonella* infections in children (Zhao et al., 2003).

b. Percentage of resistant[1] isolates from all *Salmonella* isolates tested for antimicrobial susceptibility, by antimicrobial[2]

Antimicrobial	Dairy 1996 (n=220)	Dairy 2002 (n=283)	Dairy 2007 (n=556)
Amikacin (AMI)	0.0	0.0	0.0
Amoxicillin-clavulanic acid (AMO)	0.9	4.9	1.8
Ampicillin (AMP)	3.6	4.6	2.2
Apramycin (APR)	0.0	NA	NA
Cefoxitin (FOX)	NA	3.9	1.6
Ceftiofur (TIO)	0.0	4.6	2.0
Ceftriaxone (AXO)	0.0	2.5	0.2
Cephalothin (CEP)	2.3	4.9	NA
Chloramphenicol (CHL)	1.4	4.6	2.5
Ciprofloxacin (CIP)	0.0	0.0	0.0
Gentamicin (GEN)	0.0	0.7	0.2
Kanamycin (KAN)	1.4	0.7	0.0
Nalidixic acid (NAL)	0.0	0.0	0.0
Streptomycin (STR)	4.1	9.9	2.7
Sulfamethoxazole[3] (SUL)	1.8	3.9	2.3
Tetracycline (TET)	2.3	12.4	3.1
Ticarcillin (TIC)	3.2	NA	NA
Trimethoprim-sulfamethoxazole (TRI)	0.0	0.0	0.0

[1]Intermediate isolates were classified as susceptible. Resistance break points were those current at the time of sample collection. Break points for extended spectrum cephalosporins changed in 2010 and testing was done prior to this change.
[2]Only cows healthy at the time of collection are included.
[3]Sulfisoxazole replaced sulfamethoxazole in 2007.

6. Multidrug resistance patterns

There were 53 multidrug-resistant isolates identified over the 3 study years. In 1996 and 2002, more *S.* Typhimurium isolates were resistant to multiple drugs compared with other serotypes. In 2007, however, no multidrug-resistant *S.* Typhimurium was observed. Dairy 2007 was the first NAHMS dairy study in which multidrug resistance was observed in *S.* Montevideo, which was one of the top three serotypes identified in each of the previous NAHMS studies.

Number of multidrug-resistant isolates by serotype and by resistance pattern[1]

Serotype	Resistance Pattern[2]	Dairy 1996 Isolates (n=356)	Dairy 2002 Isolates (n=291)	Dairy 2007 Isolates (n=620)
Agona	AMO, AMP, FOX, TIO, CHL, KAN, STR, SUL, TET, TRI	0	0	1
	CHL, STR, SUL, TET	0	0	2
Albany	AMO, AMP, CEP, TIC	1	0	0
Anatum	AMO, CEP	1	0	0
Cerro	CHL, TET	0	0	1
Dublin	AMP, CHL, KAN, STR, SUL, TET, TIC	2	0	0
Kentucky	AMP, CEP, TIC	1	0	0
Mbandaka	AMO, CEP, TET	0	1	0
	AMP, CEP, TIC	1	0	0
Menhaden	AMO, CEP	1	0	0
Montevideo	AMO, AMP, FOX, TIO, CHL, STR, SUL, TET	0	0	8
	AMO, AMP, TIO, CHL, STR, SUL, TET	0	0	1
	AMP, TIO, CHL, STR, SUL, TET	0	0	1
Muenster	AMP, CEP, TIC	1	0	0
Newport	AMO, AMP, FOX, TIO, AXO, CHL, STR, SUL, TET	0	0	1
	AMO, AMP, FOX, TIO, CEP, CHL, GEN, KAN, STR, SUL, TET	0	1	0
	AMO, AMP, FOX, TIO, CEP, CHL, STR, SUL, TET	0	5	0
	AMO, AMP, FOX, TIO, CEP, CHL, STR, TET	0	1	0
	AMO, AMP, FOX, TIO, CHL, STR, SUL, TET	0	0	8
Reading	AMO, AMP, FOX, TIO, CEP, CHL, GEN, KAN, STR, SUL, TET	0	1	0
	AMO, AMP, FOX, TIO, CHL, STR, SUL, TET	0	0	4
Saintpaul	AMP, GEN, TET	0	0	1
Typhimurium	AMO, AMP, CEP, CHL, GEN, KAN, STR, SUL, TET, TIC, TRI	1	0	0
	AMO, AMP, FOX, TIO, CEP, CHL, STR, SUL, TET	0	2	0
	AMO, AMP, FOX, TIO, CEP, CHL, STR, TET	0	1	0
	AMO, AMP, TIO, CEP, CHL, STR, SUL, TET	0	2	0
	AMP, CHL, SUL, TET, TIC	1	0	0
	AMP, KAN, STR, SUL, TET, TIC	1	0	0
Total multidrug-resistant isolates		11	14	28

[1]Healthy, sick, and to-be-culled cows are included.
[2]See previous table for the full name of the antimicrobial corresponding to the abbreviations listed here.

B. *Campylobacter*

1. Background

Campylobacter is recognized as a major cause of acute bacterial gastroenteritis in humans worldwide, comparable with or even surpassing *Salmonella* (Friedman et al., 2000). Mead et al. (1999) estimated that in the United States there are approximately 2.5 million cases of *Campylobacter jejuni* (*C. jejuni*) infections each year, 80 percent of which are food related. *Campylobacter coli* (*C. coli*) was estimated to cause approximately 26,000 cases in 2000 (Tam et al., 2003). Human cases of campylobacteriosis in the United States are estimated to cost $18.8 billion annually (Scharff, 2010).

Typical signs of *Campylobacter* infection in humans include abdominal cramping, vomiting, fever, and diarrhea (with or without blood), lasting from several days to more than a week (Skirrow and Blaser, 2000). Of individuals that recover from the disease, 20 percent may relapse or experience prolonged or severe illness requiring antimicrobial treatment. The disease is rarely fatal, and only about 10 percent of infected individuals are hospitalized.

The recently recognized association between development of Guillain-Barré syndrome in humans and prior *C. jejuni* infection, along with other sequelae, has increased the level of public health concern for this pathogen. Guillain-Barré syndrome is an autoimmune disease of the nervous system that can result in paralysis, pain, and muscle wasting; it has an annual incidence of about 2 in 100,000 persons in the United States (Allos, 2001). An estimated 0.1 percent of reported *Campylobacter* illnesses result in Guillain-Barré syndrome (CDC, 2010).

C. jejuni and *C. coli,* commonly found in the intestinal tracts of food animals, are the most frequently isolated *Campylobacter* species found in cases of human infection (Engberg et al., 2000). Poultry and poultry products have been documented as a major source of *Campylobacter* infection in humans (Corry and Atabay, 2001). Beef and dairy cattle are also common carriers of *Campylobacter* (Atabay and Corry, 1998; Wesley et al., 2000; Stanley and Jones, 2003; Bae et al., 2005). Young animals are more often colonized than older animals (Sato et al., 2004). Feedlot cattle are more likely than grazing cattle to carry *Campylobacter* (Giacoboni et al., 1993; Beach et al., 2002).

Although *Campylobacter* species can be considered commensal organisms or normal flora in livestock, they can produce clinical disease with diarrhea in neonatal calves and may cause abortion, infertility, and early embryonic death (Wesley et al., 2000; Smith, 2002). *Campylobacter* spp. has been identified from many livestock species. Although cattle can be colonized by *C. coli*, *C. jejuni* is the most common *Campylobacter* species isolated in cattle (Wesley et al., 2000; Harvey et al., 2004; Bae et al., 2005).

Foodborne transmission of *Campylobacter* can occur through fecal contamination of carcasses at slaughter, although *Campylobacter* is not frequently isolated from cattle carcasses or fresh beef (Minihan et al., 2004; Whyte et al., 2004; Hakkinen et al., 2007). Fecal contamination of milk or water is another potential route of human exposure (CDC, 2002; Clark et al., 2003). Unpasteurized milk has emerged as a risk factor for human campylobacteriosis in epidemiological studies (Jacobs-Reitsma, 2000; Studahl and Andersson, 2000; Neimann et al., 2003), and numerous outbreaks of human *Campylobacter* infection have occurred through consumption of raw dairy products (Evans et al., 1996; Altekruse et al., 1999; Schildt et al., 2006).

2. Sampling and testing overview

NAHMS has examined *Campylobacter* occurrence using individual fecal samples from dairy cows in three separate studies: Dairy 1996, Dairy 2002, and Dairy 2007. Typically, NAHMS studies generate population-based estimates, and appropriate sample sizes are used to arrive at such estimates. Field resources, laboratory capacity, and the expense of culturing samples make it difficult to provide a national estimate of *Campylobacter* prevalence based on fecal culturing of individual animals. Therefore, for the *Campylobacter* estimates in this section, all three NAHMS dairy studies used a sample of approximately 100 operations, which is not an optimal sample size for providing national estimates of prevalence. Despite this limitation, the NAHMS studies provide valuable information on *Campylobacter* occurrence and antimicrobial susceptibility patterns on U.S. dairies and represent the only national examination of *Campylobacter* on dairy operations in the United States. Other research studies have examined *Campylobacter* occurrence in dairy cattle but have been limited to specific regions of the United States.

Campylobacter monitoring in the NAHMS studies focused on *C. jejuni* and *C. coli* because these species are most commonly associated with human disease. Each of the three studies investigated the prevalence of *Campylobacter* on U.S. dairy operations. Antimicrobial susceptibility patterns of the *Campylobacter* isolates were evaluated in 2002 and 2007. At the time of sampling, records were kept as to whether each cow was sick, healthy (from the milking string), scheduled for culling (within 7 days of leaving the operation), or dry (dry cows were sampled only in Dairy 1996 and Dairy 2002; dry cows were grouped with healthy cows in the following estimates). Dairy 1996 compared the prevalence of *Campylobacter* in milk cows on-farm to that of milk cows on-farm scheduled for culling within 7 days, and to cull cows at markets. To allow for comparisons across the three studies, results presented in this report focused primarily on healthy cows.

The methods used to identify samples as *Campylobacter* positive varied across the three NAHMS studies. Dairy 1996 used PCR methods, and Dairy 2002 and Dairy 2007 used culture and PCR methods. A different PCR was used in Dairy 1996 than was used in Dairy 2002 and Dairy 2007. These differences in identification methods should be noted when interpreting *Campylobacter* results for the NAHMS dairy studies. Because Dairy 1996 identification methods were limited to PCR only, no antimicrobial susceptibility testing was performed. In addition, the PCR test from Dairy 1996 identified isolates with a 460-bp fragment as *C. coli* and isolates with both 160- and

460-bp fragments as *C. jejuni*. Because of the overlap between species at 460 bp, it could not be determined whether any samples were positive for both *C. jejuni* and *C. coli*. There were only 14 *C. coli* isolates in Dairy 1996, and for the purposes of this report it was assumed that no samples were positive for both *C. jejuni* and *C. coli*. For Dairy 2002, isolates were characterized as presumptive positive based on culture and microscopy, with PCR being used to confirm isolates as *Campylobacter* and to determine species. However, PCR was performed on only a subset of the presumptive-positive isolates. For Dairy 2007, species identification was performed on all positive isolates, and antimicrobial susceptibility testing was performed on all viable *C. jejuni* and *C. coli* isolates.

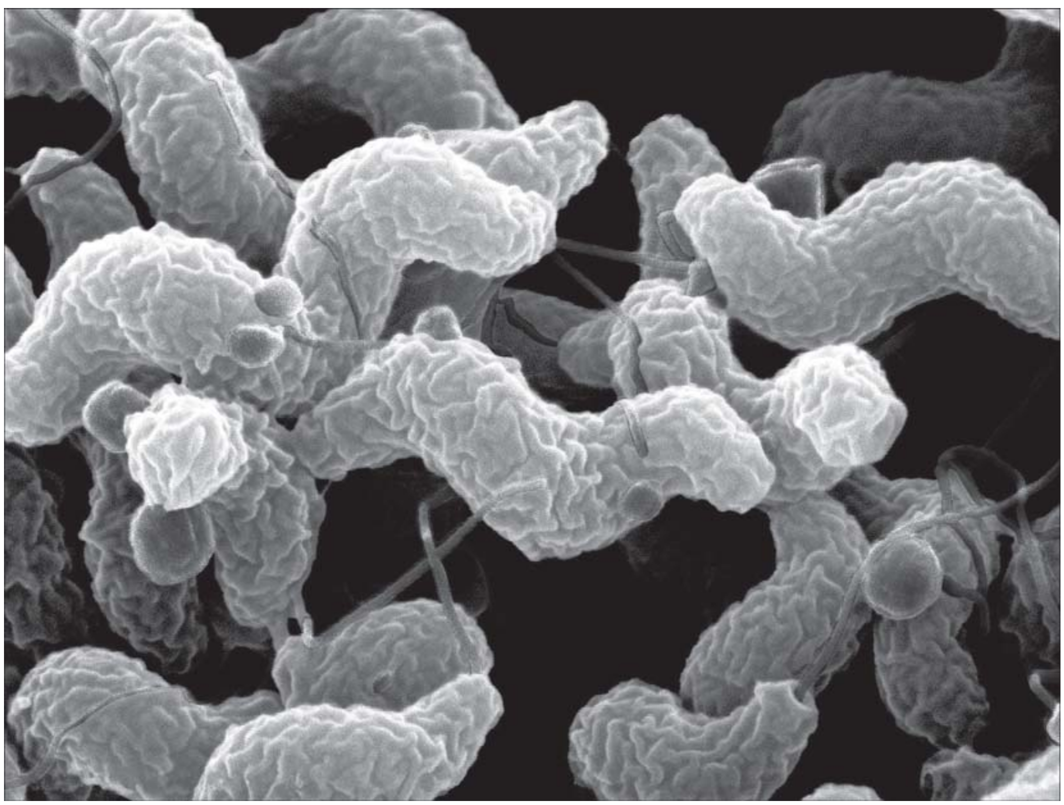


Photo of *C. jejuni* courtesy of CDC.

***Campylobacter* fecal sampling methods, by study**				
Study	**Number of Operations Sampled**	**Sampling Period**	**Number of Samples per Operation**	**Notes**
Dairy 1996	31 dairy operations/ 17 States	Feb. 26 to July 10, 1996	40 or 50, depending on herd size, plus all to-be-culled cows	All samples were taken rectally from individual cows. There were no specific targets as to the number of sick, dry, or milking string cows, other than the sample was to be representative of the cows on hand on the day of the visit. Cow type was noted at the time of collection. **Dairies with 30–99 cows**: Operations were visited once. Up to 40 fecal samples were collected, which included samples from all cows scheduled for culling present on the day of the visit. **Dairies with 100 or more cows:** Operations were visited three times. During one visit, 50 cows (from milking string, dry, or sick) were sampled along with up to 20 cows scheduled for culling in the next 7 days. On 2 other visits, up to 20 samples were taken from cows scheduled for culling in the next 7 days.
	36 dairy cull cow markets/ 14 States	Feb. 26 to July 10, 1996	25	Twenty-five fresh fecal samples per market—either by rectal retrieval from individual cows or from pen floors if restraining facilities were not available.
Dairy 2002	97 dairy operations/ 21 States	Mar. 27 to Sept. 25, 2002	15	The goal was to collect 15 individual fecal samples during a single visit, all via rectal retrieval. There were no specific targets for number of sick, dry, or milking string cows to be sampled, but cow type was noted at the time of collection.
Dairy 2007	121 dairy operations/ 17 States	Feb. 28 to Aug. 30, 2007	17	All samples were taken via rectal retrieval from individual cows at a single visit. The goal was to collect 17 to 18 samples per operation. Sampling for *Salmonella* was performed at the same time, with samples numbered from 1 to 35. While all 35 samples were tested for *Salmonella*, either the odd or even sample numbers were tested for *Campylobacter*. There were no specific targets as to the number of sick cows or cow scheduled for culling to be tested per operation for *Campylobacter*. However, because there were specific goals for testing these cow groups for *Salmonella*, in general 2 to 3 sick cows and 2 to 3 cows scheduled for culling (within 7 days of leaving the operation) were tested for *Campylobacter*, with the remainder up to 18 being from cows with saleable milk

3. Prevalence

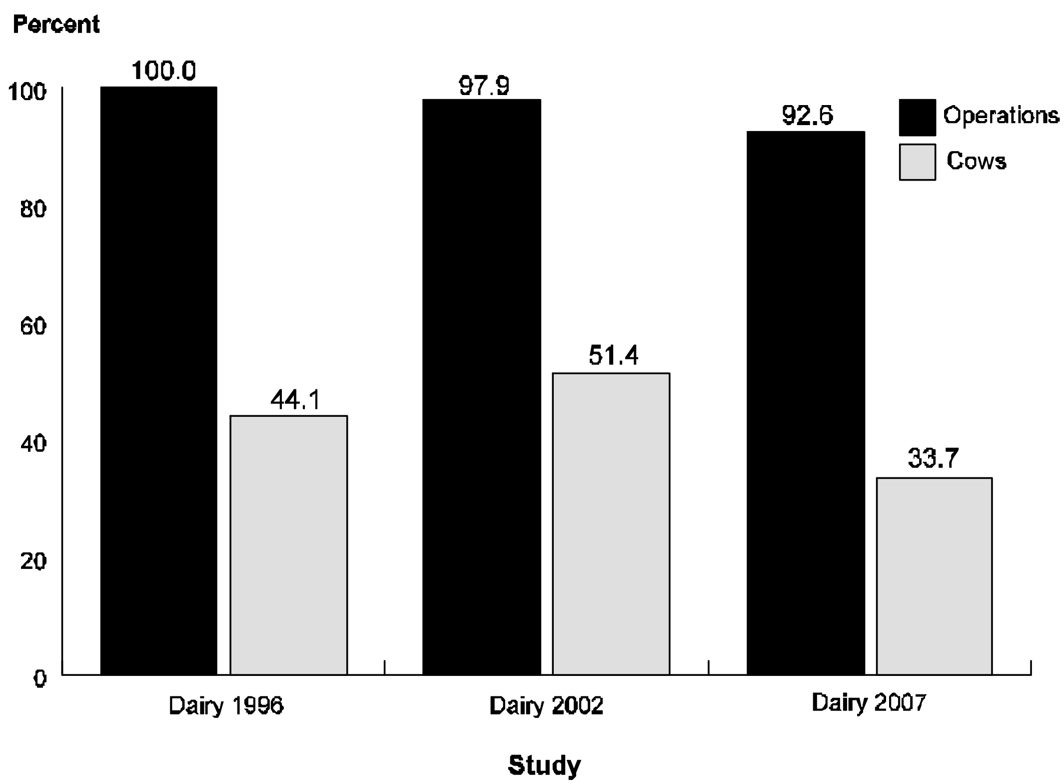
In 1996, *Campylobacter* was detected in at least one cow on all 31 sampled operations. In 2002, 97.9 percent of operations sampled had at least one cow shedding *Campylobacter* in feces. In 2007, 92.6 percent of operations had at least one cow shedding *Campylobacter* in feces.

a. Percentage of operations and percentage of healthy cows fecal-culture positive for *Campylobacter*

Study	Operations[1]	Cows
Dairy 1996[2]	100.0 (31/31)	44.1 (505/1,144)
Dairy 2002[3]	97.9 (95/97)	51.4 (732/1,424)
Dairy 2007	92.6 (112/121)	33.7 (635/1,885)

[1]Operations with at least one positive cow were considered positive.
[2]Only milk cow or cull cow was recorded for *Campylobacter* results for Dairy 1996, so a few operations might have had a small number of sick cows sampled.
[3]Data for 2002 were presumptive positives based on culture and microscopy. Confirmatory testing was performed only on a subset of these presumptive-positive isolates.

Percentage of Operations and Percentge of Healthy Cows Fecal-culture Positive for *Campylobacter*



C. jejuni was found on all of the *Campylobacter*-positive operations from the 1996, 2002, and 2007 studies for which species identification was performed. In contrast, *C. coli* was found on 19.4 to 39.8 percent of *Campylobacter*-positive operations during the three NAHMS studies.

b. Of the *Campylobacter* isolates tested for species identification, percentage of operations[1] and percentage of healthy cows fecal-culture positive for *C. jejuni* or *C. coli*

	C. jejuni				*C. coli*			
Study	**Percent**		**Cows**		**Percent**		**Cows**	
Dairy 1996[2]	100.0	(31/31)	97.2	(491/505)	19.4	(6/31)	2.8	(14/505)
Dairy 2002[3]	100.0	(93/93)	89.1	(465/522)	39.8	(37/93)	10.9	(57/522)
Dairy 2007	100.0	(112/112)	90.1	(554/615[4])	25.0	(28/112)	9.3	(57/615[4])

[1]Operations with at least one positive cow were considered positive.
[2]Only milk cow or cull cow was recorded for *Campylobacter* results for Dairy 1996, so a few operations may have had a small number of sick cows sampled.
[3]Species identification was performed on a subset of presumptive-positive isolates from Dairy 2002.
[4]Four of the 615 isolates in 2007 were *C. lari*. Twenty isolates were nonviable at the time of species identification, and these are not included in the isolates listed here.

For Dairy 2002 and Dairy 2007, a slightly higher percentage of sick cows were fecal-culture positive for *Campylobacter* compared with other cow types.

c. Percentage of cows fecal-culture positive for *Campylobacter*, by cow type

	Cow Type							
Study	**Healthy**		**Sick**		**Scheduled for Culling**		**All Cows**	
Dairy 2002	51.4	(732/1,424)	56.3	(9/16)	40.0	(2/5)	51.4	(743/1,445)
Dairy 2007	33.7	(635/1,885)	46.4	(51/110)	35.4	(28/79)	34.4	(714/2,074)

During all three study years, a lower percentage of cows on small operations than on large operations were fecal-culture positive for *Campylobacter*.

d. Percentage of healthy cows fecal-culture positive for *Campylobacter*, by herd size

	Herd Size (Number of Cows)		
Study	**Small** (Fewer than 100)	**Medium** (100–499)	**Large** (500 or More)
Dairy 1996*	38.5 (150/390)	45.2 (208/460)	50.0 (147/294)
Dairy 2002	43.7 (211/483)	49.2 (287/583)	65.4 (234/358)
Dairy 2007	22.1 (133/603)	36.3 (269/742)	43.1 (233/540)

*Only milk cow or cull cow was recorded for *Campylobacter* results for Dairy 1996, so a few operations may have had a small number of sick cows sampled.

In 1996, the percentage of cows PCR positive for *Campylobacter* was similar in the East and West regions. In 2002 and 2007, a slightly higher percentage of cows in the West region were culture positive for *Campylobacter* compared with cows in the East region.

e. Percentage of healthy cows fecal-culture positive for *Campylobacter*, by region

	Region	
Study	**East**	**West**
Dairy 1996*	44.6 (323/724)	43.3 (182/420)
Dairy 2002	46.9 (477/1,018)	62.8 (255/406)
Dairy 2007	31.7 (507/1,597)	44.4 (128/288)

*Only milk cow or cull cow was recorded for *Campylobacter* results for Dairy 1996, so a few operations may have had a small number of sick cows sampled.

In 1996, 2002, and 2007 over 90 percent of operations were positive for *Campylobacter*. Among all operations tested, the median within-herd prevalence in 1996, 2002, and 2007 was 42.9, 58.3, and 30.8 percent, respectively. Among all operations, the top quartile within-herd prevalence was 64.0, 73.3, and 52.9 percent in 1996, 2002, and 2007, respectively.

The within-herd prevalence for *Salmonella* and *Campylobacter* in healthy cows differed greatly on dairy operations. The majority of operations were *Salmonella* negative, and the highest percentage of positive herds had a within-herd prevalence of 10 percent or less. In contrast, for *Campylobacter* most operations were *Campylobacter* positive, and most positive herds had a within-herd prevalence of over 10 percent.

f. Number of operations by within-herd prevalence of *Campylobacter*[1]

Within-herd Prevalence	Dairy 1996	Dairy 2002	Dairy 2007
0.0	0	2	9
0.1–10.0	1	4	7
10.1–20.0	3	7	24
20.1–30.0	6	7	20
30.1–40.0	5	17	18
40.1–50.0	5	6	14
50.1–60.0	4	22	11
60.1–70.0	6	7	8
70.1–80.0	0	15	7
80.1–90.0	0	4	2
90.1–100.0	1	6	1
Total	31	97	121

4. Antimicrobial susceptibility

Antimicrobial susceptibility testing was conducted on a subset of *Campylobacter* isolates from Dairy 2002 and on all isolates from Dairy 2007. Antimicrobial susceptibility testing was not performed in Dairy 1996. In Dairy 2002, 49.2 percent of the *C. jejuni* isolates from healthy cows were susceptible to all antimicrobials against which they were tested. In Dairy 2007, 37.1 percent of the *C. jejuni* isolates from healthy cows were susceptible to all antimicrobials. A relatively low percentage of isolates were resistant to two or more antimicrobials.

a. Percentage of *C. jejuni* isolates by number of antimicrobials in which antimicrobial resistance[1] was observed[2]

Study (n=Number of Isolates)	**Susceptible to All Antimicrobials**	**Resistant to a Single Antimicrobial**	**Resistant to Two or More Antimicrobials**	**Total**
Dairy 2002 (n=465)	49.2	47.4	3.4	100.0
Dairy 2007 (n=553)	37.1	60.9	2.0	100.0

[1]Intermediate isolates were classified as susceptible.
[2]Only cows healthy at the time of collection are included.

Of the antimicrobials in the table below, ciprofloxacin and erythromycin are especially important because they are often used when treatment is indicated for *Campylobacter* infection in humans (Gupta et al., 2004). Very few of the *C. jejuni* isolates were resistant to ciprofloxacin or erythromycin in 2002 and 2007. The highest percentages of *C. jejuni* isolates were resistant to tetracycline in 2002 and 2007 (47.5 and 62.4 percent, respectively).

b. Percentage of resistant[1] isolates from all *C. jejuni* isolates tested for antimicrobial susceptibility, by antimicrobial[2]

Antimicrobial	**Dairy 2002** (n=465)	**Dairy 2007** (n=553)
Azithromycin (AZI)	0.9	0.4
Ciprofloxacin (CIP)	2.6	1.3
Chloramphenicol (CHL)	0.0	NA
Clindamycin (CLI)	0.6	0.2
Erythromycin (ERY)	0.4	0.4
Florfenicol (FLO)	NA	0.0
Gentamicin (GEN)	0.2	0.0
Nalidixic acid (NAL)	4.1	1.6
Telithromycin (TEL)	NA	0.0
Tetracycline (TET)	47.5	62.4

[1]Intermediate isolates were classified as susceptible.
[2]Only cows healthy at the time of collection are included.

5. Multidrug resistance patterns

The table below shows resistance patterns for *C. jejuni* and *C. coli* isolates from all cow types for 2002 and 2007. No isolates were resistant to more than four antimicrobials. No isolates were resistant to both ciprofloxacin and erythromycin.

Number of *Campylobacter* isolates, by resistance pattern[1]

Species	Resistance Pattern2	Dairy 2002 Isolates	Dairy 2007 Isolates
jejuni	AZI, CLI, ERY, TET	0	1
	AZI, CLI, ERY, NAL	1	0
	AZI, CLI, TET	1	0
	AZI, ERY, TET	1	1
	CIP, NAL, TET	6	7
	CIP, NAL	6	3
	NAL, TET	0	2
	AZI, CLI	1	0
	NAL	6	0
	GEN	1	0
	TET	214	381
	Pansusceptible	234	228
	Total	471	623
coli	AZI, CLI, ERY, NAL	1	0
	AZI, CLI, ERY, TET	2	1
	AZI, ERY, TET	2	1
	AZI, CLI, NAL	1	0
	CIP, NAL, TET	0	6
	CLI, TET	1	0
	GEN, TET	2	0
	NAL, TET	3	0
	TET	29	32
	Pansusceptible	18	24
	Total	59	64

[1]Healthy, sick, and to-be-culled cows are included.
[2]See preceding table for the full name of the antimicrobials.

Section III: Sampling and Diagnostic Testing

A. Farm Selection

Dairy 1996

A stratified random sample of dairy operations from the USDA National Agricultural Statistics Service (NASS) list frame in each of 20 selected States,[1] representing 80.2 percent of U.S. dairy operations and 83.1 percent of U.S. dairy cows, was the basis for selecting participating operations in the Dairy 1996 study. More than 2,500 and 1,200 dairy producers participated in Phase I and Phase II of the study, respectively. A convenience sample of 100 of the 1,200 dairies was selected for participation in *Salmonella* sampling. This sample included 50 dairies with 30 to 99 dairy cows, and 50 dairies with 100 or more dairy cows. The number of small and large operations allocated to each State was proportional to the number of small and large operations in the State. Cull-cow markets were also selected for fecal sampling in these 20 States, allocated based on the number of cull dairy-cow markets within the State. Previous history of salmonellosis was not a selection factor. Samples were collected from February 26 to July 10, 1996.

Dairy 2002

A stratified random sample of dairies was chosen based on herd size from the NASS listing for each of 21 selected States.[2] This sample represented 85.5 percent of the U.S. dairy cows and 82.8 percent of U.S. dairy operations. Dairy operations reporting one or more milk cows in inventory on January 1, 2002, were eligible for Phase I of the study, and operations with at least 30 dairy cows were eligible for Phase II. Participation in the study included over 2,400 dairy producers in Phase I and 1,000 producers in Phase II. Of the Phase II operations, bulk-tank milk samples from 861 operations were collected by Federal and State veterinary medical officers or animal health technicians. Samples were collected from February 27 to July 1, 2002. A convenience sample of 100 of these operations with at least 30 milk cows was selected for fecal sampling. Approximately five operations per State were selected. Previous history of salmonellosis was not a selection factor. Samples were collected from March 27 to September 25, 2002.

[1]California, Florida, Idaho, Illinois, Indiana, Iowa, Kentucky, Michigan, Missouri, New Mexico, New York, Minnesota, Ohio, Oregon, Pennsylvania, Tennessee, Texas, Vermont, Washington, and Wisconsin.

[2]California, Colorado, Florida, Idaho, Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Pennsylvania, Ohio, Tennessee, Texas, Vermont, Virginia, Washington, and Wisconsin.

Dairy 2007

Data were collected during the NAHMS Dairy 2007 study from dairy operations in 17 major dairy States[3] representing 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. The survey design was a stratified random sample with unequal selection probabilities within each stratum to ensure that large dairy operations were well represented in the sample. Dairy operations reporting one or more milk cows in inventory on January 1, 2007, were eligible for Phase I of the study, and operations with at least 30 dairy cows were eligible for Phase II. Participation in the study included over 2,194 dairy producers in Phase I and 582 producers in Phase II. Of the Phase II operations, bulk-tank milk and in-line milk filter samples from 538 operations were collected by Federal and State veterinary medical officers or animal health technicians. A convenience sample of 121 of these operations with at least 30 milk cows was selected for individual cow fecal sampling. Previous history of salmonellosis was not a selection factor. Samples were collected from February 28 to August 29, 2007.

Photo courtesy of Agriculture Research Service

[3]California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Virginia, Washington, and Wisconsin.

B. Sampling Methods

1. Bulk-tank milk and milk filter sampling

A single bulk-tank milk sample from each participating operation was collected during the Dairy 2002 and Dairy 2007 studies and tested for *Listeria* and *Salmonella*. Bulk-tank milk was not tested for *Salmonella* or *Listeria* in Dairy 1996. Milk filters were collected only in 2007. Dairy 2002 used both culture and PCR methods for *Salmonella* detection, but only PCR was used for Dairy 2007. Bulk-tank milk samples were aseptically collected only when milk from at least 70 percent of the operation's lactating cows was represented in the sample. Additionally, for Dairy 2007, milk filters were collected at the time of sampling. If the milk filter was not available for removal from the milk line during the sample visit, farm operators were requested ahead of time to place the filter from the most recent milking in a clean plastic bag and store in the refrigerator. For Dairy 2007, sample collectors were instructed not to freeze samples. In some cases for Dairy 2002, the samples were frozen prior to shipping. Bulk-tank milk and milk filters were shipped overnight with ice packs to the USDA–Agricultural Research Service (ARS) Environmental Microbial Safety Laboratory (EMSL) in Beltsville, MD.

2. Fecal sampling

Each of the three dairy studies had slightly different objectives with regard to *Salmonella* sampling, which led to differences in the types of cattle sampled. Although the numbers of samples taken on each operation were similar across studies, they were not identical. A subset of samples taken for *Salmonella* testing during the three dairy studies was tested for *Campylobacter*. Thus, the type of cattle sampled, the number of cattle sampled, and the sampling collection methods were the same for *Salmonella* and for *Campylobacter*, but fewer samples were tested for *Campylobacter* than for *Salmonella*.

Dairy 1996

The Dairy 1996 study set out to determine if *Salmonella* prevalence differed among milk cows on the farm, cows scheduled for culling within 7 days, and cull cows at livestock markets. Small dairies (30 to 99 cows) were visited once for fecal sampling, and up to 40 samples were collected at this single visit. All cows scheduled for culling within 7 days were sampled, and the remainder of samples—up to 40—were taken from other cows, including healthy milking cows, dry cows, and sick cows. Dairies with 100 or more cows were visited 3 times. At one visit, 50 cows (milking string, dry, or sick) were sampled along with up to 20 cows scheduled for culling. During the other two visits, up to 20 samples were taken from cows scheduled for culling. There were no specific target numbers for sick, dry, or milking string cows, other than samples were to be representative of the cows on hand on the day of the visit. Cow type was recorded at the time of collection. At each livestock market, 25 fresh fecal samples were taken, either by rectal retrieval or from pen floors if restraining facilities were not available. Samples were taken by rectal retrieval, and a separate glove was used to collect each fecal sample to avoid cross-contamination during sampling. Samples were placed in sterile screw-top vials. Fecal samples were approximately golf-ball sized and were kept on ice and shipped to NVSL. *Salmonella*-positive samples were sent to the USDA–ARS Bacterial Epidemiology and Antimicrobial Resistance Unit (BEAR) [formerly the Antimicrobial Resistance Research Unit] in Athens, GA, for antimicrobial susceptibility testing. At 50 samples per herd (40 per herd for operations with fewer than 100 cows), this sample provided 95-percent confidence of detecting at least 1 positive animal if the within-herd prevalence was greater than or equal to 5 percent, assuming an equal risk of fecal shedding for each cow sampled. *Campylobacter* testing was done on all samples from 31 of the operations.

Dairy 2002

The Dairy 2002 study set out to estimate *Salmonella* prevalence and describe antimicrobial resistance on U.S. dairies. Operations were visited once. The goal was to collect 40 samples per operation regardless of herd size, or from all cows if the operation had fewer than 40 cows. There were no specific targets for numbers of sick, dry, or milking string cows to be sampled, but cow type was recorded at the time of collection. Samples were taken by rectal retrieval, and a separate glove was used to collect each fecal sample to avoid cross-contamination during sampling. Samples were placed in sterile Whirl-pak® bags. Fecal samples were approximately golf-ball sized and were shipped on ice to BEAR for culturing and antimicrobial susceptibility testing. *Campylobacter* testing was done on 15 of the samples per operation.

Dairy 2007

The Dairy 2007 study set out to estimate *Salmonella* prevalence and describe antimicrobial resistance on U.S. dairies. An additional goal was to evaluate testing strategies for detecting *Salmonella* using fecal samples from individual cows, pooled fecal samples, and composite fecal samples. Operations were visited once. Up to 35 fecal samples per operation were taken via rectal retrieval. The goal was to collect 35 fecal samples from every operation, regardless of operation size. Up to 5 sick cows and up to 5 cows scheduled for culling were sampled, with the remainder (up to 35) taken from cows with saleable milk. A separate glove was used to collect each fecal sample to avoid cross-contamination during sampling. Fecal samples were approximately golf-ball sized. Samples were placed in sterile Whirl-pak bags. Samples were kept on ice and shipped to BEAR for culturing and antimicrobial susceptibility testing. Samples from individual cows were pooled at the laboratory, with each pool representing five cows.

C. Laboratory Methods

1. *Salmonella* testing of bulk-tank milk and milk filters

Dairy 2002

Culture was one of the testing methods used to detect *Salmonella* in milk samples (Van Kessel et al., 2004). Briefly, milk (250 µL) was plated in triplicate directly onto XLT4 agar (XLT4 agar base with XLT4 supplement; BD Diagnostics) using an Autoplate 4000. Plates were incubated at 37°C and scored for presumptive *Salmonella* colonies (black colonies) at 24 and 48 h. For enrichment of *Salmonella*, 5 to 10 mL of milk was added to 90 mL of tetrathionate broth. The variation in volume was due to variation in available sample volume. Enrichment bottles were incubated at 37°C for 24 h and then the broth was streaked (10 µL) onto XLT4 agar. Plates were incubated at 37°C and examined at 24 and 48 h for the presence of black colonies. Isolated, presumptive *Salmonella* colonies were transferred from XLT4 plates onto XLT4, brilliant green, and L-agar. Colonies that exhibited the *Salmonella* phenotype (black on XLT4 and pink on brilliant green) were preserved for future analysis. Colony biomass was transferred from the L-agar plates to a vial containing 0.5 mL of a 1:1 mixture of Lennox broth and the 2x freezing medium for cells (Schleif and Wensink, 1981). The isolates were stored at -80°C. L-agar slants were inoculated and, after incubation at 37°C for 24 h, sent to NVSL for serotyping.

PCR was also used to detect *Salmonella* in milk samples using RT-PCR, as described by Van Kessel, et al. (2003). Briefly, 5 to 10 mL of milk was added to 95 mL of tetrathionate broth. The variation in volume was due to variation in available sample volume. Enrichment bottles were incubated at 37°C for 24 h. After incubation, enriched samples (1.5 mL) were centrifuged (13,000 x *g*) in microcentrifuge tubes, the supernatants were discarded, and the pellets were stored at -20°C. DNA was extracted from bacterial pellets using 200 µL of InstaGene Matrix (Bio-Rad Laboratories, Hercules, CA) following the manufacturer's directions. The DNA preparations were stored at -20°C and later analyzed for the presence or absence of *Salmonella* via RT-PCR . RT-PCR was carried out using the Ruggedized Advanced Pathogen Identification Device (RAPID) [Idaho Technology Inc., Salt Lake City, Utah]. Premixed, freeze-dried PCR reagents that target the *spa*Q gene on the chromosome of *Salmonella* were used according to the manufacturer's directions using 2 µL of sample. Preincubation was at 94°C for 60 s. Forty-five PCR cycles were run under the following conditions: 95°C for 0 s (the cuvettes are heated to 95°C but not held there), followed by 60°C for 20 s with a temperature transition rate of 20°C/s. Other variable parameters included: channel 2, gain 8, and mode 1. The RAPID system, in conjunction with the *Salmonella* detection kit, has the capability of running melting point curves on the PCR reaction products. Melting point curves were run on all samples that were identified as *Salmonella*-positive by the RAPID software. The initial temperature was 94°C for 1 min; the temperature was reduced to 50°C, and then increased from 50 to 94°C at a rate of 0.2°C/s. The fluorescence in the sample was read at each stage of the temperature gradient and a first derivative plot of fluorescence vs. temperature was used to determine the melting point of any

PCR products present. The software supplied by the manufacturer provided a score for each reaction based upon the degree that the maximum level of fluorescence recorded during the PCR run differed from the baseline calculated in the early stages of the run. Thus, the score depended upon the magnitude of fluorescent signal generated and the quality of the baseline. The higher the score, the more the maximum fluorescent signal varied from the baseline. For samples with a very low PCR score, a subjective analysis of the melting point curve and the RT-PCR amplification curve was used to decide if a sample was finally considered *Salmonella*-positive or *Salmonella*-negative (Van Kessel et al., 2003). Logistic regression analysis of the relationship between RT-PCR signal and the likelihood of obtaining a positive culture was done using the PROC PROBIT procedure in SAS 9.1 (SAS Inst. Inc., Cary, NC). Samples that gave a positive result in the real-time assay were subjected to two rounds of conventional PCR using primer set 139-141 targeting the *inv*A gene as described by Rahn et al. (1992) and shown by Malorny et al. (2003) to detect a wide range of *Salmonella*. The conditions for the first round of PCR were those described by Malorny et al. (2003) except that 1 U of Amplitaq Gold (Applied Biosystems, Foster City, CA) was used per 25 µL reaction, a 10-min incubation at 95°C was added to activate the enzyme at the beginning of the reaction, and the PCR was run for 40 cycles. A portion (1 to 3 µL) of the InstaGene preparation from the tetrathionate broth enrichments of raw milk samples was added to each reaction. For the second round of PCR, 5 µL of first-round product was added to 20 µL of fresh PCR mix to give the same final composition as the first-round reactions. Amplification was done on a Biometra Personal Cycler (Biometra, Göttingen, Germany). The PCR products were separated by electrophoresis on a 2-percent horizontal agarose gel in Tris-borate buffer as described by Maniatis et al. (1982). The gel contained 0.5 µg/mL ethidium bromide; bands were visualized on a UV transilluminator, and documented with a video camera. Detection of a band in the region of 284 bp indicated the presence of *Salmonella*.

Dairy 2007

Bulk-tank milk and/or in-line milk filter samples were analyzed by RT-PCR. Ten mL of milk were added to 10 mL of 2X tetrathionate broth and incubated overnight at 37°C. Milk filters were cut into pieces and mixed with buffered peptone water in a stomacher bag and pummeled for 2 min. Five mL of the liquid of the stomacher bag were added to 5 mL of 2X tetrathionate broth and incubated at 37°C overnight. After incubation, 1.5 mL of the broth was centrifuged (16,000 x *g*) for 2 min in microcentrifuge tubes. The supernatant was discarded, and the DNA was extracted from the pellet biomass using 200 µL of InstageneGene Matrix (Bio-Rad Laboratories, Hercules, CA) following manufacturer's instructions. The DNA preparations were stored at -20°C and analyzed for presence of *Salmonella* via PCR for the *invA* gene using the primers described by Rahn et al. (1992) and shown by Malorny et al. (2003) to be effective for the detection of multiple serotypes of *Salmonella*. The PCR reactions were run at EMSL and monitored in real time through the addition of EVAGreen dye (Biotium, Inc., Hayward, CA). PCR-positive samples were then cultured to allow for *Salmonella* serotyping.

2. *Listeria* testing of bulk-tank milk and milk filters

Dairy 2002

Milk (250 µL) was plated in triplicate directly onto Modified Oxford Medium (MOX) agar (BD Diagnostics) using an Autoplate 4000. Plates were incubated at 37°C and scored for presumptive *Listeria* colonies (esculin hydrolysis, black colonies) at 24 and 48 h. For enrichment of *Listeria*, 5 to 10 mL of milk were added to 90 mL of Modified *Listeria* Enrichment Broth (BD Diagnostics). Enrichment bottles were incubated at 37°C for 48 h, and then the broth was streaked (10µL) onto MOX agar. Plates were incubated and scored as described previously. Isolated, presumptive *Listeria* colonies were transferred from MOX plates onto MOX, PALCAM (BD Diagnostics), and trypticase soy agar with 0.6 percent yeast extract (TSA-YE). Colonies that exhibited the *Listeria* phenotype (black on MOX and gray-green with esculin hydrolysis on PALCAM) were preserved for future analysis. Colony biomass was transferred from the TSA-YE plates to 1.5 mL of tryptic soy broth and incubated at 37°C for 48 h. The enriched broth was centrifuged (16,000 x *g*), and the supernatants were discarded. The bacterial pellet was resuspended in 0.5 mL of 1x freezing medium for cells of Schleif and Wensink (1981), and the isolates were stored at -80°C. Presumptive *Listeria* isolates were grown on TSA-YE for further testing. Isolates were tested for oxidase with 1-percent tetramethyl-p-phenylenediamine dihydrochloride (BD Diagnostics), catalase with 3 percent hydrogen peroxide, and gram-stained using a 3-step staining kit (BD Diagnostics). Hemolytic activity was determined by stabbing blood agar (Columbia with 5 percent sheep blood; Remel, Lenexa, KS) and incubating at 37°C for 48 hours. The Christie-Atkins-Munch-Peterson test was performed on each isolate using *Staphylococcus aureus* Beta Lysin Disks (Remel) and *Rhodococcus equi* (ATCC 6939; American Type Culture Collection, Manassas, VA) on sheep blood agar. Additionally, RT-PCR was run on DNA extracts of the presumptive *Listeria* isolates. Isolates were grown in 1.0 mL of tryptic soy broth at 37°C for 48 h. The enriched broth was centrifuged (16,000 x *g*), and the supernatants were discarded. The DNA was extracted from the bacterial pellets using a commercially prepared extraction preparation (InstaGene Matrix; Bio- Rad Laboratories, Hercules, CA) following the manufacturer’s directions. The DNA preparations (200 µL) were stored at -20°C prior to analysis. RT-PCR was run according to the method described by Nogva et al. (2000) using a Mx4000 Multiplex Quantitative PCR System (Stratagene, La Jolla, CA). Amplification reactions (50 µL) contained 300 nM of each primer, 250 nM probe, 12.6 µg of BSA, 25 µL of TaqMan Master Mix (Applied Biosystems, Foster City, CA), and 5 µL of extracted DNA product. The thermal profile used for PCR was 50°C for 2 min followed by 95°C for 10 min followed by 40 cycles of 95°C for 15 s and 60°C for 60 s. Serotyping of the *L. monocytogenes* isolates was conducted using a previously described ELISA (Palumbo et al., 2003).

Dairy 2007

Ten mL of milk was mixed with 90 mL 1X modified *Listeria* Enrichment Broth (mLEB) for enrichment of *Listeria* and incubated at 37°C for 40 to 48 h. Milk filters were cut into pieces and mixed with 2 parts (w/w) buffered peptone water in a stomacher bag and pummeled for 2 min. Then 5 mL of liquid from stomacher bag was mixed with 5 mL 2X mLEB and incubated at 37°C for 40 to 48 h. After 48 h, 2 mL of each enrichment was harvested by centrifuging at 16K x *g* for 2 min in a 2-mL cryovial. The supernatant was removed and the pelleted biomass was suspended in 0.5 mL of preservation medium and frozen at -80°C to archive live cells (Preservations). Biomass was harvested from 1.5 mL of each enrichment in a 1.7-mL microcentrifuge tube. The supernatant was removed and the pellet was saved for DNA extraction by freezing at -20°C. A 10-µL loop was used to streak 10 µL of each enrichment onto Modified Oxford Agar plates (MOX). Plates were incubated at 37°C for 48 h and examined for colonies with morphology resembling *Listeria*. Identity of colonies was confirmed as *Listeria* and determined to be *L. monocytyogenes* vs. non-*L. monocytyogenes* by patching suspect colonies onto PALCAM and BCM media. Any phospholipase-positive isolates were further characterized with a CAMP test to distinguish *L. ivanovii* from *L. monocytyogenes*.

3. *Salmonella* testing of fecal samples

Various diagnostic testing methods are available for detecting *Salmonella*, including culture, PCR, and ELISA. Culture methods must be used if antimicrobial susceptibility testing is to be performed. Culture was the diagnostic method used in the Dairy 1996, Dairy 2002, and Dairy 2007 studies, and culture methods were similar across studies. The following culture methods apply to Dairy 1996, Dairy 2002, and Dairy 2007, unless noted otherwise.

Approximately 1 g of feces from each sample was placed into each of two culture media—gram-negative Hajna broth and tetrathionite broth—which were incubated at 37°C for 24 and 48 h, respectively. Following primary enrichments, 100 µL culture aliquots from each broth enrichment were transferred into Rappaport R-10 medium for secondary enrichment, giving two Rappaport secondary enrichments per sample. In each case, Rappaport R-10 medium was incubated overnight at 37°C and then streaked onto brilliant green agar with sulfadiazine and xylosine-lysine-tergitol-4 (XLT-4) plates, resulting in four plates per sample. All plates were incubated overnight at 37°C. At least three (Dairy 1996) or four (Dairy 2002 and 2007) colonies having the typical appearance of *Salmonella* were inoculated into triple sugar iron and lysine iron agar slants. All slants were incubated overnight at 37°C. All isolates presumed to be *Salmonella* were serogrouped using serogroup-specific sera and sent to NVSL for serotyping. Isolates with different serogroups from each sample were kept. If all four colonies from a sample had the same serogroup, only one isolate was kept.

Salmonella isolates were tested for antimicrobial drug susceptibility at BEAR. For Dairy 1996, Dairy 2002, and Dairy 2007, susceptibility testing was conducted with a custom-designed panel of antimicrobial drugs using a Sensititre semi-automated testing system (TREK Diagnostic Systems, Inc.). Antimicrobial agents included in the custom designed panel differed slightly for each of the three NAHMS studies. The minimum inhibitory concentration (MIC) for each isolate was determined, and each isolate was classified as susceptible, intermediate, or resistant, according to guidelines published by the National Committee on Clinical Laboratory Standards for broth-microdilution susceptibility testing, when available. When guidelines were not available, breakpoint interpretations were determined using National Antimicrobial Resistance Monitoring System (NARMS) guidelines. The antimicrobials included for all studies included amikacin, amoxicillin-clavulanic acid, ampicillin, ceftiofur, ceftriaxone, chloramphenicol, ciprofloxacin, gentamicin, kanamycin, nalidixic acid, streptomycin, tetracycline, and trimethoprim-sulfamethoxazole. Apramycin was included in Dairy 1996 only. Cefoxitin was included in Dairy 2002 and 2007 but not Dairy 1996. Cephalothin was included in Dairy 1996 and 2002 but not 2007. Ticarcillin was included in Dairy 1996 only. Sulfamethoxazole was included in Dairy 1996 and 2002, and then a similar sulfa antimicrobial, sulfisoxazole, replaced it in Dairy 2007.

Breakpoints used for susceptibility testing of *Salmonella*[1,2]

		Breakpoints (µg/mL)		
Antimicrobial Class	**Antimicrobial Agent**	**Susceptible** (less than or equal)	**Intermediate**	**Resistant** (greater than or equal)
Aminoglycosides	Amikacin	16	32	64
	Gentamicin	4	8	16
	Kanamycin	16	32	64
	Streptomycin	32	NA	64
β-lactam/β-lactamase inhibitor combinations	Amoxicillin-clavulanic acid	8/4	16/8	32/16
Cephems	Cefoxitin	8	16	32
	Ceftiofur	2	4	8
	Ceftriaxone[2]	8	16–32	64
Folate pathway inhibitors	Sulfamethoxazole/ sulfisoxazole[3]	256	NA	512
	Trimethoprin-sulfamethoxazole	2/38	NA	4/76
Penicillin	Ampicillin	8	16	32
Phenicols	Chloramphenicol	8	16	32
Quinolones	Ciprofloxacin	1	2	4
	Nalidixic acid	16	NA	32
Tetracyclines	Tetracycline	4	8	16

[1]Breakpoints were adopted from CLSI (Clinical and Laboratory Standards Institute), except for streptomycin, which has no CLSI breakpoints.
[2]CLSI revised the breakpoints for ceftriaxone in its M100-S20 document published in January 2010. The old breakpoints were used for the data in this report.
[3]Sulfamethoxazole was tested from 1996 through 2003 and was replaced by sulfisoxazole in 2004.

4. *Campylobacter* testing of fecal samples

Various diagnostic testing methods are available for detecting *Campylobacter*. Culture is the traditional identification method, but PCR is also commonly used. Culture methods are required in order to perform antimicrobial susceptibility testing. Specific PCR and culture methods differed among the dairy studies, and diagnostic procedures follow.

Dairy 1996

For *Campylobacter* testing, a multiplex PCR was used that allowed for the simultaneous identification of *C. jejuni* and *C. coli* (Harmon et al., 1997). The assay targeted the *flA* genes of *C. jejuni* and *C. coli*, which yielded a 460-bp product. A second set of primers identified a nucleic acid sequence unique to *C. jejuni* and yielded a 160-bp product. Within 36 h of sample collection, approximately 1 g of feces was diluted (10 percent wt/vol) in buffered peptone water (9 mL). An aliquot (0.4 mL) of the fecal suspension was plated to the surface of modified blood-free charcoal, cefoperazone deoxycholate agar (CM 739; Oxoid Ogdensburg, NY) and incubated microaerobically for 2 to 3 d at 42°C (Ono et al., 1995). After incubation, bacterial growth from the first quadrant was harvested with a bacteriological loop, placed in Tris-EDTA buffer (pH 7.4, 200µL) and frozen (-20°C) prior to PCR analysis. The bacterial suspension in Tris-EDTA (200 µL) was boiled for 5 min prior to PCR analysis and centrifuged (13,000 x g, 1 min at room temperature), and a 5-µL aliquot was used as the PCR template. Samples were subjected to an initial denaturation step (94°C for 4 min), followed by 25 amplification cycles. Each amplification cycle consisted of denaturation (1 min at 94°C), primer annealing (1 min at 45°C), and primer extension (1 min at 72°C). Final primer extension (7 min at 72°C) followed the last amplification cycle. PCR products were electrophoretically separated (120 V, 45–55 min). *C. coli* were identified by the appearance of a 460-bp product, and *C. jejuni* was identified by presence of both a 460-bp and a 160-bp product. Antimicrobial susceptibility testing was not performed on *Campylobacter* isolates from the Dairy 1996 study.

Dairy 2002

Fecal samples were diluted 1:4 and 1:40 in phosphate-buffered saline. 100-µL aliquots of each dilution were spread uniformly on duplicate Campy-Cefex plates (Stern et al., 1992). The plates were placed in zip-top bags and incubated microaerobically (5 percent O_2, 10 percent CO_2, and 85 percent N_2) for 48 h at 42°C. *Campylobacter* was presumptively identified from microscope wet mounts of cells using phase contrast optics at 100x. Samples from 97 operations were tested for *Campylobacter*, and antimicrobial susceptibility testing was performed on isolates from 94 operations. For 26 operations, all available isolates were tested for antimicrobial susceptibility. For cost reasons, 5 isolates (or as many as were available for operations with fewer than 5 isolates) were randomly chosen for antimicrobial susceptibility testing from the remaining 68 operations. From each sample with *Campylobacter* growth, a single colony was selected for antimicrobial susceptibility testing. The isolates were identified to the species level using the *Campylobacter* BAX® PCR (DuPont Qualicon, Wilmington, DE), a multiplex assay specific for *C. coli* and *C. jejuni* (Englen and Fedorka-Cray, 2002). A total of 532 isolates, including 473 *C. jejuni* and 59 *C. coli*, were selected for susceptibility testing to 8 antimicrobials. The Etest® method (AB-Biodisk, Piscataway, NJ) was used according to the manufacturer's directions as described by Englen et al. (2005). Briefly, 150-mm Mueller Hinton plates containing 5 percent lysed horse blood (B-D Biosciences, Sparks, MD) were inoculated with 100 µL of a cell suspension equal to a 1.0 McFarland standard. The inoculum was swabbed evenly across the entire plate surface, and four Etest strips were laid at right angles onto each plate. The plates were put into zip-top bags and incubated in a microaerobic atmosphere (5 percent O_2, 10 percent CO_2, and 85 percent N_2) for 48 h at 42°C. Following incubation, the point at which the zone of growth inhibition intersected the strip was read as the MIC of the antimicrobial in µg mL^{-1}. Quality control ATCC strains *C. jejuni* 33560, *Escherichia coli* 25922, and *Staphylococcus aureus* 25923 were tested biweekly to confirm susceptibility to all eight antimicrobials. The antimicrobial resistance break points (MICs) used were those established by NARMS in accordance with Clinical and Laboratory Standards Institute guidelines: azithromycin, $\geq$2 µg mL^{-1}; chloramphenicol, $\geq$32 µg mL^{-1}; ciprofloxacin, $\geq$4 µg mL^{-1}; clindamycin, $\geq$4 µg mL^{-1}; erythromycin, $\geq$8 µg ml^{-1}; gentamicin, $\geq$16 µg ml^{-1}; nalidixic acid, $\geq$32 µg ml^{-1}; tetracycline, $\geq$16 µg ml^{-1}.

Dairy 2007

Fecal samples were diluted 1:10 in phosphate-buffered saline before being enriched in Bolton's enrichment broth for 48 h at 42°C under microaerophilic conditions (5 percent O_2, 10 percent CO_2, 85 percent N_2). Aliquots (10 µL) were spread onto Campy-Cefex plates (Stern et al., 1992) which were incubated as in 2002. Presumptive *Campylobacter* colonies were selected by observation of cellular morphology and motility using a wet mount under phase-contrast microscopy. Isolates were identified using the *Campylobacter* BAX PCR (DuPont Qualicon, Wilmington, DE), a multiplex assay specific for *C. coli* and *C. jejuni*. The assay was performed according to manufacturer directions as previously described (Englen and Fedorka-Cray, 2002). If a PCR product was not obtained using the BAX PCR, a traditional PCR was used as previously described (Wang et al., 2002). This traditional PCR can identify *C. jejuni, C. coli, C. lari, C. fetus,* and *C. upsaliensis. Campylobacter* isolates were susceptibility tested using broth microdilution in a custom panel of nine antimicrobials: azithromycin, ciprofloxacin, clindamycin, erythromycin, florfenicol, genamicin, nalidixic acid, telithromycin, and tetracycline. The semi-automated Sensititre™ System (TREK Diagnostic Systems, Inc., Cleveland, OH) was used per manufacturer's instruction. MICs were determined for each isolate and classified as susceptible, intermediate, or resistant according to Clinical and Laboratory Standards Institute standards, where available. Otherwise, breakpoint determinations were based on those used by NARMS (FDA, 2009).

Breakpoints used for susceptibility testing of *Campylobacter*[1]

		Breakpoints (µg/mL)		
Antimicrobial Class	**Antimicrobial Agent**	**Susceptible** (less than or equal)	**Intermediate**	**Resistant** (greater than or equal)
Aminoglycosides	Gentamicin	2	4	8
Ketolides	Telithromycin	4	8	16
Lincosamides	Clindamycin	2	4	8
Macrolides	Azithromycin	2	4	8
	Erythromycin	8	16	32
Phenicols	Florfenicol[2]	4	NA	8
Quinolones	Ciprofloxacin	1	2	4
	Nalidixic acid	16	32	64
Tetracyclines	Tetracycline	4	8	16

[1]Breakpoints were adopted from CLSI (Clinical and Laboratory Standards Institute) when available.
[2]For florfenicol, only a susceptible breakpoint (=4 µg/mL) has been established. In this report, isolates with an MIC =8 µg/mL are categorized as resistant.

D. Testing Methods Overview

The table below presents a synopsis of the testing methods used on each NAHMS dairy study, by organism and type of sample.

c. Testing method by NAHMS study, organism, and type of sample

	Study Year					
	1996		2002		2007	
Organism/ Sample Type	Culture	PCR	Culture	PCR	Culture	PCR
Salmonella						
Individual cow fecal samples	X		X		X	
Composite fecal (environmental) samples					X	
Bulk-tank milk sample			X	X		X
Milk filter samples						X
Campylobacter						
Individual cow fecal samples		X	X		X	
Listeria						
Bulk-tank milk samples			X		X	
Milk filter samples					X	

Appendix I: NAHMS Study Methodology—Phase II*

NAHMS Dairy Studies			
	1996	**2002**	**2007**
Data collection dates	2/26–7/10	3/27–9/25	2/28–8/30
Minimum number of dairy cattle	30	30	30
Number of States	20	21	17
Data collectors	State and Federal veterinary medical officers and animal health technicians		
Participating States as a percentage of U.S. population coverage			
Operations	85.6	86.9	84.7
Cows	82.7	85.7	82.5
Respondent sample profile (herd size)			
Small (fewer than 100 cows)	630	400	233
Medium (100–499 cows)	502	392	215
Large (500 or more cows)	87	221	134
Respondent sample profile (region)			
East	931	805	474
West	288	208	108
Response category			
Survey complete	1,219	1,013	582
Percent of total	76.0	70.4	54.0
Refused	340	335	380
Did not contact	16	76	111
Ineligible	29	14	4
Total	1,604	1,438	1,077

*For more detailed information about the methodology for each study, see methodology section of each descriptive report at: http://nahms.aphis.usda.gov

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Appendix III. Previously Published Material

Dairy 1996

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Dairy 2007

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Antibiotic Use on U.S. Dairy Operations, 2002 and 2007

In 2007, the U.S. Department of Agriculture's (USDA) National Animal Health Monitoring System (NAHMS) conducted the Dairy 2007 study. In all, 17 of the Nation's major dairy States*, representing 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows, participated in the study. In the Dairy 2002 study, 21 major dairy States participated, representing 82.9 percent of operations and 85.5 percent of dairy cows.

One goal of the Dairy 2007 study was to evaluate the use of antibiotics for disease prevention, disease treatment, and growth promotion on U.S. dairies. Dairy 2002 also evaluated antibiotic practices and provided a baseline comparison for 2007 antibiotic-use practices. Producers completed a form detailing the number of animals displaying clinical signs of disease, the number treated with antibiotics, and then listed the antibiotic that was used for the majority of those animals during each study year. For the purposes of this information sheet, the term "antibiotic" refers to all antimicrobial drugs.

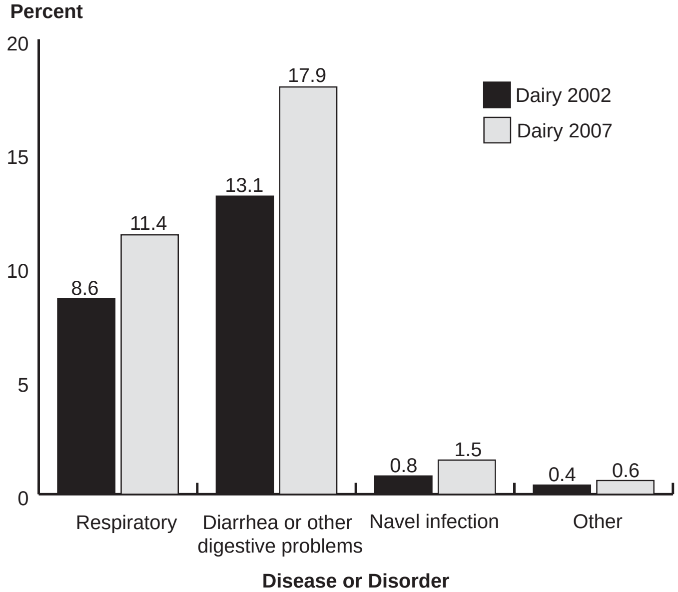
Preweaned heifers—disease prevention and growth promotion

Over one-half of operations (57.5 percent) fed medicated milk replacer to preweaned heifers in 2007, similar to the 55.7 percent of operations that did so in 2002. The most common medication in milk replacer was a combination of oxytetracycline and neomycin, which was used by 49.5 percent of operations in 2007 and 25.6 percent of operations in 2002.

Disease treatment for preweaned heifers

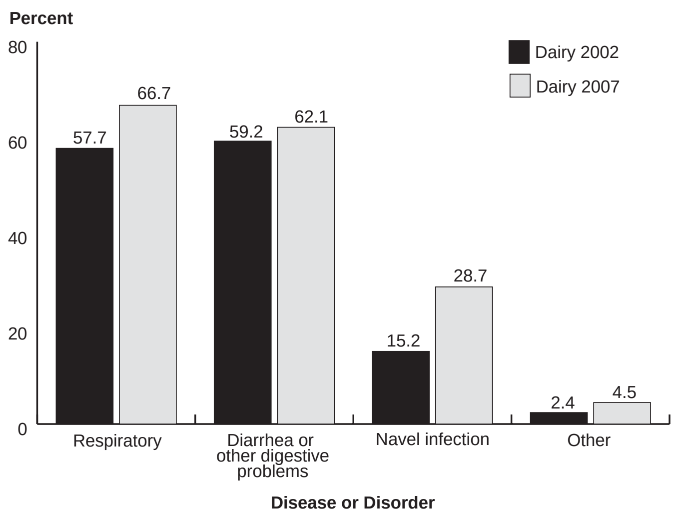
In 2007, 17.9 percent of preweaned heifers were treated with antibiotics for diarrhea or other digestive problems during the previous 12 months, up from 13.1 percent in 2002. About 1 of 10 preweaned heifers (11.4 percent) were treated for respiratory disease in 2007 compared with 8.6 percent in 2002 (figure 1).

Figure 1. Percentage of Preweaned Heifers Treated with Antibiotics for the Following Diseases or Disorders During the Previous 12 Months, 2002 and 2007



In 2007, 66.7 percent of operations used an antibiotic to treat preweaned heifers with respiratory disease, compared with 57.7 percent in 2002. Just under two-thirds of operations treated preweaned heifers with antibiotics for diarrhea or other digestive problems in 2007 and 2002 (62.1 and 59.2 percent of operations, respectively) [figure 2].

Figure 2. Percentage of Operations (Including Those not Reporting Diseases or Disorders) that Treated Preweaned Heifers with Any Antibiotic for the Following Diseases or Disorders During the Previous 12 months, 2002 and 2007



***States**
California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Virginia, Washington, and Wisconsin.

In 2007 and 2002, about one-fourth of preweaned heifers treated with antibiotics for diarrhea or other digestive problems received a sulfonamide as the primary antibiotic (table 1). Tetracycline was the next most common antibiotic used to treat diarrhea or other digestive problems in 2007 and 2002.

Table 1. For Preweaned Heifers Treated for Diarrhea or Other Digestive Problems During the Previous 12 Months, Percentage of Preweaned Heifers by Primary Antibiotic Used for Treatment, 2002 and 2007

	Percent Treated Preweaned Heifers	
Primary Antibiotic Used*	**2002**	**2007**
Aminocyclitol	NA	5.1
Aminoglycoside	11.5	11.5
Noncephalosporin beta-lactam	14.4	11.0
Cephalosporin	10.6	9.5
Florfenicol	3.8	5.2
Macrolide	7.1	2.8
Sulfonamide	23.8	23.3
Tetracycline	21.9	16.5
Other	6.9	15.1
Total	100.0	100.0

*See table 4 (insert) for antibiotic classes and common product names.

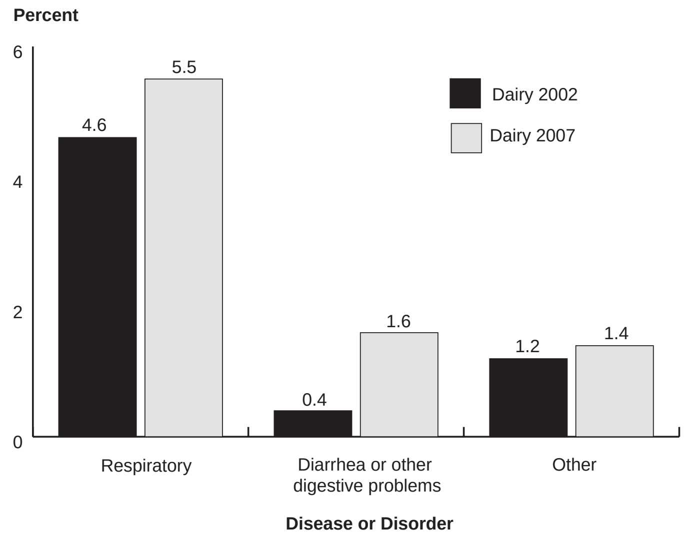
Weaned heifers—disease prevention and growth promotion

In 2007, 18.2 percent of operations used antibiotics other than ionophores in rations for weaned heifers, similar to the 17.5 percent of operations that did so in 2002. The use of ionophores remained the same, with 45.2 percent of operations using ionophores in heifer rations in 2007 and 44.2 percent doing so in 2002.

Disease treatment for weaned heifers

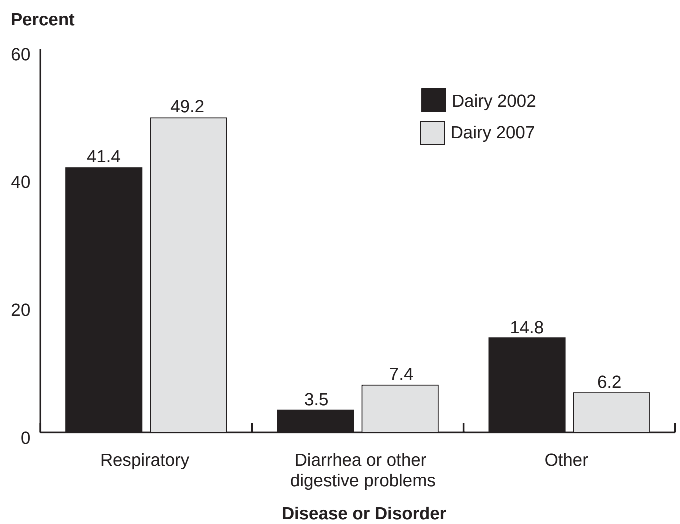
A much lower percentage of weaned heifers than preweaned heifers were affected by disease and thus fewer weaned heifers received antibiotic treatments. In 2007, only 5.5, 1.6, and 1.4 percent of weaned heifers were treated for respiratory disease, diarrhea or other digestive problems, or other disorders, respectively. In 2002, 4.6, 0.4, and 1.2 percent of weaned heifers were treated for respiratory disease, diarrhea or other digestive problems, or other disorders, respectively (figure 3).

Figure 3. Percentage of Weaned Heifers Treated with Antibiotics for the Following Diseases or Disorders During the Previous 12 Months, 2002 and 2007



In 2007, 49.2 percent of operations treated some weaned heifers for respiratory disease compared with 41.4 percent in 2002. A lower percentage of operations (generally less than 10 percent) treated weaned heifers for diarrhea or other diseases in 2007 and 2002 (figure 4).

Figure 4. Percentage of Operations (Including Those not Reporting Diseases or Disorders) that Treated Weaned Heifers with Any Antibiotic During the Previous 12 Months, 2002 and 2007



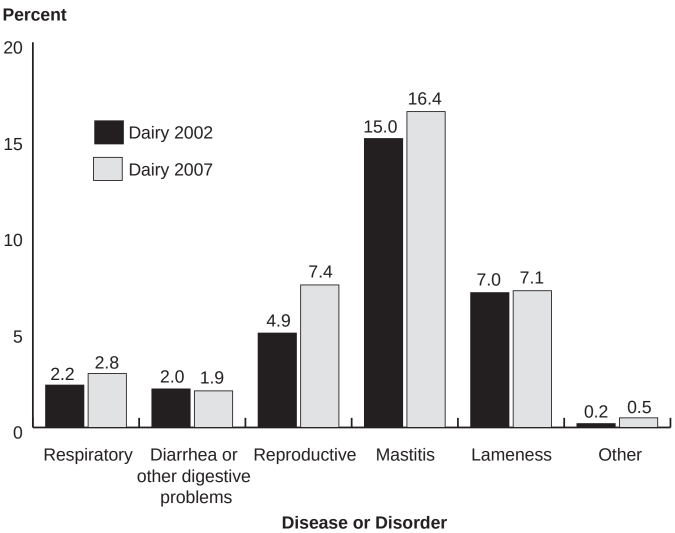
Cows—disease prevention

Nine of 10 operations (90.1 percent) used intramammary antibiotics at dry-off in 2007, similar to the 94.1 percent of operations that did so in 2002. About 80 percent of operations that used intramammary antibiotics at dry-off treated all cows on the operation. Penicillin G (procaine)/dihydrostreptomycin and cephapirin were the most commonly used intramammary antibiotics at dry-off.

Disease treatment for cows

Mastitis was the most commonly treated disease in cows in 2007 and 2002, with 16.4 and 15.0 percent of cows treated with antibiotics for mastitis, respectively. The percentage of cows treated with antibiotics for reproductive disorders increased from 4.9 percent in 2002 to 7.4 percent in 2007 (figure 5).

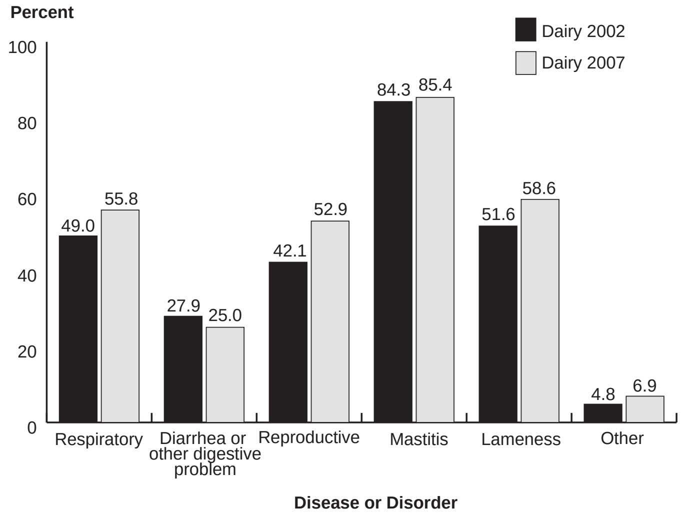
Figure 5. Percentage of Cows Treated with Antibiotics for the Following Diseases or Disorders During the Previous 12 Months, 2002 and 2007



The percentage of operations that used antibiotics to treat mastitis in cows remained unchanged (85.4 percent in 2007 and 84.3 percent in 2002). Overall, about one-half of operations used antibiotics to treat cows for respiratory disease, reproductive disorders, or lameness (figure 6).

Although a sizeable percentage of operations used antibiotics to treat respiratory disorders and diarrhea or other digestive problems, only a small percentage of cows were treated with antibiotics for these disorders in 2007 and 2002 (about 2 to 3 percent of cows).

Figure 6. Percentage of Operations (Including Those not Reporting Diseases or Disorders) that Treated Cows with Any Antibiotic for the Following Diseases or Disorders During the Previous 12 Months, 2002 and 2007



The primary antibiotics used to treat mastitis in 2007 were cephalosporin, lincosamide, and noncephalosporin beta-lactam, (53.2, 19.4, and 19.1 percent of treated cows, respectively) [table 2]. The use of noncephalosporin beta-lactam to treat cows with mastitis decreased substantially in 2007 compared with 2002 (19.1 and 33.8 percent of treated cows, respectively). This decrease may be due to the introduction since 2002 of a new cephalosporin.

Table 2. For Cows Treated for Mastitis During the Previous 12 Months, Percentage of Cows by Primary Antibiotic Used for Treatment, 2002 and 2007

	Percent Treated Cows	
Primary Antibiotic Used*	**2002**	**2007**
Aminocyclitol	NA	2.9
Aminoglycoside	1.0	0.2
Noncephalosporin beta-lactam	33.8	19.1
Cephalosporin	36.8	53.2
Florfenicol	0.0	0.0
Lincosamide	21.3	19.4
Macrolide	2.8	0.2
Sulfonamide	0.7	1.2
Tetracycline	3.1	2.0
Other	0.5	1.8
Total	100.0	100.0

*See table 4 (insert) for antibiotic classes and common product names.

Almost one-half of cows treated for lameness in 2007 (42.1 percent) received tetracycline as the primary antibiotic (table 3). There was little change in the type of antibiotics used to treat lameness from 2002 and 2007.

Table 3. For Cows Treated for Lameness During the Previous 12 months, Percentage of Cows by Primary Antibiotic Used for Treatment, 2002 and 2007

	Percent Treated Cows For Lameness	
Primary Antibiotic Used*	**2002**	**2007**
Aminocyclitol	NA	0.0
Aminoglycoside	0.1	0.0
Noncephalosporin beta-lactam	17.3	19.5
Cephalosporin	29.8	27.2
Florfenicol	0.0	0.5
Macrolide	0.2	0.5
Sulfonamide	4.4	4.2
Tetracycline	42.4	42.1
Other	5.8	6.0
Total	100.0	100.0

*See table 4 (insert) for antibiotic classes and common product names.

Conclusions

Antibiotic use on U.S. dairy operations remained mostly unchanged from 2002 to 2007. Since 2002, just over half of operations have used medicated milk replacer. About 60 percent of operations used antibiotics to treat preweaned heifers for disease, primarily respiratory disorders and diarrhea or other digestive problems. Sulfonamide and tetracycline were the most common antibiotics used to treat preweaned heifers. The use of ionophores and other antibiotics in weaned heifer rations remained the same from 2002 to 2007. Respiratory disease was the most common condition treated with antibiotics among weaned heifers in 2002 and 2007. Mastitis was the most common disease in cows for which antibiotics were used. Cows with mastitis were treated with antibiotics by about 85 percent of operations, and approximately 90 percent of operations used intramammary antibiotics for cows at dry-off. Cephalosporin was the primary antibiotic used for treating mastitis in 2002 and 2007. Tetracycline was the primary antibiotic used to treat lameness for both study years.

For more information, contact:

USDA–APHIS–VS–CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

#N534.1008

Table 4. Antibiotic classes and common product names - 2007

Antibiotic Class	Product Name
aminocyclitol	Adspec®
Aminoglycoside	AmTech Neomycin Oral Solution
	Biosol® Liquid
	Gentamicin
	Neomix Ag® 325 Soluble Powder
	Neomix® 325 Soluble Powder
	Neomycin 325 Soluble Powder
	Neomycin Oral Solution
	Neo-Sol 50
	Strep Sol 25%
	Streptomycin Oral Solution
NonCephalosporin Beta-lactam	Agri-Cillin™
	Amoxi-Bol®
	Amoxi-Inject ®
	Amoxi-Mast® Intramammary Infusion
	Aquacillin™
	Aqua-Mast Intramammary Infusion
	Combi-Pen™-48
	Crysticillin 300 AS Vet.
	Dariclox® Intramammary Infusion
	Duo-Pen®
	Durapen™
	Hanford's/US Vet Masti-Clear Intramammary Infusion
	Hanford's/US Vet/Han-Pen G/Ultrapen
	Hanford's/US Vet/Han-Pen-B/Ultrapen B
	Hetacin®K Intramammary Infusion
	Microcillin
	Pen-G Max™
	Penicillin G Procaine
	PFI-Pen G®
	Polyflex®
	Princillin Bolus
	Pro-Pen-G™ Injection
Cephalosporin	Cefa-Lak®/Today Intramammary Infusion
	Excede™ Sterile Suspension
	Excenel® RTU
	Naxcel®
	Spectramast™ LC Intramammary Infusion
	ToDAY® Intramammary Infusion

Antibiotic Class	Product Name
Florfenicol	Nuflor Injectable Solution
Lincosamide	Pirsue® Intramammary Infusion
Macrolide	Draxxin™
	Gallimycin®-100 Injection
	Gallimycin®-36 Intramammary Infusion
	Micotil® 300 Injection
	Tylan Injection 50/200 Tylosin Injection
Other	AS700
	CORID 20% Soluble Powder
	CORID 9.6% Oral Solution
	Deccox-M
	Linco-Spectin® Sterile Solution
	TMZ
Sulfonamide	20% SQX Solution
	Albon® Bolus
	Albon® Concentrated Sol.12.5%
	Albon® Injection 40%
	Albon® SR Bolus
	Di-Methox & 12.5% Oral Solution
	Di-Methox Injection 40%
	Di-Methox Soluble Powder
	Liquid Sul-Q-Nox
	SDM Injection
	SDM Injection 40%
	SDM Solution
	Sulfadimethoxine 12.5% Oral Solution
	Sulfadimethoxine Inj. 40%
	Sulfadimethoxine Soluble Powder
	Sulfa-Nox Concentrate
	Sulfa-Nox Liquid
	Sulfaquinoxaline Sodium Solution 20%
	SulfaSure™ SR Cattle/Calf Bolus
	Sulmet® Drinking Water Solution 12.5%
	Sulmet® Oblets®
	Sulmet® Soluble Powder
	Sustain III® Cattle Bolus
	Vetisulid Injection
	Vetisulid Powder

Antibiotic Class	Product Name
Tetracycline	Agrimycin™ 100
	Agrimycin™ 200
	AmTech Oxytetracycline HCL Solution Powder - 343
	Aureomycin® Soluble Powder
	Aureomycin® Soluble Powder Concentrate
	Bio-Mycin® 200
	Bio-Mycin® C
	CLTC 100 MR
	Duramycin-100
	Duramycin-200
	Liquamycin® LA-200®
	Maxim-200®
	Maxim™-100
	Oxy 500 and 1000 Calf Bolus
	Oxybiotic™ 200
	Oxycure™ 100
	Oxy-Mycin™ 100
	Oxy-Mycin™ 200
	Oxytetracycline HCL Soluble Powder
	Oxytetracycline HCL Soluble Powder 343
	Panmycin® 500 Bolus
	Pennchlor™ 64 Soluble Powder
	Pennox™ 200 Injectable
	Pennox™ 343 Soluble Powder
	Polyotic® Soluble Powder
	Promycin™ 100
	Solu/Tet Soluble Powder
	Terramycin® 343 Soluble Powder
	Terramycin® Scours Tablets
	Terramycin® Soluble Powder
	Terra-Vet 100
	Tet-324
	Tetra-Bac 324
	Tetracycline HCL Soluble Powder-324
	Tetradure™ 300

Veterinary Services
Centers for Epidemiology and Animal Health

October 2008

Bovine Leukosis Virus (BLV) on U.S. Dairy Operations, 2007

In 2007, the U.S. Department of Agriculture's (USDA) National Animal Health Monitoring System (NAHMS) conducted the Dairy 2007 study. In all, 17 of the Nation's major dairy States* participated in the study. These States divided into two regions and represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows participated in the study.

This information sheet presents and compares data on BLV prevalence in U.S. dairy cattle collected during Dairy 2007 and during a previous NAHMS dairy study, Dairy 1996.

BLV

BLV is a retrovirus that infects dairy and beef cattle's lymphoid tissue, causing malignant lymphoma and lymphosarcoma in 1 to 5 percent of infected animals. The virus is transmitted to cattle primarily by direct exposure with infected blood, saliva, semen, and milk.[1] Most BLV-infected cattle seldom present with clinical signs of disease. Signs of infection may include tumors in lymphoid tissues, enlarged lymph nodes, weight loss, decreased milk production, fever, loss of appetite, rear-limb weakness or paralysis, protruding eyeballs, gastrointestinal obstructions, and increased blood lymphocytes counts. Because no vaccine is available for BLV, virus specific antibodies found in serum or milk are a good indicator of exposure and a practical method for disease screening.

Economic impact of BLV on U.S. dairies

Producers can incur economic losses because of BLV through cattle deaths, reduced reproductive efficiency, increased replacement and veterinary costs, and the ineligibility to export live cattle, semen, and ova to countries where BLV control efforts are in place.[2 3]

A BLV certification program conducted in New York indicated that the disease had a significant economic impact on operations with high seroprevalence of BLV in which morbidity and mortality rates were high due to malignant lymphoma.

The association between cattle exposed to BLV and herd-level productivity was studied using data from the NAHMS Dairy 1996 study.[4] This study found that herds with test-positive cows produced 218 kg less milk per cow, per year than those with no test-positive cows.

BLV prevalence on U.S. dairies, 1996 and 2007

The Dairy 1996 study was the first statistically based study in the United States to provide a baseline prevalence of BLV and the measures for controlling it. During the study, blood samples from cattle on 1,006 operations were tested using the Agar Gel Immuno-diffusion test (AGID). Results showed that 89.0 percent of U.S. dairy operations had cattle seropositive for BLV; 74.8 percent of these operations had an estimated within-herd prevalence of 25 percent or higher. Dairy operations with fewer than 100 cows had lower individual animal prevalences and were less likely to be seropositive for BLV than operations with more than 200 cows.

As part of the 2007 dairy study, bulk tank milk was collected from 534 operations with 30 or more dairy cows and tested with an Enzyme Linked-Immunosorbent Assay (ELISA) for the presence of antibodies against BLV. Results showed that 83.9 percent of U.S. dairy operations were positive for BLV (table 1).

Table 1. Percentage of Operations in Which Bulk Tank Milk Tested Positive for BLV via ELISA, by Herd size

Herd Size (Number of Cows)	**Percent Operations**
Small (fewer than 100)	83.2
Medium (100-499)	82.1
Large (500 or more)	100.0
All operations	83.9

***States/Regions:**
- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

BLV prevalence estimates were also reported by region: 78.4 percent of operations in the study's West region and 84.4 percent in the East region tested positive for BLV antibodies.

Only 7.5 percent of all operations had independently confirmed the presence of BLV on their premises via laboratory testing during the 12 months prior to the Dairy 2007 interview (table 2). Of these operations, the majority (88.5 percent) submitted blood samples for disease confirmation. Only 6.3 percent submitted tissues for necropsy.

Table 2. Percentage of Operations in Which BLV was Confirmed Via Laboratory Testing During the Previous 12 months, by Herd size

Herd Size (Number of Cows)	**Percent Operations**
Small (fewer than 100)	5.7
Medium (100-499)	12.4
Large (500 or more)	7.8
All operations	7.5

Summary

Although the 1996 and 2007 dairy studies used different testing methods (AGID vs. milk ELISA) and different samples (serum vs. bulk tank milk), both studies suggest that BLV is present on the majority of U.S. dairy operations. Different regions were used in the 1996 and 2007 studies for the geographic distribution of dairy operations. For this reason, regional differences in BLV herd-level prevalence were not comparable.

In addition, the Dairy 2007 study found that only 7.5 percent of operations independently confirmed the presence of BLV on their operations via laboratory testing. Although no details were available regarding the reasons why these operations submitted samples for BLV testing, it is possible that they had cattle with clinical signs compatible with BLV. The low percentage of operations that tested for BLV supports the concept that although infection is common, clinical signs of BLV are not frequently observed. A lower percentage of small operations had antibodies detected than large operations.

The high individual animal prevalence of BLV reported in the Dairy 1996 study suggests that testing and culling seropositive animals may not be a cost effective method to control the disease. Instead, preventing disease transmission by implementing preventive practices would likely be more cost-effective. Since the primary route of infection is through contact with infected blood, prevention involves eliminating blood transmission from cow to cow. Prevention practices include using a new needle for each injection, discarding or cleaning syringes contaminated with blood, and cleaning blood-contaminated equipment such as dehorning equipment and tattoo pliers. Additionally, feeding calves pasteurized colostrum and milk, and using BLV seronegative dams for embryo transfer should assist in reducing the incidence of BLV.[1]

To review complete reports from the Dairy 1996 and Dairy 2007 studies, visit the NAHMS Website at: http://nahms.aphis.usda.gov.

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For more information, contact:

USDA–APHIS–VS–CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov
#N526.0708

Bovine Viral Diarrhea (BVD) Management Practices and Detection in Bulk Tank Milk in the United States, 2007

In 2007, the U.S. Department of Agriculture's National Animal Health Monitoring System (NAHMS) conducted the Dairy 2007 study. The study collected data on dairy health and management practices from 17 of the Nation's major dairy States. These States represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows.

One objective of the Dairy 2007 study was to estimate the prevalence of BVD virus on U.S. dairies. During the study, producers were asked about their BVD management practices, and bulk-tank-milk samples were collected and tested for BVD using polymerase chain reaction (PCR).[1] Samples were collected from 527 operations from March through August 2007.

Persistently and transiently infected cattle

BVD infection in a dairy herd can result in large economic losses, primarily due to reproductive problems in infected cattle, decreased overall animal health, and decreased milk production.[2, 3] BVD causes two types of infections in cattle: persistent infection and transient infection. Persistently infected (PI) cattle are infected while in the uterus. These animals are infected for life and are the primary source of new PI animals, as they continually shed large amounts of virus throughout the herd. Transiently infected (TI) animals are exposed to BVD after they are born. These animals may have mild or severe signs of disease such as diarrhea or decreased milk production, but they will eventually clear the virus and recover. If a cow becomes transiently infected while pregnant, her calf may be aborted, born with congenital abnormalities, born with no abnormalities and not infected with BVD, or may be persistently infected. Calves born alive to PI cows are always persistently infected themselves. In this way, the next generation of PI animals is created, continuing the BVD cycle in the herd.[4]

BVD is usually introduced into a herd through the purchase and introduction of TI or PI cattle. Purchasing additions from BVD-PI test-negative herds reduces the risk of herd infection, but the herd can still become infected by test-negative cows carrying PI fetuses.

Producer familiarity

Recently, BVD educational campaigns administered by producer and veterinary groups have generated numerous articles about BVD in dairy industry publications. In the NAHMS Dairy 2007 study, almost one-third of producers (31.3 percent) were fairly knowledgeable about BVD, while nearly one-half (47.6 percent) of producers knew some basics about the disease. Only 2.5 percent had not heard of BVD (table 1).

Table 1. Percentage of Operations by Producer Level of Familiarity with BVD

Percent Operations			
Level of Familiarity			
Fairly Knowledge-able	Knew Some Basics	Recognized Name, Not Much Else	Had Not Heard of It
31.3	47.6	18.6	2.5

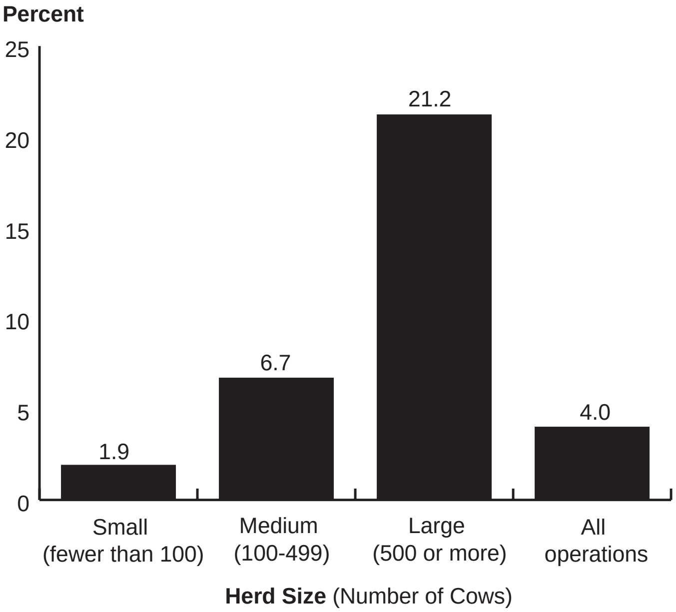
Producer testing

Identifying and culling PI cattle are critical steps in eliminating BVD from a dairy herd. Though some PI animals appear ill, many show no signs of disease. There are several testing options for identifying PI animals. One method of determining if a cow is PI with BVD is to test her calf. Since a PI cow will always produce a PI calf, neither the cow nor the calf is infected if the calf tests negative. However, a PI calf does not necessarily mean the cow is PI, since a transient infection in the cow can lead to a PI calf.

Ear notch testing is a popular and accurate method of identifying PI animals. Ear notch tests using either immunohistochemistry (IHC) or antigen-capture ELISA (ACE) can be used on cattle of any age. Alternatively, serum samples can be tested using virus isolation, ACE or PCR, although serum samples are not able to distinguish PI animals from TI animals with a single sample. Animals that test positive on the initial sample must be retested in about 3 weeks to accurately determine their status. In addition, serum tests can be inaccurate in animals younger than two months. Testing via PCR on whole blood can be used with accuracy in young calves.[5]

Few operations (4.0 percent) routinely tested heifer replacements for PI with BVD. The percentage of operations that did test increased as herd size increased (figure 1).

Figure 1. Percentage of Operations that Routinely Tested Heifer Replacements to Determine if They were Persistently Infected with BVD, by Herd Size



Of operations that routinely tested heifers for PI with BVD, the majority (66.8 percent) used individual ear notch tests, while 21.1 percent tested individual serum samples (table 2).

Table 2. For Operations that Routinely Tested Heifer Replacements to Determine if They were PI with BVD, Percentage of Operations by Testing Method Used

Testing Method	Percent Operations
Individual ear notch	66.8
Pooled ear notch	11.4
Individual serum sample	21.1
Pooled serum sample	6.0
Other	6.5

Cattle identified as PI with BVD should be removed from the herd. If not removed, the virus will continue to circulate within the herd and the probability of infertility problems and the creation of new PI cattle will continue or be increased. PI cattle should ideally be sold with full disclosure of their status and sent directly to slaughter, since introducing or exposing PI cattle to noninfected cattle or herds will lead to the spread of the virus.

Producer confirmation of disease

Overall, 2.8 percent of operations confirmed BVD on their operations during the previous 12 months. About 1 of 10 large operations (9.6 percent) confirmed disease, compared with 1.1 percent of small operations and 5.9 percent of medium operations. BVD was confirmed on 5.3 percent of operations in the West region and 2.5 percent of operations in the East region (see table 3, next page, for region breakout).

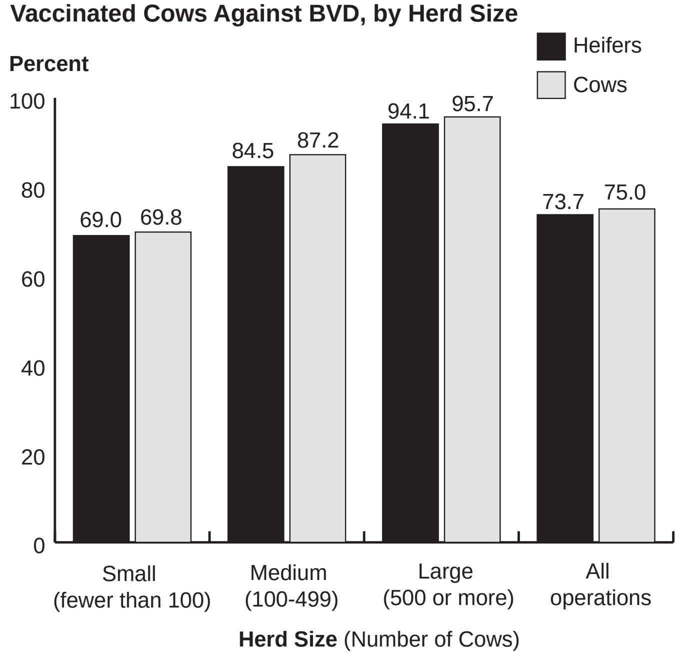
The most commonly submitted samples were blood (47.5 percent) and ear notches (41.3 percent). Additionally, tissues at necropsy and aborted fetuses were used to confirm disease by 15.7 and 13.9 percent of operations, respectively.

Vaccination

Vaccination is an important management tool for controlling BVD and should be implemented in tandem with a plan to test and remove PI cattle.

About three-fourths of operations vaccinated heifers and cows for BVD (73.7 and 75.0 percent, respectively). The percentage of operations that vaccinated for BVD increased as herd size increased (figure 2).

Figure 2. Percentage of Operations that Normally Vaccinated Heifers and Percentage that Normally Vaccinated Cows Against BVD, by Herd Size



A higher percentage of operations in the West region vaccinated heifers and cows against BVD compared with operations in the East region (table 3).

Table 3. Percentage of Operations that Normally Vaccinated Heifers and Percentage that Normally Vaccinated Cows Against BVD, by Region

	Percent Operations	
	Region*	
	West	East
	Percent	Percent
Heifers	85.6	72.8
Cows	82.2	74.4

***West:** California, Idaho, New Mexico, Texas, and Washington
East: Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

In general, the two types of BVD vaccines available contain modified-live and killed virus. The most notable advantage of modified-live virus vaccines is that they provide quicker, stronger, and longer lasting immunity than killed vaccines. The biggest advantage of killed virus vaccines is their overall safety, especially when administered during pregnancy. Although vaccination of the dam provides some degree of fetal protection, no vaccine has been shown to completely protect the fetus from becoming persistently infected with BVD if the cow is exposed to the BVD virus during pregnancy.[6, 7, 8]

A higher percentage of operations administered killed BVD vaccines than modified-live vaccines to cows (56.3 and 48.9 percent, respectively). The opposite was true for heifers, where a higher percentage of operations administered modified-live BVD vaccines than killed virus vaccines to heifers (62.2 percent and 43.1 percent, respectively) [table 4].

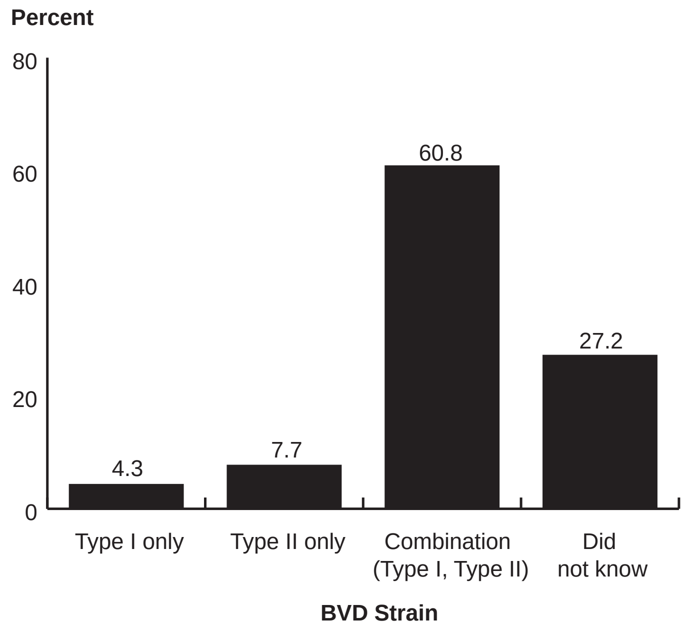
Table 4. For Operations that Vaccinated Heifers or Cows Against BVD, Percentage of Operations by Type of BVD Vaccine Given

	Percent Operations	
	Heifers	Cows
Type of Vaccine	**Percent**	**Percent**
Killed	43.1	56.3
Modified live	62.2	48.9

Two different genetic groups (genotypes) of BVD virus are recognized. Historically, vaccines only contained Type I BVD, but many vaccines now contain both type I and type II. Although a Type I vaccine will provide some cross-protection against Type II infections,[9] a vaccine that contains both Type I and Type II is recommended.

For operations that administered BVD vaccine to heifers or cows, 60.8 percent reported that the vaccine used contained both Type I and Type II strains. Approximately one-quarter of operations (27.2 percent) did not know what strain(s) was included in the vaccine administered (figure 3).

Figure 3. For Operations that Vaccinated Heifers or Cows Against BVD, Percentage of Operations by Type of BVD Vaccine Administered



More than four of five operations that administered BVD vaccine to cows (80.2 percent) gave annual booster vaccines.

Bulk-tank-milk testing

Bulk-tank-milk samples can be tested for the presence of BVD virus using PCR. Bulk-milk testing is primarily intended to detect the presence of PI cows in the lactating herd. TI cows will shed a small amount of BVD virus in their milk for a short period (several days), but PI animals continually shed larger amounts of virus.[10] Although bulk-milk testing is useful as a screening tool for the lactating herd, it will not fully screen the operation for the presence of BVD since PI animals are more likely to be found in the young stock than in the lactating herd. Additionally, all cows are not represented in a single bulk-tank sample. If the operation's only PI cow is dry or her milk is not entering the bulk tank at the time of sampling she would not be detected.

No small operations tested positive for BVD in bulk milk, whereas about one of eight large operations (12.8 percent) tested positive (table 5).

Table 5. Percentage of Operations in which Bulk-Tank Milk Samples Tested Positive for BVD, by Herd Size

Percent Operations			
Herd Size (Number of Cows)			
Small (Fewer than 100)	**Medium** (100-499)	**Large** (500 or More)	**All Operations**
Percent	**Percent**	**Percent**	**Percent**
0.0	3.5	12.8	1.7

A higher percentage of operations in the West region (7.7 percent) tested positive for BVD bulk milk compared with operations in the East region (1.1 percent).

Summary

Almost 80 percent of producers at least knew some basics about BVD, and approximately three-quarters of operations vaccinated heifers and cows against the disease. BVD virus was found on more than 10 percent of large dairy operations and 1.7 percent of all operations. However, the actual prevalence of BVD is likely higher, since all cattle on the operation are not included in a single bulk-tank-milk sample. BVD is an important disease to the dairy industry. It is recommended that dairy producers consult their veterinarians to develop a customized plan for BVD testing and vaccination.

To review complete reports from the Dairy 2007 study, visit the NAHMS Website at: http://nahms.aphis.usda.gov.

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For more information, contact:
USDA-APHIS-VS-CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Calving Intervention on U.S. Dairy Operations, 2007

Calving difficulty—or dystocia—costs the U.S. beef and dairy cattle industries more than $400 million annually.[1] Besides the potential outcome of losing both the calf and the dam, dystocia has detrimental effects that can undermine animals' health and reduce productivity. Calves that survive a dystocia are more susceptible to disease and slower to grow, and dams that experience a dystocia might be culled earlier, produce less milk, and rebreed later than cows that calve unassisted.[2, 3]

Many factors contribute to calving difficulty. For heifers, an important factor is the relationship of the calf size to the heifer size. In cows, dystocias are often related to multiple fetuses or malposition of the fetus.

Appropriate sire selection and nutritional programs can help reduce dystocias related to maternal/fetal size disproportion. Other causes of dystocia, such as multiple fetuses, abnormal calf position, and uterine torsion, are unpredictable and necessitate appropriate intervention to increase the likelihood of a successful outcome.

This information sheet provides baseline information about calving interventions on U.S. dairy operations collected during the Dairy 2007 study, conducted by the National Animal Health Monitoring System (NAHMS). NAHMS administered the study of health and management practices in 17 of the Nation's major dairy States,* which represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. The operations were divided into 3 herd-size categories based on the number of milk cows present: small (fewer than 100 cows), medium (100 to 499 cows), and large (500 or more cows).

Calving assistance on U.S. dairies

A lower percentage of heifers (69.0 percent) than cows (79.4 percent) calved unassisted during the 12 months preceding the NAHMS study interview (table 1). A higher percentage of heifers than cows experienced severe dystocia (6.8 percent of heifers and 3.5 percent of cows) or mild dystocia (11.8 percent of heifers and 7.3 percent of cows).

*States/Regions:
- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

Table 1. Percentage of Heifers and Cows That Calved During the Previous 12 Months, by Calving Difficulty:

Calving Difficulty	Percent Heifers[1]	Percent Cows[2]
Severe dystocia (surgical or mechanical extraction	6.8	3.5
Mild dystocia	11.8	7.3
No dystocia, but assistance provided anyway	12.4	9.8
No assistance	69.0	79.4
Total	100.0	100.0

[1]As a percentage of dairy cow replacements entering the milking herd in 2006.

[2]As a percentage of cows on the operation at the time of VS Initial Visit interview.

Guidelines and training

Although proper management can reduce the frequency of dystocias due to maternal/fetal disproportion, dystocias will still occur and must be handled properly and in a timely manner to produce the best outcome.

Guidelines, such as those developed by Colorado State University, are available to help producers and employees know when and how to assist with calving problems.[4, 5] Intervening too early or too late in the calving process can cause injury or death to the dam, the calf, or both. Usually, recommendations for intervention are slightly different for heifers and cows.

About 60 percent of operations had guidelines (e.g., standard operating procedures) on when to intervene during calving for heifers and cows. There were no differences in the percentage of operations with calving guidelines by herd size or region. For operations with guidelines for both heifers and cows, about one-half of the operations used different guidelines for heifers and cows.

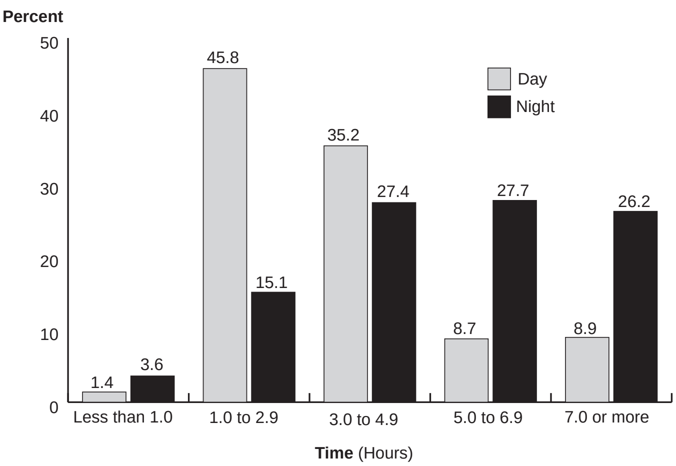
More than 90 percent of operations provided training in calving intervention for owners/employees of the operation. Most operations (90.4 percent) used on-the-job training in calving intervention. About one-quarter of operations provided training through discussion and/or lecture. Some operations used more than one method to train owners/employees in calving intervention.

Observation of animals close to calving

Ideally, heifers and cows close to calving would be observed at all times, but this is not practical or even possible for many operations. Generally, however, no more than 3 hours should pass between observation periods.[5]

Cows and heifers close to calving were observed more frequently during the day than at night (figure 1). About one-half of operations (47.2 percent) allowed less than 3 hours, on average, to pass between observations during the day, with 17.6 percent of operations allowing 5 hours or more between observation periods. During the night, 18.7 percent of operations allowed less than 3 hours to pass between observations, and 53.9 percent of operations let 5 hours or more pass between observation periods.

Figure 1. Percentage of Operations by Average Time Between Observation Periods of Cattle Close to Calving, and by Time of Day



Although the normal calving process is classified into three stages, the process is continuous and proceeds gradually from one stage to the next. Recognizing these stages and knowing when it is appropriate to intervene are critical in achieving a positive outcome for both dam and calf.

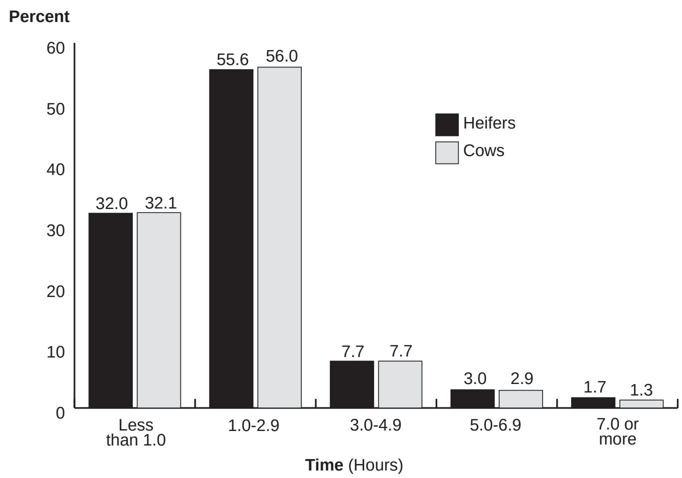
Stage 1 Labor. Stage 1 is characterized by cervical dilation and uterine contractions, which usually are not evident as abdominal contractions. Because of discomfort from the uterine contractions, heifers and cows in stage 1 labor are often off feed and appear restless. Stage 1 usually lasts 2 to 6 hours but may last longer in heifers.

The majority of operations (63.1 percent for heifers and 61.9 percent for cows) would examine or assist an animal within 5 hours if she showed signs of stage 1 labor without subsequent straining. More than one-quarter of operations (27.0 percent for heifers and 27.7 percent for cows) would wait 7 hours or more to examine or assist an animal that exhibits signs of stage 1 labor without subsequent straining.

Stage 2 labor. During stage 2, which includes the appearance of the amniotic sac (or water bag) in the vulva, uterine contractions continue and abdominal contractions become evident. Stage 2 ends in the delivery of the fetus(es) and usually takes less than 2 hours for mature cows but up to 4 hours for heifers. Once straining is observed, the animal should be assessed if she is not making good progress in delivery within 2 to 3 hours for heifers and 1 hour for cows.

More than 85 percent of operations wait less than 3 hours to assist heifers or cows that are observed to be straining but are not progressing in delivery of the calf (figure 2).

Figure 2. Percentage of Operations by Length of Time Producers Would Wait to Examine or Assist a Heifer or Cow that has Begun to Strain but is not Progressing in Delivery of the Calf



About 95 percent of operations reported that they examine or assist heifers and cows within 3 hours of the water bag appearing at the vulva. Almost one-half of operations would assist heifers and cows within 1 hour of the water bag appearing.

Stage 3 labor. The fetal membranes (placenta) are expelled in stage 3. If the membranes have not passed within 12 hours of calving, treatment might be needed to facilitate passage.

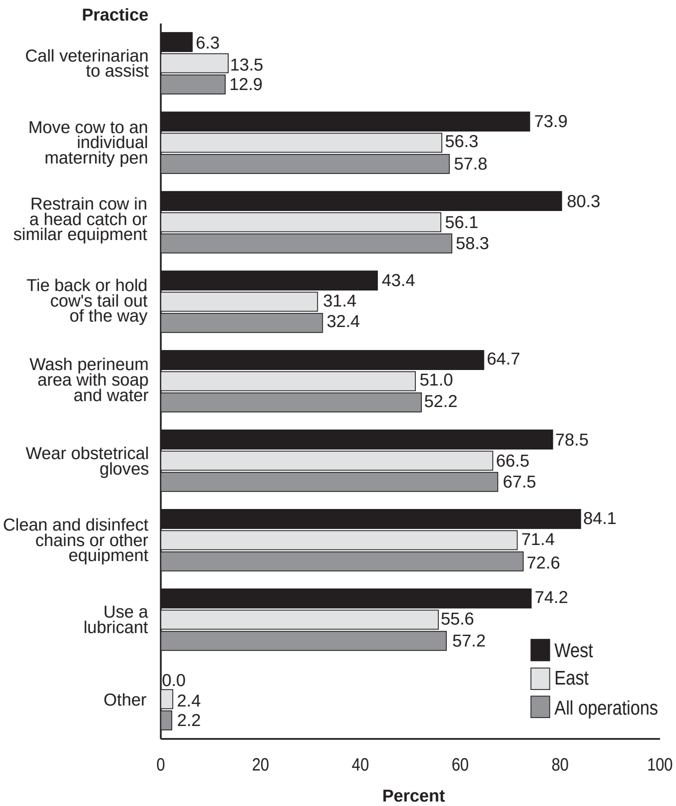
Calving interventions

The practices listed in figure 3 provide measures that can facilitate the hygienic delivery of the calf while preventing infection or injury to the dam. Their use is generally recommended during calving intervention.

More than 50 percent of operations reported that they generally implemented the recommended practices, except for calling a veterinarian to assist or tying or holding the tail out of the way (figure 3).

Use of three of the recommended calving intervention practices differed by region. A higher percentage of operations in the West region than in the East region would generally move the cow to an individual maternity pen (73.9 and 56.3 percent, respectively), restrain the cow in a head catch or similar equipment (80.3 and 56.1 percent, respectively), or use a lubricant (74.2 and 55.6 percent, respectively).

Figure 3. Percentage of Operations by Practice Generally Implemented Once a Decision is Made to Intervene in Calving, and by Region



During dystocia, additional lubricant can help in delivering a healthy calf and in protecting the dam from trauma. Mineral oil, soap, commercial obstetrical lubricant, and shortening may be helpful; water used alone is not. The recommended choice is a commercial obstetrical lubricant mixed with water and used generously.

More than 50 percent of operations that reported generally using a lubricant during calving intervention used a commercial lubricant, soap, or water with other lubricant.

Any instrument used to assist with a difficult delivery should be easy to sanitize, especially instruments that are used inside the vagina and uterus to deliver calves. Most operations (71.1 percent) used stainless-steel OB chains for pulling calves; these chains are easy to sanitize and are recommended for use. Almost one-half of operations (49.6 percent) used twine to pull calves, while 22.1 percent used rope.

The amount of pressure exerted on the calf during an assisted delivery can be enough to cause injury or death to the cow and calf. Studies have reported that two strong people can exert a force of 400 to 600 lb while delivering a calf, whereas a calf jack can exert 2,000 lb of force.[6] If two strong people can't deliver a calf manually, then an alternative delivery method, such as a C-section for live calves or a fetotomy for dead calves, is usually recommended.

On more than one-half of operations (53.7 percent), the method most commonly used to apply traction to deliver the calf was one or two people pulling on the chains, rope, or twine. About one of five operations (22.0 percent) used a calf jack to apply traction. A higher percentage of small operations than large operations used a block and tackle (5.9 and 0.2 percent, respectively). A higher percentage of medium and large operations used a calf jack (34.3 and 37.0 percent, respectively) compared with small operations (16.1 percent).

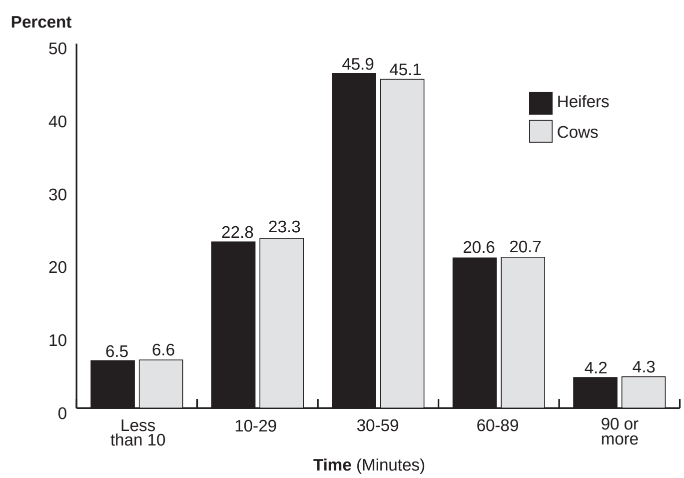
To reduce the possibility of injury to the dam during calving intervention, traction should be applied only when the dam is straining. More than three of four operations (77.3 percent) reported that traction is generally applied in conjunction with the dam straining.

Veterinary assistance

Although 12.9 percent of operations routinely call a veterinarian to assist once a decision is made to intervene during a difficult calving (figure 3), almost all operations (94.8 percent), regardless of herd size or region, sometimes seek veterinary assistance for difficult calvings.

The best chance of ending up with a live calf and a healthy dam after a difficult calving requires that the method being used be reassessed if no progress is made within 15 to 20 minutes. Longer intervention times, without veterinary assistance, can lead to death of the calf and possibly of the dam. The length of time operations intervened before calling for assistance was about the same for both heifers and cows. About 30 percent of operations would call for veterinary assistance within 30 minutes of intervening in a calving (figure 4). The highest single percentage of operations would seek assistance within 30 to 59 minutes of intervening for both heifers and cows.

Figure 4. For Operations that Ever Seek Veterinary Assistance for Difficult Deliveries, Percentage of Operations by Length of Time from Beginning Intervention During Calving Until Calling for Veterinary Assistance



Assistance for compromised calves

Although calves experiencing a dystocia are more likely to be stillborn and suffer subsequent health problems, calves that are born alive can be given assistance to increase their chances of survival.

Calves that survive dystocia are likely to have low levels of oxygen in their blood, and their blood pH is frequently acidic instead of neutral. These impairments can lead to other problems, such as decreased ability to nurse, decreased absorption of IgG, and inability to regulate temperature. After a difficult calving, efforts to dry and warm the calf, stimulate muscular activity and movement, provide shelter from weather, feed warm colostrum, and supplement intranasal oxygen can substantially increase calf survival.

On 80.7 percent of operations, a calf that experienced a dystocia would receive nostril stimulation to initiate breathing. The calf would be hung upside down on 66.3 percent of operations. Hanging the calf upside down—once promoted to help remove fluid from the calf's lungs—might actually be harmful for two reasons: most of the liquid comes from the abomasum and not the lungs, making the calf more susceptible to dehydration; and hanging the calf upside down increases pressure on the chest, making it more difficult for the calf to breathe. Three of the practices that are simple to perform and don't require special equipment or materials—positioning the calf on its sternum, drying the calf manually with towels or a hair dryer, and trying to elicit a suckle response—were performed by at least one-half of operations. Few operations (1.4 percent) would provide supplemental oxygen.

Use of some of these practices varied with the size of the operation. Almost two-thirds of large operations resuscitated the calf via assisted breathing, compared with about one-third of small and medium operations. A higher percentage of small and medium operations (61.5 and 55.6 percent, respectively) than large operations (27.4 percent) dried the calf manually with towels, hair dryer, etc. Additionally, a higher percentage of small and medium operations (45.8 and 58.5 percent, respectively) provided calf coats or calf jackets compared with large operations (26.6 percent).

Conclusion

The effects of dystocia on calves are well known and are associated with increased stillbirths, morbidity, and mortality. To minimize and mitigate these negative consequences, producers should establish protocols for handling a dystocia and implementing practices to aid both dam and calf. Operations with employees should provide written calving-intervention guidelines and thorough training in calving management for employees.

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For more information, contact:

USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Veterinary Services
Centers for Epidemiology and Animal Health

May 2011

Clostridium difficile on U.S. Dairy Operations

Disease caused by *Clostridium difficile* is linked most commonly to nosocomial (hospital-acquired) infections in humans, especially when antibiotics are administered that alter normal gastrointestinal flora. Humans develop a spectrum of disease after infected with some strains of *C. difficile*. Symptoms range from mild diarrhea to life-threatening toxic megacolon and pseudo-membranous colitis (Weese, 2010). Even though *C. difficile* is typically seen as a nosocomial infection, there are increasing reports of community acquired infections.

C. difficile is a spore-forming organism which can survive in the environment for long periods and can be ingested by animals or humans through contaminated foodstuffs and water (Yaeger et al., 2002). *C. difficile* has also been associated with clinical disease in young pigs and dairy calves (Yaeger et al., 2002; Hammitt et al., 2008). Shedding of *C. difficile* bacteria in animal feces can occur in the absence of clinical signs (Weese, 2010). In addition, some strains of *C. difficile* have been isolated from ground beef, ground pork, and ground veal purchased from retail markets in Canada which could serve as a source of infection in humans (Rodriguez-Palacios et al., 2007; Weese et al., 2009). To date, there has been little information available on the distribution and characteristics of *C. difficile* on various types of livestock operations across the United States.

Dairy 2007 study

The U.S. Department of Agriculture's National Animal Health Monitoring System (NAHMS) conducted the Dairy 2007 study, which focused on dairy health and management practices in 17 States.[1] These States represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. The operations were divided into 3 herd-size categories based on the number of milk cows present: small (fewer than 100 cows), medium (100 to 499 cows), and large (500 or more cows). One objective of the Dairy 2007 study was to determine the prevalence of *C. difficile* in the feces of dairy cows presumed to be healthy on U.S. dairy operations.

C. difficile prevalence

During the Dairy 2007 study, testing for *C. difficile* was performed on 118 dairy operations across the 17 participating States. Individual cow fecal samples were taken via rectal retrieval for culture.[2]

Overall, 1,858 fecal samples from dairy cows were tested for the presence of *C. difficile*. Of the 1,858 fecal samples tested, *C. difficile* was isolated from 29 samples (1.6 percent) [table 1]. At least 1 positive sample was found on 15 of the 118 operations (12.7 percent).

Table 1. Number and percentage of samples and operations tested for *C. difficile*, by test result

	Samples Tested		Operations Tested	
Test Result	Number	Percent	Number	Percent
Positive	29	1.6	15	12.7
Negative	1,829	98.4	103	87.3
Total	1,858	100.0	118	100.0

[1] **States/Regions:**
West: California, Idaho, New Mexico, Texas, Washington
East: Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

[2] Culture methods available in Thitaram et al. (2011).

Sample-level results

Herd size and region

Sample-level prevalence estimates are shown in tables 2 and 3. Overall, the prevalence of *C. difficile* in fecal samples was low. Only 1.6 percent of fecal samples from cows were positive (table 2). The proportion of samples positive was different by herd size where a higher percentage of small herds were positive for *C. difficile* compared with medium herds (p=0.04).

Table 2. Number of samples tested and number and percentage of samples positive for *C. difficile*, by herd size

	Herd Size (number of dairy cows)			
	Small (fewer than 100)	**Medium** (100–499)	**Large** (500 or more)	**Total**
Number samples tested	580	759	519	1,858
Number samples positive	19	3	7	29
Percent samples positive	3.3	0.4	1.4	1.6

There was no significant regional difference in the percentage of samples positive for *C. difficile* (p=0.18) [table 3].

Table 3. Number of samples tested and number and percentage of samples positive for *C. difficile*, by region

	Region	
	West	**East**
Number samples tested	282	1,576
Number samples positive	8	21
Percent samples positive	2.8	1.3

Operation-level results

Herd size and region

The operation-level prevalence for *C. difficile* varied by herd size (p=0.04). A lower percentage of medium operations (4.3 percent) had at least one sample positive for *C. difficile* compared with small and large operations (22.2 and 14.3 percent, respectively) [table 4].

Table 4. Number of operations tested and number and percentage of operations with at least one sample positive for *C. difficile*, by herd size

	Herd Size (number of dairy cows)			
	Small (fewer than 100)	**Medium** (100–499)	**Large** (500 or more)	**Total**
Number operations tested	36	47	35	118
Number operations positive	8	2	5	15
Percent operations positive	22.2	4.3	14.3	12.7

There was no significant regional difference in the percentage of operations positive for *C. difficile* (p=0.07) [table 5].

Table 5. Number of operations tested and number and percentage of operations with at least one sample positive for *C. difficile*, by region

	Region	
	West	**East**
Number operations tested	19	99
Number operations positive	5	10
Percent operations positive	26.3	10.1

Summary

There was a difference in *C. difficile* results by herd size at the sample and herd levels. Because confounding factors may be present (e.g., average herd size differs by region), these univariate associations need to be explored further with statistical models or additional studies.

The recovery of *C. difficile* from feces on livestock operations warrants further investigation. Not all strains of *C. difficile* appear to have the same propensity to cause disease. Therefore, isolates from this study will be further characterized to determine how related these isolates are to those causing human disease. Further characterization of *C. difficile* isolates, including molecular typing and additional epidemiological studies, is needed to ascertain if a relationship exists between food animal isolates and those from humans in order to determine the potential for foodborne disease.

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For more information, contact:

USDA–APHIS–VS–CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
Email: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

#599.0411

APHIS Info Sheet

Veterinary Services
Centers for Epidemiology and Animal Health

March 2008

Colostrum Feeding and Management on U.S. Dairy Operations, 1991-2007

In 2007, the U.S. Department of Agriculture's (USDA) National Animal Health Monitoring System (NAHMS) conducted the Dairy 2007 study. In all, 17 of the Nation's major dairy States* representing 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows participated in the study.

Dairy 2007 is NAHMS fourth national study of the U.S. dairy industry. Previous studies were the 1991 National Dairy Heifer Evaluation Project (NDHEP), Dairy 1996, and Dairy 2002. As with the previous studies, Dairy 2007 surveyed dairy producers about their colostrum feeding and management practices. This information sheet provides comparisons of these practices from 1991 to 2007 across the four study periods.

Importance of colostrum

All animals need maternal immunoglobulins to protect them from disease, and most animals receive immunoglobulins in utero, across the placenta. Conversely, calves are born with no immunoglobulins and, therefore, have inadequate immunity at birth. To obtain immunoglobulins, calves rely on the ingestion of colostrum. The process by which the cow passes immunoglobulin to the calf via colostrum is called passive transfer of immunity. Studies have shown that failure of passive transfer increases calf morbidity and mortality, reduces calf growth rate and efficiency, and decreases first and second lactation milk production in heifers.

Separating calves from dams

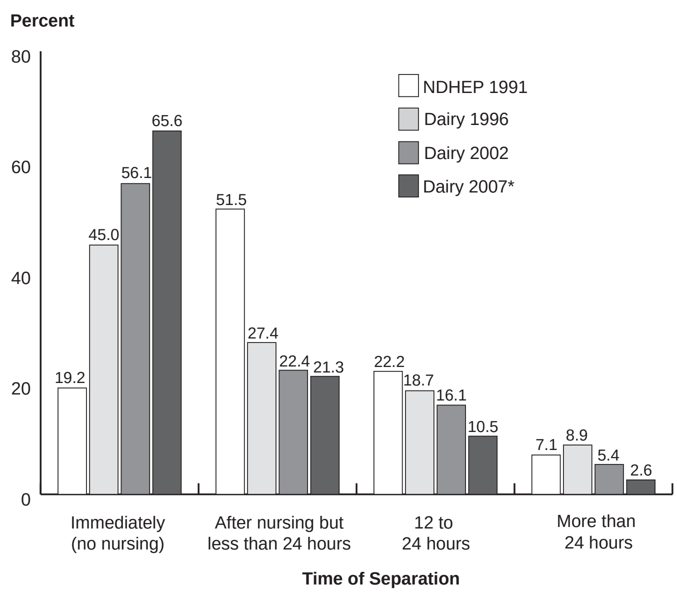
Separating calves from their dams is one way to decrease the chance of disease transmission from cow to calf. For example, separation could prevent a calf from ingesting feces, bedding, or other material in the environment contaminated by a cow infected with *Mycobacterium avium* subspecies *paratuberculosis* (MAP), the causative agent of Johne's disease.

*California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Virginia, Wisconsin, and Washington

In 2007, 55.9 percent of operations—accounting for 65.6 percent of newborn heifer calves—immediately separated calves before they nursed their dams. Allowing a calf to acquire colostrum directly from its dam at first nursing presents many problems, such as increasing the risk that the calf will not get an adequate amount of colostrum. In addition, when a calf nurses from its dam it is not possible to accurately measure the amount of colostrum consumed; nor is it possible to estimate the quantity of antibodies ingested.

The practice of removing calves from their dams before nursing increased from 19.2 percent of heifer calves in 1991 to 65.6 percent in 2007 (figure 1).

Figure 1. Percentage of Heifer Calves by Time Following Birth that Calves were Normally Separated from Their Dams

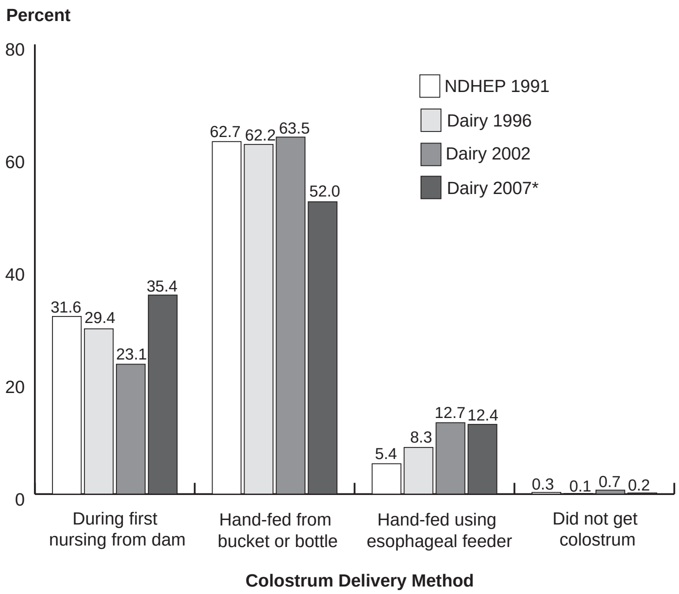


*For calves born during 2006 and alive at 48 hours

Colostrum feeding

Hand-feeding colostrum increases the likelihood that calves receive the amount necessary to provide adequate immunity during the first 24 hours of life. The percentage of heifer calves that received hand-fed colostrum from a bucket or bottle remained essentially the same from 1991 to 2002 but decreased from 63.5 percent in 2002 to 52.0 percent in 2007. The percentage of heifer calves that received the first feeding of colostrum from their dams decreased steadily from 1991 to 2002 but increased from 2002 to 2007 (figure 2).

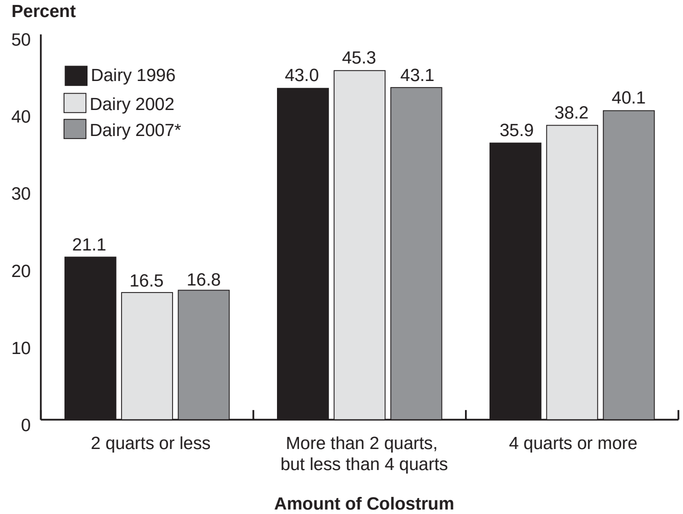
Figure 2. Percentage of Heifer Calves by Method Normally Used for Calves' First Feeding of Colostrum



*For calves born during 2006 and alive at 48 hours

In 2007, 45.8 percent of operations—accounting for 43.1 percent of heifer calves—hand-fed more than 2 quarts but less than 4 quarts of colostrum during the calves' first 24 hours of life. This trend of feeding almost half the heifer calves more than 2 quarts but less than 4 quarts of colostrum remained stable from 1996 to 2007 (figure 3).

Figure 3. For Heifers Calves on Operations that Normally Hand-fed Colostrum, Percentage of Heifer Calves by Amount of Colostrum Normally Fed During First 24 Hours



*Born during 2006 and alive at 48 hours

Colostrum quality

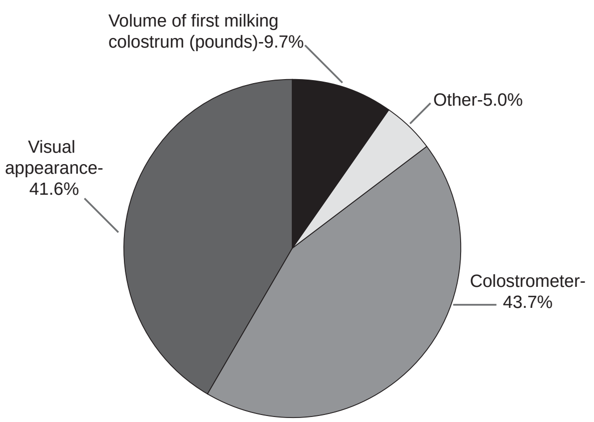
Although colostrum provides immunoglobulin and other immune factors to the calf, it can also be a route of disease transmission from cow to calf. As a result, colostrum quality plays a vital role in calf health. High-quality colostrum has adequate concentrations of immunoglobulin and is free of pathogens. Factors that determine immunoglobulin concentrations include the dam's age, disease history, pathogen exposure, prepartum milking, and leaking of milk from the udder prior to calving. Procedures that decrease the risk of pathogen contamination include hygienic collection, pasteurization, storage, and handling of colostrum harvested from nondiseased cows. Feeding poor-quality colostrum may result in decreased immunity in calves and, ultimately, increased infection.

Dairy producers can estimate the quality of colostrum by using a colostrometer, which uses specific gravity as a measure of immunoglobulin G (IgG) concentrations. Alternatively, serum from calves between 1 and 7 days of age can be evaluated for IgG level or total protein, which are used to measure the passive-transfer status of calves. IgG concentrations in blood of 1,000 mg/dl should be attained to provide adequate protection against failure of passive transfer.[1] The NDHEP 1991 study reported that over 40 percent of calves had IgG levels below 1,000 mg/dl or had failure of passive transfer.

In 2007, 13.0 percent of operations that hand-fed colostrum either estimated the immunoglobulin levels of colostrum or evaluated its quality before feeding, compared with 3.9 percent of operations in 2002. The most common methods used for evaluating colostrum quality in 2007 were a colostrometer and visual appearance (43.7 and 41.6 percent of operations, respectively) [figure 4].

Overall, 2.1 percent of operations routinely measured passive transfer via serum proteins. A higher percentage of large operations (14.5 percent) routinely evaluated passive transfer compared with medium and small operations (2.4 and 1.1 percent, respectively).

Figure 4. For Operations that Estimated Immunoglobulin Levels in Colostrum or Evaluated its Quality, Percentage of Operations by Primary Method Used for Measuring Immunoglobulin, 2007



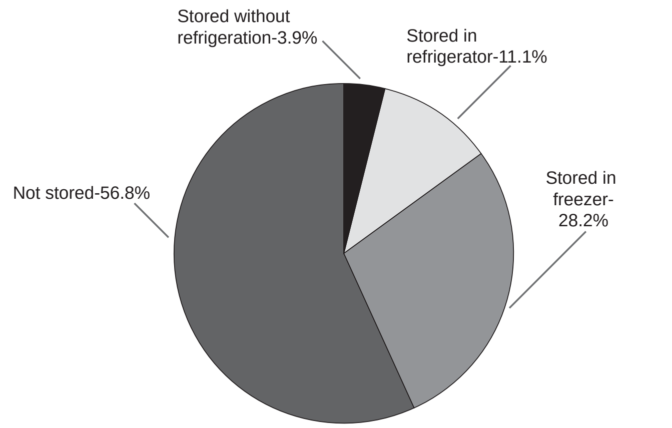
Pooling colostrum is not recommended because doing so may decrease colostrum quality and contribute to disease transmission. The percentage of operations that pooled colostrum decreased from 27.0 percent in 2002 to 21.0 percent in 2007.

Commercial colostrum replacer is an alternative to feeding calves colostrum from their dams. However, colostrum replacers vary greatly in their ability to provide adequate passive transfer. [2 3 4 5]

Colostrum storage

The method of colostrum storage also affects colostrum quality by either increasing bacterial growth in the colostrum or by shortening its storage life. Studies have demonstrated that refrigeration slows pathogen growth when colostrum is stored for 24 hours.[6] Moreover, refrigeration is recommended if colostrum is to be stored for less than 24 hours, and freezing is recommended if it is stored more than 24 hours.[7] The most common methods of storing colostrum in 2007 were freezing and refrigeration, although the majority of operations did not store colostrum (figure 5).

Figure 5. For Operations that Normally Hand-fed Colostrum, Percentage of Operations by Primary Method of Storing Colostrum, 2007



Colostrum pasteurization

Pasteurizing colostrum or milk reduces bacteria counts. In general, two methods can be used: high temperature-short time (HTST) and batch pasteurization. Since HTST pasteurization reduces immunoglobulin levels by 25 to 30 percent and increases viscosity, it is not currently recommended for use with colostrum. Alternatively, using a commercial batch pasteurization unit to heat colostrum to 60 degrees Celsius for 60 to 120 minutes reduces bacterial pathogens and does not reduce antibody concentrations or change overall viscocity.[8 9] In Dairy 2007, less than 1 percent of operations that hand-fed colostrum pasteurized the colostrum before feeding it to calves, which is similar to the percentage reported in the Dairy 2002 study (0.6 percent of operations). In 2007, a higher percentage of large operations (6.4 percent) pasteurized colostrum compared with medium and small operations (0.9 and 0.2 percent, respectively).*

Summary

Since 1991, the way colostrum is managed and fed to calves has changed on U.S. dairy operations. More operations are removing calves from their dams immediately after birth, which decreases the risk of direct disease transmission. Colostrum quality is being evaluated on a higher percentage of operations. Fewer operations are pooling colostrum, while more operations are pasteurizing colostrum. All these factors help to improve the quality of colostrum fed to calves. However, the quantity of colostrum administered to an individual calf on dairy operations has not changed since 1991. Dairy producers can improve their colostrum management practices by ensuring that every calf gets 4 quarts of high-quality colostrum during the first 12 hours of life.

*Herd size (number of dairy Cows)=
small (fewer than 100), medium (100-499), large (500 or more)

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For more information, contact:

USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Prevalence of Contagious Mastitis Pathogens on U.S. Dairy Operations, 2007

One of the objectives of the National Animal Health Monitoring System (NAHMS) Dairy 2007 study was to estimate the prevalence of the three major contagious mastitis pathogens on U.S. dairies: *Staphylococcus aureus, Streptococcus agalactiae,* and *Mycoplasma* spp. These pathogens generally colonize the teat skin and mammary gland and typically cause a chronic intramammary infection.[1]

Background

Cow-to-cow spread of these pathogens typically occurs during milking. Since these pathogens are contagious and the resulting infections chronic in nature, prevention and routine monitoring by milk culture are very important. Although udder infections by any organism typically cause an increase in somatic cell counts (SCC), low SCC does not preclude an infection, even with contagious pathogens.

S. aureus, typically more pathogenic than *S. agalactiae*, causes a greater reduction in milk yield, clinical signs of mastitis, and a variable SCC. Intramammary infections commonly result in microabscesses in the mammary gland, which make antibiotic therapy less successful. Chronic infections with *S. aureus* are common and likely to recur in subsequent lactations.[1 2]

S. agalactiae is the least pathogenic of the contagious mastitis pathogens, typically causing subclinical infections and a decrease in milk production. Milk yield is reduced due to the destruction of mammary tissue. The typical herd scenario observed with *S. agalactiae* is high SCC but few clinical cases. Most *S. agalactiae* infections can be treated effectively with appropriate intramammary antibiotics, but some chronic cases may not resolve.[1]

Mycoplasma spp. commonly resides in a cow's respiratory and urogenital tract, resulting in multiple forms of transmission. Intramammary infections can result in clinical mastitis, elevated SCC, fibrosis of the udder, and a dramatic decrease in milk production. This pathogen requires special culture media and is resistant to all treatments.[1 3]

Maintaining a closed herd or culturing milk from new additions before bringing them into the herd can help prevent the introduction and/or spread of contagious mastitis pathogens. In addition, cows with *Mycoplasma* mastitis should be segregated or removed from the herd.[1]

The first steps in reducing the spread of contagious mastitis in a herd is to implement recommended milking procedures and identify infected cows through SCC monitoring and milk cultures. Once an infected cow is identified, its milk should not come in contact with uninfected cows via milking equipment or the hands of milkers. Infected cows should be milked last or with a separate milking unit.

Proper milking procedures, a cornerstone of contagious mastitis control, involve the use of gloves, single-use towels, effective pre- and post-milking teat disinfectant, and properly functioning milking equipment. By identifying infected cows and implementing proper milking procedures, contagious mastitis can be successfully controlled.

Dairy 2007 study

The NAHMS Dairy 2007 study estimated the herd-level prevalence of three contagious mastitis pathogens, and evaluated the association between the isolation of these pathogens and herd demographics.

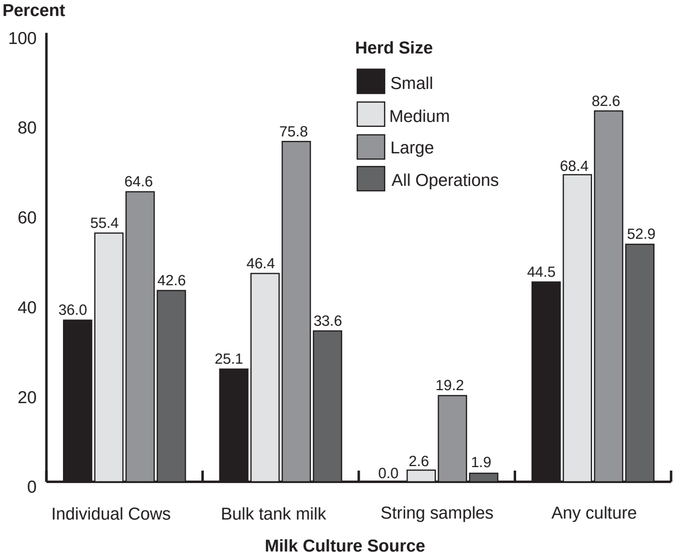
The top 17 dairy States participated in the Dairy 2007 study, with the States divided into West and East regions.* These States accounted for 79.5 percent of dairy operations and 82.5 percent of U.S. milk cows. Participating operations were also divided into three size categories: small (fewer than 100 cows), medium (100 to 499 cows), and large (500 or more cows).

Milk cultures by producers

More than half of operations (52.9 percent) performed milk cultures during the previous 12 months. During the 12 months prior to the study, a lower percentage of small operations performed individual cow, bulk-tank milk, string sample, or any milk cultures compared with medium and large operations (figure 1).

***States/Regions:**
- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

Figure 1. Percentage of Operations by Source of Milk Cultures Performed During the Previous 12 Months, and by Herd Size



Chronic clinical cases and clinical cases that did not respond to treatment were the two most common types of cows from which milk was cultured. Of operations that performed cultures on individual cows, a higher percentage of large operations performed cultures on fresh cows and all clinical cases compared with small and medium operations.

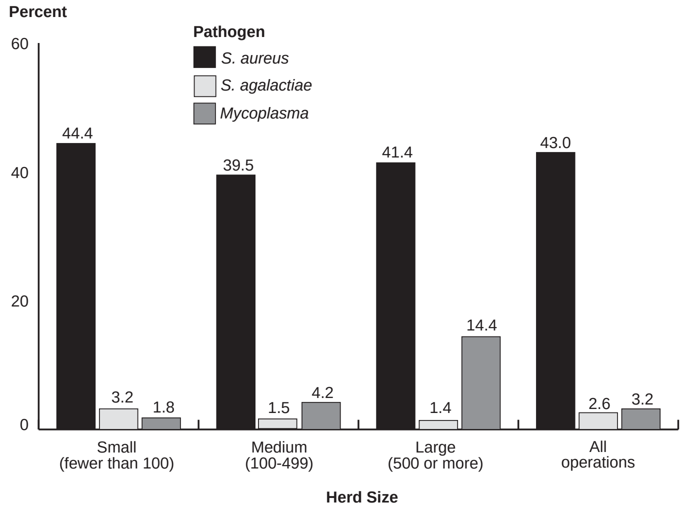
Of operations that performed milk cultures during the previous 12 months, a similar percentage detected *S. aureus* (52.3 percent), *E. coli*/Klebsiella/other gram negative bacteria (53.3 percent), or environmental strep (60.1 percent). A higher percentage of large operations (21.4 percent) and operations in the West region (17.7 percent) identified *Mycoplasma,* compared with medium and small operations (3.8 and 4.0 percent, respectively) and operations in the East region (4.2 percent).

Prevalence of contagious mastitis pathogens on U.S. dairies

To estimate the prevalence of contagious mastitis pathogens on U.S. dairies, a single bulk-tank-milk sample was collected from 534 operations with 30 or more milk cows. These samples were collected from February 28 to August 30, 2007, and cultured using recommended procedures.[4]

Of the three contagious mastitis pathogens, *S. aureus* had the highest herd-level prevalence at 43.0 percent of operations, while *S. agalactiae* and *Mycoplasma* spp. were found on 2.6 and 3.2 percent of operations, respectively. The only herd-size difference in prevalence occurred with *Mycoplasma* spp., which increased as herd size increased (figure 2). No significant regional differences were found in the prevalence of the three pathogens.

Figure 2. Prevalence of Contagious Mastitis Pathogens, by Herd Size



Conclusion

S. aureus is the most prevalent contagious mastitis pathogen in the United States, and its prevalence does not appear to be related to herd size or region. *Mycoplasma* spp. were more frequently isolated in large herds. More than half of operations performed milk cultures during the previous 12 months.

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For more information, contact:
USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov Or visit NAHMS on the Web at http://nahms.aphis.usda.gov

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APHIS Technical Brief

Veterinary Services
Centers for Epidemiology and Animal Health

March 2011

Prevalence of *Coxiella burnetii* in Bulk-tank Milk on U.S. Dairy Operations, 2007

Background

Coxiella burnetii is the bacterium that causes Q fever in animals and humans and is found throughout most of the world. While most animals, including domestic cats and dogs and wild animals, can become infected with *C. burnetii*, cattle, sheep, and goats are considered the most important domestic reservoirs of the bacteria.[1 2 3] Although animals infected with *C. burnetii* often show no clinical signs, the organism can cause abortions in sheep and goats.

Importantly, *C. burnetii* can be transmitted from animals to humans. Symptoms of infection in humans vary from unapparent to severe. Some human cases cause mild flu-like symptoms such as headache, fever, and muscle aches, which usually resolve without treatment. For people with chronic *C. burnetii* infections, the liver and heart are usually affected.[1]

C. burnetii is highly infectious and spreads mainly through inhalation of bacteria shed via the placenta, amniotic fluid, and feces of infected animals. Ticks and consumption of raw infected animal products are also suspected modes of transmission. Because *C. burnetii* localizes in the mammary gland raw dairy products have been associated with animal-to-human transmission.[1 2 3] High temperature, short-time pasteurization standards (71.7°C for 15 seconds) in the United States have been developed to inactivate *C. burnetii* in milk.[4] The Centers for Disease Control and Prevention recommend the consumption of only pasteurized milk and milk products to prevent *C. burnetii* infection[5]

Animals infected with *C. burnetii* may clear the infection or remain infected for life. Shedding of *C. burnetii* in milk ranges from sporadic to persistent, suggesting that at least some animals are infected for an extended period.[6] In addition, a U.S. study reported a positive association among dairy cows that tested positive for *C. burnetii* and chronic subclinical mastitis, as measured by somatic cell counts.[7]

The prevalence of *C. burnetii* in bulk-tank milk from dairy cattle in England and Wales was reported at 21 percent.[8] A U.S. study found *Coxiella* antibodies in 22 of 24 veterinary-school-associated dairy herds,[9] while another study of primarily Northeast dairy herds reported a herd-level prevalence of more than 94 percent over a 3 year period.[10]

Dairy 2007 study

In 2007, the U.S. Department of Agriculture's (USDA) National Animal Health Monitoring System conducted the Dairy 2007 study. The study was conducted in 17 of the Nation's major dairy States*, representing 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. Operations were divided into 3 categories based on the number of dairy cows: small (fewer than 100 cows), medium (100 to 499 cows), and large (500 or more cows).

Objectives of the Dairy 2007 study included estimating the prevalence of specific food-safety pathogens and describing antimicrobial resistance patterns. No antimicrobial testing was performed for *C. burnetii* during the study; however, testing was done to estimate the herd-level prevalence of *C. burnetii* using bulk-tank milk samples from operations with 30 or more cows.

Sample collection and testing

To estimate the prevalence of *C. burnetii* on U.S. dairies, a single bulk-tank milk sample was collected from each of 528 participating operations from March through August 2007. On small operations, an average of 50 cows contributed milk to the bulk-tank samples. Samples taken from medium and large operations represented milk from an average of 166 and 958 cows, respectively. Samples were shipped overnight on ice to Antel BioSystems, Inc., which processed the samples and froze the resultant milk pellets. The resuspended milk pellets were sent to the Wisconsin Veterinary Diagnostic Laboratory where DNA was extracted and evaluated using polymerase chain reaction (PCR) to detect *C. burnetii.*

Results

The percentage of operations PCR-positive for *C. burnetii* increased as herd size increased, with 69.8 percent of small operations and 98.8 percent of large operations testing positive (table 1). Overall, milk from bulk tanks on more than three of four operations (76.9 percent) tested positive for *C. burnetii*.

---

* **States/Regions:**
- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

Table 1. Percentage of Operations in which Bulk-tank Milk Tested PCR-Positive for *C. burnetii,* by Herd Size

Herd size (Number of Dairy Cows)	Percent Operations
Small (fewer than 100 head)	69.8
Medium (100-499 head)	90.8
Large (500 or more head)	98.8
All Operations	76.9

A higher percentage of operations in the West region (see region breakouts on previous page) had bulk-tank samples positive for *C. burnetii* compared with operations in the East region (90.1 and 75.7 percent, respectively).

Operations PCR-positive for *C. burnetii* showed significant differences in health outcomes after adjusting for herd size and regional differences compared with operations that tested negative (table 2). Positive operations had a significantly higher percentage of calves born dead (6.6 percent) and a higher percentage of abortions (4.2 percent) than operations that tested negative (4.4 and 3.2 percent, respectively). In addition, positive operations removed a significantly higher percentage of cows due to reproductive problems.

Table 2. Operation-level Health Outcomes by *C. burnetii* Status

	***C. burnetii* Status**	
	Positive Operations	**Negative Operations**
Health Outcome[1]	**Percent**	**Percent**
Calves born dead[2]	6.6	4.4
Abortions[3]	4.2	3.2
Cows removed for reproductive problems[3]	7.4	5.2

[1]Adjusted for herd size and region.
[2] As a percentage of calves born.
[3]As a percentage of milk cows.

Summary

C. burnetii is more prevalent in U.S. dairy herds than previously thought, and there may be a relationship between *C. burnetii* infection, abortion, calves born dead, and cows removed for reproductive problems. More research needs to be conducted to determine the source of *C. burnetii* on dairy operations and to determine what management practices are likely to decrease transmission of the organism. *C. burnetii* was detected in raw bulk-tank milk, but pasteurization inactivates the organism and provides a level of safety to the public.

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For more information, contact:

USDA–APHIS–VS–CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Dairy Cattle Identification Practices in the United States, 2007

In 2007, the U.S. Department of Agriculture's National Animal Health Monitoring System (NAHMS) conducted the Dairy 2007 study. The study collected data on dairy health and management practices from 17 of the Nation's major dairy States.[1] These States represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. One of the goals of the Dairy 2007 study was to collect information on dairy cattle identification (ID) practices and to evaluate the use of standardized premises and animal ID methods consistent with the National Animal Identification System (NAIS). NAIS is a State-Federal-Industry partnership designed to help producers and animal-health officials respond quickly and effectively to animal-disease events in the United States. For more information on NAIS visit http://animalid.aphis.usda.gov/nais/index.shtml.

During the Dairy 2007 study, dairy producers were asked about the methods they used to identify individual cows (each cow has its own unique ID) as well as the methods used to identify cows that belong to their herds (all cows have the same ID). Producers were provided a list of possible methods[2] for uniquely identifying their herds or individual cattle and given the option to report forms of ID not listed. More than one ID method could have been used on the same cow. For example, if an electronic ear tag was used, both the ear tag and electronic ID were reported. Similarly, if a collar and branding were used, both methods were reported.

Individual ID

Almost all cows (97.4 percent) had some form of individual ID. Ear tags were the primary method of individual animal ID used on 94.0 percent of cows, followed by branding and collars (13.2 and 10.3 percent of cows, respectively). Electronic ID was used for 9.0 percent of cows and on only 4.1 percent of operations. The majority of operations (93.0 percent) uniquely identified at least some of their cows. Most operations (86.5 percent) used ear tags for individual cow ID, followed distantly by photographs or sketches (13.3 percent) and collars (12.7 percent). Even though branding was used to identify over 13 percent of cows, only 4.4 percent of operations used branding to ID individual cows (table 1).

Table 1. Percentage of Operations and Percentage of Cows, by Type of *Individual* Animal ID Used on at Least Some Cows

ID Type	Percent Operations	Percent Cows
Ear tags (all kinds)	86.5	94.0
Collars	12.7	10.3
Photograph or sketch	13.3	4.4
Branding (all methods)	4.4	13.2
Tattoo (other than tattoo for brucellosis)	7.7	8.5
Leg bands	3.0	2.9
Electronic (pedometers, bar code, RFD, etc.)	4.1	9.0
Other	7.7	4.7
Any ID	93.0	97.4

On operations that used individual animal ID, evaluating milk production was the primary reason for using animal ID on 38.1 percent of operations, and evaluating genetic improvements was the primary reason on 30.4 percent of operations. Evaluating animal health was the primary reason for using individual animal ID on 8.8 percent of operations, and a small percentage of producers (1.6 percent) reported using animal ID to allow for disease or residue traceback. However, over one-fifth of operations (21.1 percent) reported "other" primary reasons, and many of these operations reported that the listed choices (evaluating milk production, evaluating animal health, disease or residue tracking, and evaluating genetic improvements) were all primary reasons.

[1] **States/Regions**
West: California, Idaho, New Mexico, Texas, and Washington
East: Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia and Wisconsin

[2] Ear tags, collars, photographs or sketches, branding, tattoo, leg bands, electronic ID (pedometers, bar code, RFD).

Herd ID

Compared to individual cow ID, a much lower percentage of cows (54.0 percent) had herd ID. Also, only about one-third of operations (36.4 percent) used herd ID on at least some cows. As with individual ID, ear tags were the predominant ID used; however, almost one-fifth of cows (18.7) were branded as a form of herd ID (table 2).

Table 2. Percentage of Operations and Percentage of Cows, by Type of *Herd* Identification Used on at Least Some Cows

ID Type	Percent Operations	Percent Cows
Ear tags (all kinds)	34.5	41.0
Collars	2.8	2.9
Branding (all methods)	3.1	18.7
Tattoo (other than tattoo for brucellosis)	2.5	4.6
Electronic (pedometers, bar code, RFD, etc.)	1.8	3.9
Other	2.0	1.7
Any identification	36.4	54.0

Participation in NAIS

Although nationally NAIS is a voluntary program, three States (IN, MI, WI) required participation at the time the study questionnaire was administered (January 1-31, 2007). Dairy 2007 study results show that 46.7 percent of dairy operations had been assigned a unique premises ID by their State Department of Agriculture as part of the NAIS program. A slightly higher percentage of small and medium operations had unique premises ID compared to large operations.[3] Also, a higher percentage of operations in the East region (49.1 percent) had a unique premises ID compared with operations in the West region (16.5 percent).

Once an operation has been assigned a unique premises ID by its State Department of Agriculture, it can obtain officially-recognized individual animal ID, as outlined by the U.S. Animal Identification Number (AIN) guidelines. The percentages of dairy operations that had implemented an individual ID system using AIN guidelines ranged from 7.0 percent of small operations to 12.5 percent of large operations (table 3).

[3]Herd size is based on January 1, 2007, cow inventory. Small herds are those with fewer than 100 cows, medium herds are those with 100 to 499 cows, and large herds are those with 500 or more cows.

Table 3. Percentage of Operations that had Implemented an Individual Animal ID System or Technology that Utilizes AIN Guidelines, by Herd Size

Percent Operations Herd Size (Number of Cows): **Small** (Fewer than 100)	**Medium** (100-499)	**Large** (500 or More)	**All Operations**
Percent	**Percent**	**Percent**	**Percent**
7.0	9.6	12.5	7.8

Of the 46.7 percent of operations assigned a unique premises ID, 16.8 percent had implemented an individual ID system using AIN guidelines. A higher percentage of large operations with a unique premises ID (38.2 percent) were using an individual ID system compared with medium and small operations (19.8 and 14.8 percent, respectively) [table 4].

Table 4. For Operations that had a Unique Premises ID Assigned, Percentage of Operations that had Implemented an Individual Animal ID System that Utilizes AIN Guidelines, by Herd size

Percent Operations Herd Size (Number of Cows): **Small** (Fewer than 100)	**Medium** (100-499)	**Large** (500 or More)	**All Operations**
Percent	**Percent**	**Percent**	**Percent**
14.8	19.8	38.2	16.8

For more information, contact:
USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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APHIS Info Sheet

Veterinary Services
Centers for Epidemiology and Animal Health

February 2009

Injection Practices on U.S. Dairy Operations, 2007

Injections are administered to dairy cows for a variety of reasons, including preventive measures such as vaccines, antibiotic treatment for disease, manipulation of the reproductive cycle, and production enhancement. Injections must be administered properly, however, to ensure efficacy of the injected product and to minimize lesions, or scar tissue, resulting from the injections.

About 10 years ago, national Beef Quality Assurance (BQA) program guidelines were developed to ensure proper, consistent production practices and quality beef products.[1] Among the BQA guidelines are the following recommendations for use of injectable animal health products:

- Products labeled for subcutaneous (SQ) administration should be administered SQ in the neck region (ahead of the shoulders).
- All products labeled for intramuscular (IM) use shall be given in the neck region only (no exceptions, regardless of age).
- All products cause tissue damage when injected IM. Therefore all IM use should be avoided if possible.
- Products cleared for SQ, intravenous (IV), or oral administration are recommended.
- Products with low dosage rates are recommended and proper spacing should be followed.
- No more than 10 cc of product shall be administered per IM injection site.

Although injection-site lesions are not a food-safety issue, the scar tissue affects meat quality. In the 1990s, the National Cattlemen's Association (now the National Cattlemen's Beef Association, or NCBA) began conducting beef quality audits, with one goal being to evaluate the incidence of injection-site lesions. Dairy cattle represent about 20 percent of all beef consumed in the United States,[2] and they have been included in three quality audits: the National Non-Fed Beef Quality Audit (1994),[2] the 1999 National Market Cow and Bull Quality Audit,[3] and the 2007 National Market Cow and Bull Beef Quality Audit.[4]

Injection-site lesions in the muscle cuts of the upper hip (sirloins and rounds) have decreased substantially since the first audits were conducted. In 2007, 11 percent of dairy cows had injection-site lesions,[4] compared with 49 percent from 1998-2000.[5] The 1999 audit estimated a loss of $1.46 per head due to trim loss associated with injection-site lesions.[3]

This information sheet provides baseline information about injection practices on U.S. dairy operations collected during the National Animal Health Monitoring System (NAHMS) Dairy 2007 study. NAHMS conducted the study of health and management practices in 17 of the Nation's major dairy States,* which represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. The operations were divided into 3 herd-size categories based on the number of milk cows present: small (fewer than 100 cows), medium (100 to 499 cows), and large (500 or more cows).

Number of Injections

Producers were asked to report the number of injections of any kind a dairy cow typically received during the 12 months prior to the questionnaire interview. For all operations, the operation average number of injections that a cow typically received was 13.8, or slightly more than 1 injection per month. The operation average number of injections per cow increased as herd size increased, with cows on small operations receiving 6.4 injections and cows on large operations receiving 17.3 injections per year.

On about one-half of the operations (51.0 percent), cows received fewer than five injections in the previous 12 months (figure 1). The majority of small operations (63.0 percent) gave fewer than five injections, compared with 27.0 percent of medium operations and 15.0 percent of large operations. About two-fifths of large operations (40.5 percent) typically gave 10 to

*States/Regions:
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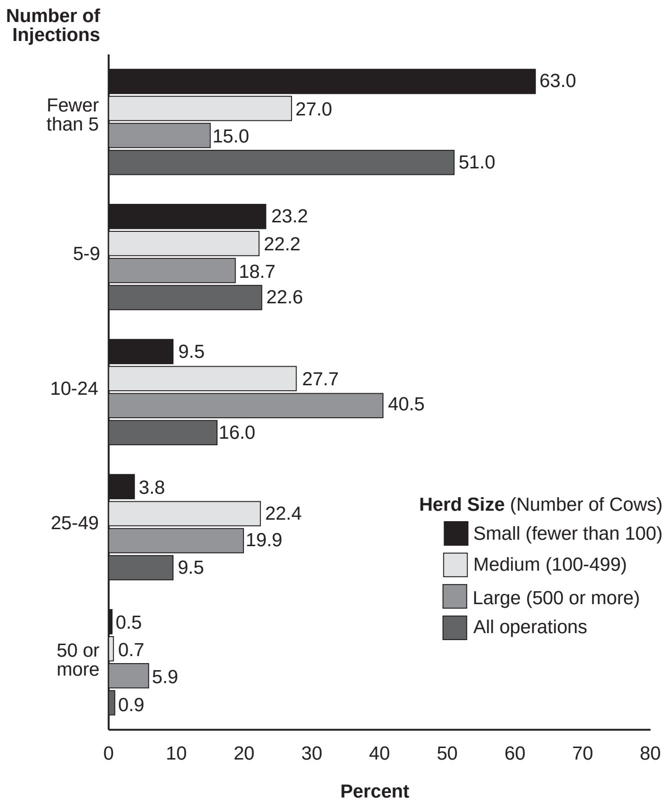
24 injections per cow during the previous 12 months, compared with 9.5 percent of small operations. The average number of injections typically received by cows for each operation was applied to every cow on that operation to calculate the number of injections by route, location, and purpose of administration.

Figure 1. Percentage of Operations by Number of Injections a Dairy Cow Typically Received During the Previous 12 Months, and by Herd Size



Injection Route

The three primary injection routes are IM, SQ, and IV. Almost all operations (97.4 percent) administered IM injections during the previous 12 months. SQ and IV injections were administered on 69.1 and 70.3 percent of operations, respectively. About two-thirds of all injections were administered IM (68.7 percent), compared with 23.9 percent administered SQ and 7.4 percent IV (table 1). There were no differences in injection route by herd size.

Table 1. Operation Average Percentage of Injections by Route, and by Herd Size:

	Operation Average Percent Injections			
	Herd Size (Number of Cows)			
	Small (Fewer than 100)	Medium (100-499)	Large (500 or More)	All Operations
Route	Pct.	Pct.	Pct.	Pct.
Intramuscular	71.1	63.7	61.5	68.7
Subcutaneous	20.9	30.3	32.6	23.9
Intravenous	8.0	6.0	5.9	7.4
Total	100.0	100.0	100.0	100.0

Injection Location

Scar tissue, which forms after IM injections, causes muscle tissue to be tough, producing a product that may be unacceptable to consumers. Because muscle cuts of the upper hip (sirloins and rounds) are frequently marketed as whole cuts, injection-site lesions may not be noticed prior to retail sale.[3] Producers are advised to follow BQA guidelines and give products labeled for IM injection in front of the shoulder—not in the hip or hind leg. The hip and hind legs likely are common injection locations because they are easier to access than the animal's neck on many dairy facilities.

The primary locations for IM injections were hind leg (45.3 percent of injections) and neck (34.2 percent of injections) [table 2].

Table 2. Percentage of IM Injections by Location, and by Herd Size:

	Percent IM Injections			
	Herd Size (Number of Cows)			
	Small (Fewer than 100)	Medium (100-499)	Large (500 or More)	All Operations
Location	Pct.	Pct.	Pct.	Pct.
Neck	11.8	16.5	50.9	34.2
Shoulder	3.3	3.0	1.3	2.1
Upper hip	16.3	17.4	8.3	12.4
Hind leg	65.5	50.2	37.1	45.3
Other	3.1	12.9	2.4	6.0
Total	100.0	100.0	100.0	100.0

A higher percentage of IM injections were administered in the neck (50.9 percent) on large operations compared with small or medium operations (11.8 and 16.5 percent, respectively). Conversely, a lower percentage of IM injections were administered in the hind leg (37.1 percent) on large operations than small operations (65.5 percent).

Purpose of IM Injections

Of IM injections administered on operations, more than two-fifths (41.3 percent) were vaccinations (table 3). Reproductive and antibiotic injections each accounted for about one-fourth of IM injections (27.3 and 23.1 percent, respectively).

Table 3. For Operations that Administered IM Injections, Operation Average Percentage of IM Injections Administered for the Following Purposes, and by Herd Size:

	Operation Average Percent IM Injections			
	Herd Size (Number of Cows)			
	Small (Fewer than 100)	**Medium** (100-499)	**Large** (500 or More)	**All Operations**
Purpose	**Pct.**	**Pct.**	**Pct.**	**Pct.**
Antibiotic	24.7	18.9	22.3	23.1
Production enhancement	3.1	8.9	5.6	4.7
Reproduction	25.5	31.9	28.0	27.3
Vaccination	42.9	36.5	43.8	41.3
Other	3.8	3.8	0.3	3.6
Total	100.0	100.0	100.0	100.0

With the exception of production enhancement injections, the percentage of IM injections for a particular purpose was similar across injection locations (table 4). More than 4 of 10 production enhancement injections (41.4 percent) were given in “Other” locations. The most common production enhancement injection, bST (Posilac), is recommended to be given subcutaneously around the tailhead.

Table 4. Percentage of IM Injections by Location and by Purpose of Injection:

	Percent IM Injections				
	Purpose				
	Anti-biotic	**Production Enhance-ment**	**Repro-duction**	**Vacci-nation**	**Other**
Location	**Pct.**	**Pct.**	**Pct.**	**Pct.**	**Pct.**
Neck	41.6	20.5	28.3	47.5	5.3
Shoulder	2.9	8.7	1.6	1.4	0.3
Upper hip	14.5	8.6	11.7	12.5	19.7
Hind leg	39.9	20.8	58.1	37.6	73.3
Other	1.1	41.4	0.3	1.0	1.4
Total	100.0	100.0	100.0	100.0	100.0

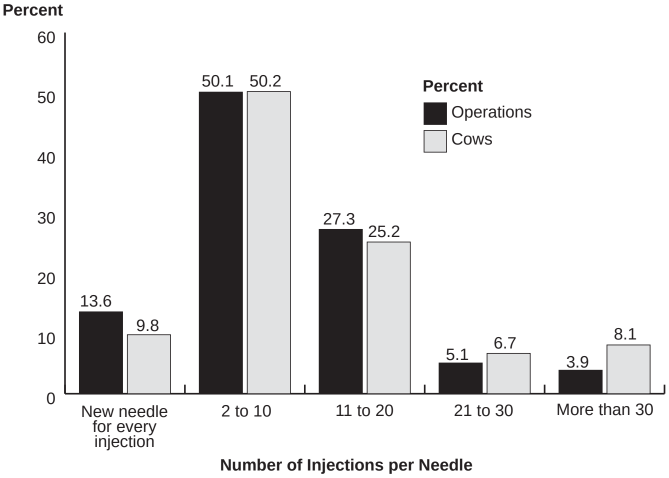
Injection Administration and Needle Use

Almost 9 of 10 injections (89.1 percent) given to dairy cows were administered by farm personnel, with no differences by herd size. Because cattle producers and other farm personnel often administer the injections to cattle on their operation, educating farm personnel about the proper injection practices is essential to ensure product efficacy and to minimize injection-site lesions.

Using a new needle for each cow can decrease disease transmission and also reduce potential injury to the cow by minimizing the possibility of broken needles. About one of seven operations (13.6 percent) used a new needle for every injection during the previous 12 months; these operations represented 9.8 percent of all cows. The majority of operations (50.1 percent), representing 50.2 percent of cows, used each needle to give 2 to 10 injections (figure 2).

About one-fourth of operations (27.3 percent), which represented 25.2 percent of cows, used each needle to give 11 to 20 injections. Although less than 4 percent of operations used needles for more than 30 injections, these operations represented 8.1 percent of cows, suggesting that this practice is more common on larger operations.

Figure 2. Percentage of Operations and Percentage of Cows* on Those Operations, by Number of Injections Given Before Changing Needles



*As a percentage of cows on the operation at time of interview (spring 2007).

Record Keeping

Keeping a record of each treatment a cow receives can help producers ensure that the appropriate therapy and withdrawal times are followed. Overall, about three-fifths of operations (58.2 percent) reported keeping a written or computerized record for each cow that received a treatment requiring a withdrawal time (table 5). A higher percentage of large operations (94.4 percent) than small operations (51.7 percent) and medium operations (67.4 percent) reported keeping a written or computerized record of each treatment.

Table 5. Percentage of Operations That Kept a Written or Computerized Record for Each Cow That Received a Treatment Requiring a Withdrawal Time Before the Cow Could be Sent to Market, and by Herd Size:

Percent Operations			
Herd Size (Number of Cows)			
Small (Fewer than 100)	**Medium** (100-499)	**Large** (500 or More)	**All Operations**
Pct.	**Pct.**	**Pct.**	**Pct.**
51.7	67.4	94.4	58.2

Conclusion

Production of high-quality meat creates economic benefits for the producer and improves the food quality for the consumer. For reasons including lack of awareness, facility design, and ease of administration, many dairy operations still administer IM injections in the hind leg and hip. Continued efforts to educate producers and personnel about the BQA guidelines and to increase compliance should improve meat quality by ensuring that all SQ and IM injections are given in the neck region.

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For more information, contact:

USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Johne's Disease on U.S. Dairies, 1991–2007

Johne's disease is caused by *Mycobacterium avium* subspecies *paratuberculosis* (MAP). This organism is also referred to as *M. paratuberculosis* and *M. paratb*. The clinical manifestation of MAP infection, termed Johne's disease, is also referred to as paratuberculosis. In addition to cattle and other ruminants, many species of domestic and wild animals worldwide have been diagnosed with MAP infection. MAP has a long incubation period, and clinical manifestation of disease (Johne's) does not commonly occur for two or more years after initial infection. Clinical signs of Johne's disease include chronic diarrhea, weight loss despite a normal appetite, and decreased milk production.

NAHMS Dairy 2007 study

In 2007, the U.S. Department of Agriculture's (USDA) National Animal Health Monitoring System (NAHMS) conducted the Dairy 2007 study. In all, 17 of the Nation's major dairy States* representing 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows participated in the study.

Dairy 2007 is the fourth national NAHMS study of the U.S. Dairy industry. Previous studies were the 1991 National Dairy Heifer Evaluation Project (NDHEP), Dairy 1996, and Dairy 2002.

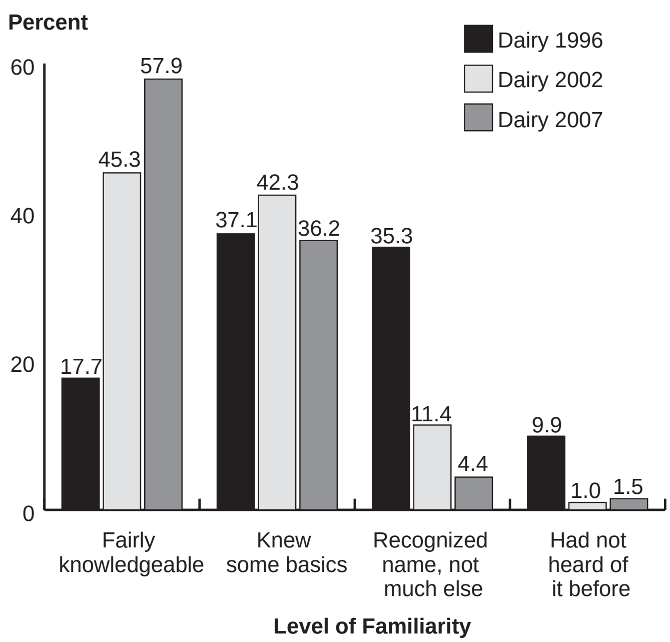
Specific objectives of the Dairy 2007 study relating to Johne's disease were to:

- Estimate herd-level prevalence (number of herds infected with MAP) in the United States.
- Compare and evaluate management practices related to perceived risk of MAP transmission between the previous NAHMS Dairy studies.

Producer familiarity

Although Johne's disease was first described in the late 1800s and has since been reported in most countries around the world, results of the Dairy 1996 study revealed that almost 10 percent of producers had not heard of Johne's disease. Dairy 1996 also revealed that just 17.7 percent of producers were fairly knowledgeable about the disease, indicating a need to increase Johne's disease education efforts. In contrast, Dairy 2007 indicated that 57.9 percent of producers were fairly knowledgeable about Johne's disease, and only 1.5 percent had not heard of the disease. In 2007, 94.1 percent of producers were either fairly knowledgeable or knew some basics about the disease, compared with only 54.8 percent of producers with these characteristics in the Dairy 1996 study (figure 1). These results indicate that educational efforts to increase awareness of the Johne's disease have been quite effective.

Figure 1. Percentage of Operations by Level of Familiarity with Johne's Disease, and by Study Year

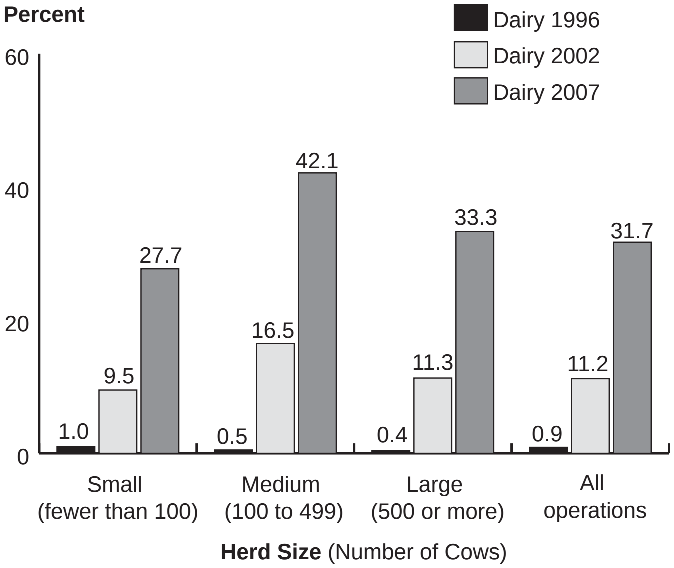


Management practices

In 2007, nearly one of three operations (31.7 percent) participated in a Johne's disease certification or control program. This was an increase compared with operations in 1996 and 2002 (figure 2). Note that in 1996 participants were asked if they were currently in a Johne's disease certification program, whereas in 2002 and 2007 participants were asked if they participated in a Johne's disease control or certification program (State-sponsored or a unique program developed specifically for their operation).

***States/Regions**
West: California, Idaho, New Mexico, Texas, and Washington
East: Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia and Wisconsin

Figure 2. Percentage of Operations that Participated in a Johne's Disease Control or Certification Program, by Study Year and by Herd Size



Separating calves from cows and their manure immediately after calving reduces the potential of newborn calves ingesting MAP. From 1991 to 1996, the percentage of operations that removed newborn calves from their dams immediately after birth increased dramatically. The percentage of operations that removed calves immediately increased steadily from 1996 (see table below). Despite these increases, in 2007 only a slight majority of producers (55.9 percent) removed calves immediately after birth, indicating that many producers still allow calves to nurse their dams.

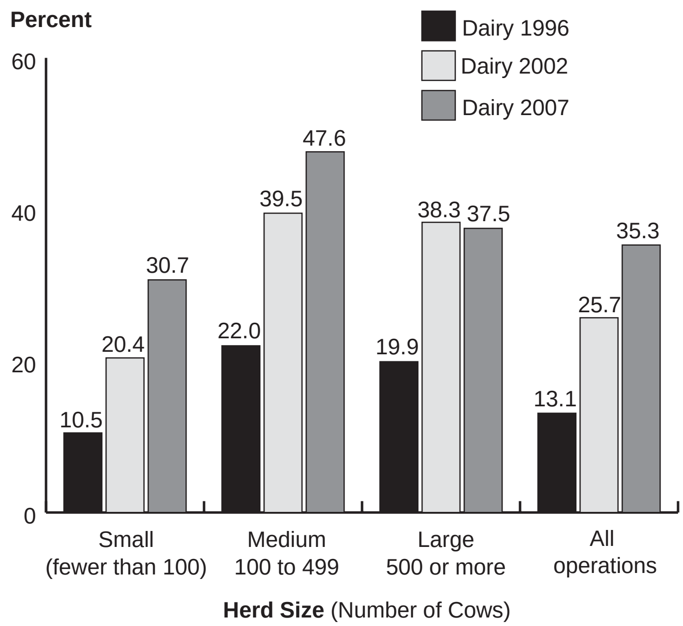
Percentage of Operations by Time Following Birth that Calves were Normally Separated from Their Dams

	Percent Operations Study Year			
Time	**NDHEP 1991**	**Dairy 1996**	**Dairy 2002**	**Dairy 2007**
Immediately (no nursing)	28.0	47.9	52.9	55.9
After nursing but less than 12 hours	39.6	20.8	22.5	22.2
12 to 24 hours	22.0	17.4	15.9	14.6
More than 24 hours	10.4	13.9	8.7	7.3
Total	100.0	100.0	100.0	100.0

Organism detection and measuring antibody response are the two main methods used to test for MAP infection. For organism detection, fecal culture is used most commonly. For antibody response, an enzyme-linked immunosorbent assay (ELISA) blood test is used most often. Fecal-culture testing takes more time to complete than the ELISA and is more expensive. Neither of these tests detects 100 percent of infected animals, due to variation in incubation periods, intermittent fecal shedding, and the varied immune response of individual animals to infection.

During the 12 months prior to the Dairy 2007 study, a higher percentage of medium operations (47.6 percent) performed any testing for Johne's disease compared with small operations (30.7 percent), a finding consistent with both the Dairy 1996 and Dairy 2002 studies as well. Compared to 1996, the percentage of all operations testing for Johne's disease increased in 2002, and an increase was seen again in 2007 (figure 3). Note that in the Dairy 1996 study, producers were asked if they performed Johne's testing during the 24 months prior to questionnaire administration rather than 12 months prior as in the 2002 and 2007 studies.

Figure 3. Percentage of Operations that Tested for Johne's Disease, by Study Year and by Herd Size



More than 2 of 10 operations (22.7 percent) reported that Johne's disease was confirmed in their herd during the previous 12 months. A lower percentage of small operations (17.4 percent) confirmed the disease compared with medium and large operations (35.0 and 34.1 percent, respectively). Almost one-quarter of operations in the East region (23.6 percent) confirmed Johne's disease compared to 12.8 percent in the West region. A diagnosis of Johne's disease was confirmed using blood, feces, and milk on 70.3, 36.4, and 12.4 percent of operations, respectively.

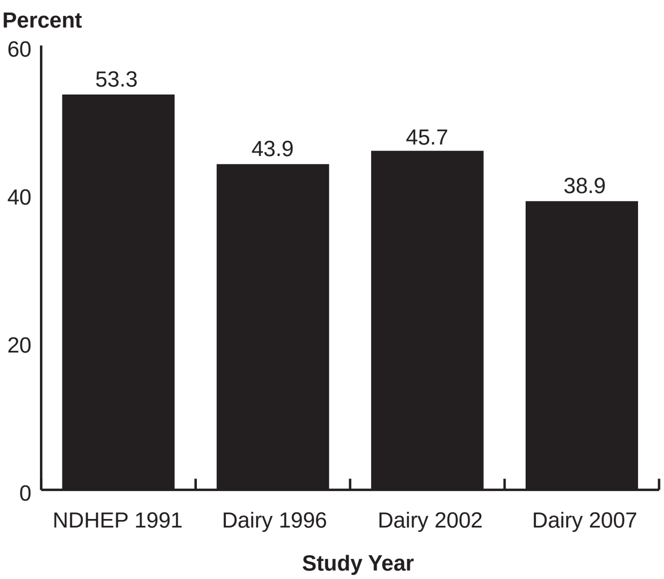
Although it has been an important component of control strategies for many years, vaccinating against MAP is a controversial management tool in the United States. Vaccine use reduces clinical manifestation of MAP infection,[1,2] but there are discrepancies among studies as to whether vaccine reduces the number of infected cattle.[1,3] Accidental self-injection may present a risk to veterinarians administering the vaccine.[4]

Additionally, MAP vaccine can interfere with tuberculosis tests, and as a result the vaccine's use is under strict state control.

Despite the limitations, vaccination remains a viable tool for controlling Johne's disease in certain infected herds and is cost-effective due to the reduction of clinically infected cattle.[2] However, it is not a widely used practice in the United States. The small percentage of operations that normally vaccinate heifers against Johne's disease has remained essentially unchanged since 1996, with 5.0 percent of operations reporting this practice in 2007.

Bringing animals onto an operation can introduce new diseases or add to the disease burden of the herd. Careful scrutiny of the source of new additions and a brief isolation or quarantine once the animals are on the dairy are good management practices. A higher percentage of operations brought any cattle onto the operation in 1991 compared with operations in 1996, 2002, or 2007. However, there has been little change in the percentage of operations bringing cattle onto the operation since 1996 (figure 4).

Figure 4. Percentage of Operations that Brought Any Cattle Onto the Operation During the Previous 12 Months, by Study Year



For operations that bring on new animals, knowing the MAP-infection status of the herd of origin can be more reliable than testing purchased animals individually. In Dairy 2007, less than one of five operations that brought cattle onto the operation during the previous year (17.2 percent) required herd-of-origin information regarding MAP-infection status. Approximately 1 of 10 operations (11.4 percent) tested individual animals brought onto the operation. A higher percentage of medium operations (16.6 percent) tested purchased animals compared with large operations (7.2 percent). For operations that did not perform individual animal testing of animals brought on, 22.3 percent reported that testing had been done by the herd-of-origin, and 28.6 percent reported that MAP infection was not a concern to their operation.

Environmental sample testing

Recommendations have been published on the "best test" for detecting MAP in U.S. cattle.[5] The authors indicate that culturing six composite fecal samples taken from the farm environment is sensitive and the most cost-effective means by which to determine whether a dairy operation is infected with MAP.[5] Based on results from previous research,[6 7 8] environmental sampling was established as an acceptable testing strategy to achieve level 1 of the test-negative component of the U.S. Voluntary Bovine Johne's Disease Control Program.[9]

To estimate Johne's herd-level prevalence for the Dairy 2007 study, 6 composite environmental samples were taken from each of 524 participating operations. The environmental samples were taken from six different adult-cow areas where manure accumulates.

Recommended locations for sampling included, but were not limited to, common pens or alleyways, manure pit or other manure storage area, holding pens or exit ways from the milking parlor, gutter cleaners, and manure spreaders. For each composite sample, approximately 4 ounces of manure/slurry were taken from each of six sites within the respective area. For example, for a cow alleyway sample, 4 ounces of manure were taken from six different locations within the alleyway and combined to form a single composite sample of approximately 24 ounces. Samples were sent to the National Veterinary Services Laboratories and cultured on Herrold's egg yolk agar and evaluated at 4 and 8 weeks. Positive cultures were confirmed as MAP by PCR methods.

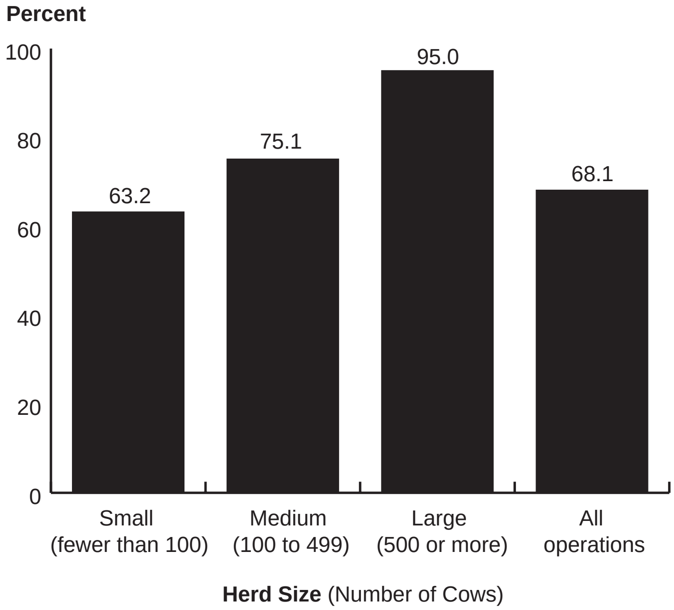
Environmental culture results

In 2007, MAP was isolated from at least one environmental sample on 68.1 percent of operations, and prevalence increased as herd size increased (figure 5). In comparison, Dairy 1996—the last study before Dairy 2007 to report the U.S. prevalence of Johne's disease—estimated that 21.6 percent of operations had at least 10 percent of their cattle infected with MAP. Additionally, the Dairy 1996 study used ELISA instead of fecal-culture. For these reasons, MAP prevalence estimates from Dairy 1996 are not directly comparable with Dairy 2007 prevalence estimates.

There were no differences in MAP prevalence between operations in the West and East study regions.

Although environmental sampling is an effective method of detecting operations infected with MAP, it will not detect all infected operations. Thus, reported percentages will be less than the true prevalences.

Figure 5. Percentage of Operations in Which at Least One Environmental Sample Cultured Positive for MAP in 2007, by Herd Size



About one-fourth of operations had six culture-positive environmental samples. Operations with one to five culture-positive samples were less common. These results suggest that at least one-fourth of U.S. dairy operations may have a relatively high percentage of infected cows in their herds.

Conclusions

In Dairy 2007, 94.1 percent of producers either were fairly knowledgeable or knew some basics about Johne's disease compared with 54.8 percent of producers in Dairy 1996. The Dairy 2007 study indicates that 68.1 percent of U.S. dairy operations are infected with MAP. Results from the NAHMS Dairy 2007 study indicate that producers are implementing management practices aimed at reducing MAP transmission, suggesting Johne's disease educational efforts are working.

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For more information, contact:

USDA–APHIS–VS–CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Milking Procedures on U.S. Dairy Operations, 2007

In 2007, the U.S. Department of Agriculture's (USDA) National Animal Health Monitoring System (NAHMS) conducted the Dairy 2007 study. In all, 17 of the Nation's major dairy States* participated in the study. These States were divided into two regions and represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. One objective of Dairy 2007 was to describe milking procedures and associated practices and to estimate the prevalence of contagious mastitis pathogens.

Contagious mastitis is caused by pathogens that typically spread from cow to cow during milking. Environmental mastitis is caused by teat-end exposure to an environmental pathogen.[1] Proper milking procedures can help control both contagious mastitis and environmental mastitis.[2]

Milker training

Although the owner/operator milked the majority of cows on most operations, the largest percentage of cows (68.2 percent) were on operations in which hired workers milked the majority of cows. Training milking personnel in the proper procedures used to milk cows and providing reasons for the procedures are usually ongoing processes.

The Dairy 2007 study reported that milker training increased as herd size increased, with 42.3 percent of small operations (fewer than 100 cows) training milking personnel compared with 75.3 percent of medium operations (100 to 499 cows), and 97.8 percent of large operations (500 or more cows).

A higher percentage of operations in the East region (48.9 percent) did not provide milker training compared with operations in the West region (15.6 percent). In the West region, hired workers milked the majority of cows on 82.7 percent of operations, while in the East region the owner/operator milked the majority of cows on 64.1 percent of operations. Almost all operations that trained milkers (97.1 percent) trained them on the job.

Milking frequency

Evidence suggests that increasing the times per day fresh cows (cows less than 30 days in milk) are milked increases milk production and that the increased production persists throughout lactation.[3 4] More than 9 of 10 operations (91.8 percent) milked fresh cows twice daily compared with 7.6 percent that milked fresh cows 3 or more times daily. The percentage of operations that milked fresh cows three times per day or more increased as herd size increased.

The majority of operations milked cows other than fresh cows twice daily (92.5 percent). As was observed with fresh cows, the percentage of operations that milked cows three times per day increased as herd size increased.

Use of gloves

Mastitis pathogens can be spread from infected to uninfected cows during milking via the milkers' hands. Using latex or similar gloves can reduce the spread of mastitis, but gloves should be disinfected between cows.[5]

Approximately half the operations (55.2 percent) reported that milkers wore gloves to milk all cows. However, 76.8 percent of cows were on operations in which gloves were used, suggesting the practice is more common on large operations.

Clinical mastitis milking practices

Milking cows with clinical mastitis at the end of milking, with a separate milking unit, or in a separate string can reduce the exposure of noninfected cows to mastitis organisms.[6] Approximately one of three operations (34.9 percent) used a separate milking unit to milk mastitic cows. A higher percentage of large operations (83.4 percent) milked mastitic cows in a separate string from healthy cows compared with small and medium operations (29.8 and 33.4 percent, respectively) [figure 1].

***States/Regions:**
- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

Figure 1. Percentage of Operations by Method Used for Milking Cows with Clinical Mastitis, and by Herd Size:

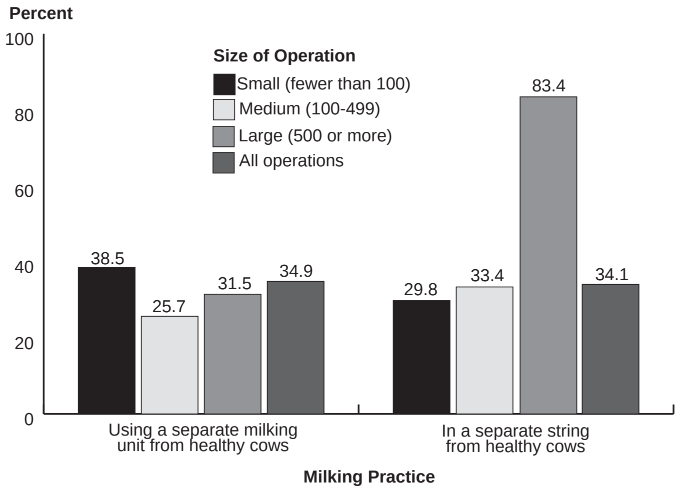
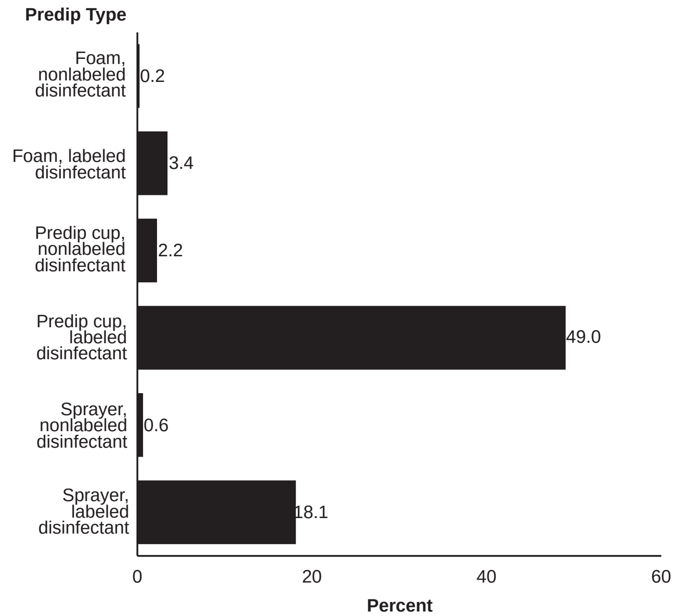


Figure 2. Percentage of Operations by Type of Predip Used



Teat preparation

Premilking teat disinfection has been shown to reduce environmental bacteria on the teat surface, reduce bacterial counts in milk, and may decrease the incidence of new infections.[9] While there are many different methods to accomplish this, disinfectants should be tested for efficacy and labeled for teat disinfection.

Methods of washing teats include a water hose with disinfecting solution, a water hose without disinfecting solution, or disinfecting wipes. Using single-use towels helps prevent the spread of mastitis pathogens from infected cows to noninfected cows.[7] More than 4 of 10 large operations (41.5 percent) used a wash pen prior to entering the parlor, compared with less than 3 percent of small or medium operations. There were no differences by herd size in the percentages of operations that used water hoses, with 2.8 percent of operations using water hoses with disinfectant and 4.2 percent using water hoses without disinfectant. A single-use towel using a labeled disinfectant was the predominant wet-wipe method used on 8.5 percent of operations.

Predip disinfectants can be applied via sprayer, cup, or foamer. Almost half of all operations (49.0 percent) applied a labeled disinfectant in a predip via a predip cup (figure 2), and no differences were observed across herd sizes. A higher percentage of operations in the East region used a predip cup to apply a labeled disinfectant to teats, compared with operations in the West region.

Forestripping

Forestripping cows stimulates milk secretion from mammary tissue, allows the milker to observe any abnormalities in the milk, and removes milk with a higher concentration of somatic cells, thereby improving milk quality.[7] Overall, 92.6 percent of operations forestripped some or all cows.

If forestripping is performed before teat disinfection or while disinfectant is still on the teat, it may reduce the transfer of organisms from the milker to the teat. Teats may become recontaminated with bacteria if the forestripping is performed after drying.[8] Over half the operations that forestripped any cows (56.7 percent) did so prior to teat disinfection or after teat disinfection but prior to drying, while 43.3 percent did so after disinfection and/or drying.

Drying

If teats are wet prior to milking, they should be dried with a single-use towel to decrease the risk of new infections. Liner slips—which occur more frequently when teats are wet—can cause rapid air movement inside the milking claws, resulting in injection of bacteria into the teat canal.[7] In summer and winter, single-use paper and cloth towels were used to dry teats on approximately 55 and 21 percent of operations, respectively, while multiple-use paper and cloth towels were used on 0.6 percent and 7.1 percent of operations, respectively.

Automatic takeoffs

Incorrectly removing the milking unit can have a detrimental impact on udder health. Automatic takeoffs may improve teat-end condition by promptly removing the milking claws at a predetermined milk-flow rate.[10] A higher percentage of medium and large operations (76.9 and 89.5 percent, respectively) used automatic takeoffs compared with 30.2 percent of small operations.

Postmilking teat dipping

Applying postmilking teat disinfectant kills mastitis pathogens before they can enter the teat canal and is the single most effective practice of reducing the incidence of contagious mastitis.[2] More than three of four operations dipped teats with a labeled postdip in summer and winter. Approximately 13 percent of operations sprayed teats with a commercial postdip in summer and winter. About 5 percent of operations performed no teat disinfection.

The majority of operations (about 70 percent) used iodophor compounds as predips and postdips in both summer and winter. Chlorhexidine was the next most common compound and was used by about 13 percent of operations.

Postmilking barrier teat dips provide additional protection against new coliform intramammary infections, although germicidal dips appear to provide better protection against environmental streptococci and contagious pathogens.[2] Approximately one of four operations used a barrier teat dip on all cows all the time (24.5 percent), and no differences were observed across herd sizes. About two-thirds of operations (66.7 percent) did not use a barrier teat dip. A higher percentage of operations in the East region (68.4 percent) did not use a barrier dip compared with operations in the West region (49.0 percent).

Backflush systems

A backflush system is used to wash the milking claw or cluster between cows, which reduces the spread of contagious mastitis pathogens.[11] A total of 6.8 percent of operations used a backflush system. Although no differences in the use of a backflush system were observed by herd size, there was a regional difference: 20.9 percent of operations in the West region used a backflush system compared to 5.4 percent in the East region.

Residue testing

Every tanker load of milk in the United States is tested at the milk plant for the presence of specific antibiotics prior to processing. Consequences of a positive test may include discarding the entire truckload of milk and suspension of the producer’s permit to sell milk.

Milk from cows treated with antibiotics should be discarded for a specified withdrawal period, as directed by the drug manufacturer via the product label. Manufacturers are required to go through an exhaustive drug approval process that determines the withdrawal period. If approved drugs are used in the manner prescribed on the label, producers can use the withdrawal period stated on the label, knowing that the milk does not contain violative drug residues. However, producers may use on-farm drug-residue testing to be confident that the milk they are selling is free from violative drug residues.

One caveat of on-farm drug testing is that the residue testing kits are approved for bulk tank milk, not for individual cows. Using residue tests on individual cows may result in milk being discarded, even though it is below the violative level. Almost half the operations (49.8 percent) performed milk residue testing, with a higher percentage of medium operations (64.5 percent) testing compared with small operations (44.2 percent). While there are numerous residue screening tests available, the majority of operations that tested for residues (62.9 percent) used Delvotest®. Nine of 10 operations that screened for antibiotic residues (90.9 percent) tested individual cows that were recently treated for mastitis, and about 6 of 10 operations (57.8 percent) tested fresh cows.

Dry-cow therapy

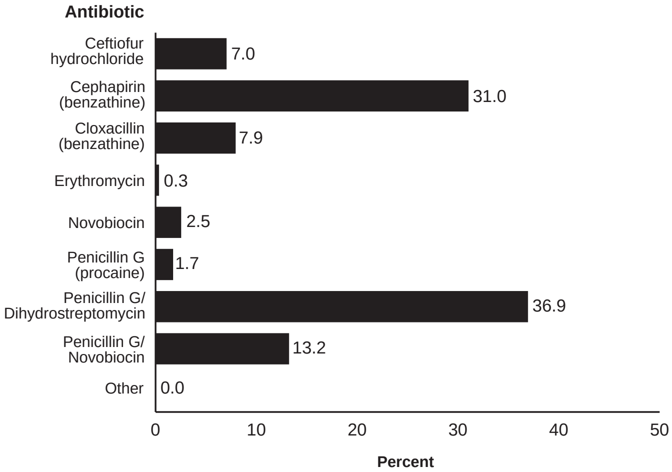
The purpose of dry cow therapy is to prevent new intramammary infections during the dry period and to treat subclinical udder infections.[13] Dry-cow therapy includes the use of external sealants, internal sealant infusions, and antimicrobial infusions.

External teat sealants coat the exterior of the teat to prevent bacterial entrance into the gland. More than 8 of 10 operations (82.8 percent) did not use an external teat sealant at dryoff, while 14.0 percent of operations used a sealant on all cows at dryoff. There were no differences across herd sizes or by regions.

Internal teat sealants are another way to supplement the teat’s defenses against bacterial infections. Proper hygienic insertion of the teat sealant is important to prevent contamination of the mammary gland.[13] A higher percentage of medium and large operations used internal teat sealants on all cows at dryoff (45.7 and 49.0 percent, respectively) compared with 22.7 percent of small operations. Overall, 30.1 percent of operations used an internal teat sealant.

The use of intramammary antibiotics at the time of dryoff can cure many existing infections and reduce new infections. Almost 1 of 10 operations did not use any dry-cow treatment. Some of these operations were organic operations where the use of antibiotics is not allowed. For cows treated with dry-cow intramammary antibiotics, the most commonly used antibiotics were cephapirin and penicillin G/dihydrostreptomycin (31.0 and 36.9 percent of cows, respectively) [figure 3].

Figure 3. For Cows Treated with Dry-Cow Intramammary Antibiotics During the Previous 12 Months, Percentage of Cows Treated, by Type of Antibiotic



To review complete reports from the Dairy 2007 study, visit the NAHMS Web site at: http://nahms.aphis.usda.gov

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For more information, contact:

USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Methicillin-resistant *Staphylococcus aureus* in Bulk-tank Milk on U.S. Dairy Operations, 2007

Background

Methicillin-resistant *Staphylococcus aureus* (MRSA) first emerged in hospitals during the 1970s and has recently become a worldwide public health problem. It remains a major cause of hospital-acquired infections in humans. In addition, community-acquired MRSA has also become a major concern.[1] Currently, increasing evidence points to domestic animals—including food animals—as reservoirs and shedders of MRSA, and transmission between host species may be possible.[2] Over the past decade, a growing number of MRSA isolates have been reported in companion and food animals and in their human associates, including pet owners, farmers, and veterinary personnel. MRSA has been detected in dogs, cats, horses, pigs, sheep, goats, rabbits, chickens, exotic species, and milk from cows with mastitis.[3 4]

Recent studies have shown genetic similarity between MRSA isolates from food animals—including dairy cows— to those in humans, suggesting transmission between the species.[5 6] MRSA infections in dairy cattle have been ascribed to human-to-animal transfer, but the directionality of transmission is not always known.[6 7]

Although *S. aureus* is a common mastitis pathogen and among the leading causes of foodborne bacterial infections,[8] MRSA appears to be relatively rare in foods originating from animals, and there is little evidence to suggest that MRSA is common in milk. Two studies detected MRSA in less than 1 percent of meat, milk, and cheese samples.[3 8] Pasteurization significantly reduces the risk of MRSA transmission via dairy products, and most reported instances of foodborne MRSA outbreaks have occurred through contamination by infected food handlers, rather than the food itself.[9 10]

An analysis of 2,778 *S. aureus* isolates from milk samples submitted to diagnostic laboratories in Michigan from 1994 to 2000 showed no increased resistance of mastitis isolates to antimicrobials (including oxacillin) commonly used in dairy cattle.[11] Among 357 *S. aureus* isolates recovered from milk in North Carolina, antimicrobial resistance was uncommon, and resistance to oxacillin was not detected.[12]

Dairy 2007 study

In 2007, the U.S. Department of Agriculture's (USDA) National Animal Health Monitoring System (NAHMS) conducted the Dairy 2007 study. The study was conducted in 17 of the Nation's major dairy States[*] representing 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows.

One objective of the study was to evaluate the occurrence of MRSA in bulk-tank milk from dairy operations. Operations with 30 or more cows that had completed the initial study questionnaire were eligible for bulk-tank milk sampling and testing for MRSA.

Sample collection and testing

To estimate the prevalence of mastitis pathogens and the occurrence of MRSA, a single bulk-tank-milk sample was collected from each of 542 participating operations. Samples were shipped overnight on ice to Quality Milk Production Services (QMPS) bacteriology laboratory for evaluation using routine testing methods.[13 14] After the samples were cultured for the presence of mastitis pathogens, *S. aureus*-positive samples (n=218) were stored at -20˚C for 4 weeks to 4 months, until further processing.

To detect MRSA in bulk-tank milk, phenotypic and genotypic methods were used. Phenotypic detection was based on plating of stored milk samples on a selective indicator media, CHROMagar™ MRSA.[15] In a parallel assay, the thawed milk samples were plated on blood agar to obtain multiple staphylococcal-like colonies. Suspensions of these colonies, which might have contained mixtures of *S. aureus* strains and coagulase negative staphylococci, were used for subsequent genotypic detection of MRSA based on polymerase chain reaction using *S. aureus* and *mecA* specific primer sets.[16 17] The nuc gene is specific for *S. aureus* while the mecA gene is responsible for conferring methicillin resistance. When mecA was identified in a colony suspension, efforts were made to identify individual mecA positive bacteria on the blood agar plates.

Results

Of the 218 milk samples that were originally *S. aureus*-positive, 190 were culture positive on blood agar after storage at -20˚C; however, MRSA was not

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[*] **States/Regions:**
- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

detected in these samples tested on CHROMagar. *MecA* was detected in nine colony suspensions from blood agar, twice in the absence of nuc and seven times in combination with nuc-positive. Detection of *mecA* in these samples can be due to the presence of methicillin-resistant *Staphylococcus* spp. other than *S. aureus.* In one study, methicillin resistance was found to be more common in nonaureus staphylococci from milk samples than in *S. aureus*.[18] Through analysis of individual colonies from nine bulk-tank milk samples, methicillin-resistant *Staphylococcus* spp. (but not MRSA) were obtained from five samples. From the remaining four samples, no methicillin-resistant colonies were obtained.[19]

Conclusion

MRSA could not be detected in a nationally representative sample of bulk-tank milk from the NAHMS Dairy 2007 study using phenotypic and genotypic methods, suggesting that bulk-tank milk in the United States is not a common source of MRSA. However, in an extremely small number of bulk-tank samples (less than .02 percent), methicillin resistance was identified in *Staphylococcus spp.* other than *S. aureus*.

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For more information, contact:

USDA–APHIS–VS–CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Veterinary Services
Centers for Epidemiology and Animal Health
November 2007

Off-Site Heifer Raising on U.S. Dairy Operations, 2007

In 2007, the U.S. Department of Agriculture's National Animal Health Monitoring System (NAHMS) conducted the Dairy 2007 study. In all, 17 of the Nation's major dairy States* representing 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows participated in the study. During January 2007, producers were asked about their use of off-site calf ranches.

Off-site calf ranches

Heifer rearing represents about 20 percent of the total operating expenses on dairy operations, making it the second largest expense behind feeding costs.[1] To raise heifers, dairies invest money and resources in feed, labor, and housing without receiving a return on their investments until the heifers calve, usually around 24 months of age. As dairy farms become larger, use of off-site calf ranches is becoming increasingly common.[2] Calf ranches that raise a large number of heifers likely realize economies of scale that allow them to produce heifers at a cost lower than a single dairy farm.

Calves are transported to the calf ranches at a predetermined age, such as prior to or after weaning, and are raised there. Typically, producers and calf ranches enter into a contract that specifies expectations of care and growing performance, along with payment responsibilities. Various types of contracts are used, e.g., contracts in which producers pay calf ranches by the day or by pound of gain and contracts in which the producer sells heifers to the ranch upon delivery and retains the option to buy them back prior to freshening.

On operations with limited facilities, labor, or other components of a dairy operation, contracting with an off-site calf ranch has many potential advantages. Calf-ranch personnel are usually dedicated to working only with calves, which can result in increased attention to the feeding and health of calves and also decreased exposure to adult cow disease. In addition, if calves are not commingled with older animals or animals from other operations, their exposure to disease agents such as

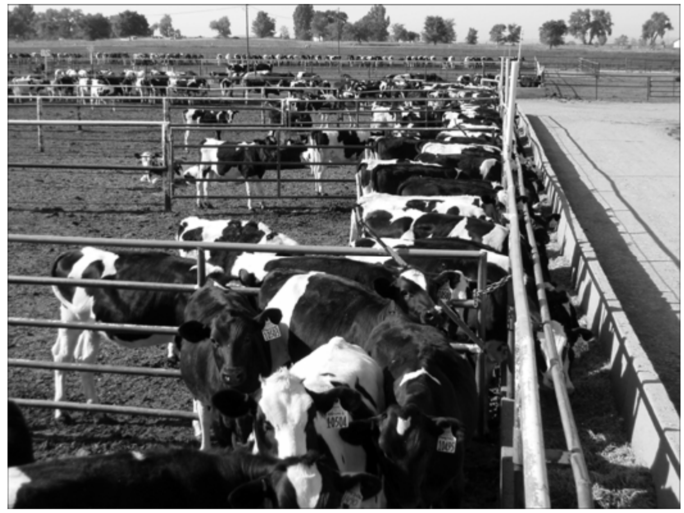


Photo courtesy of Dr. Jason Lombard

Mycobacterium avium subspecies *paratuberculosis*—the causative agent of Johne's disease—is reduced. Moving heifers off-site frees up both labor and space previously dedicated to heifer housing and feed-storage facilities that can be used for the milking herd. Raising heifers off-site also reduces the amount of manure produced at single sites and/or may allow producers to maintain larger milking herds on the same acreage. Using off-site calf ranches may enable producers to reduce expenses, especially if the heifer-raising aspect of the operation is costly or inefficient, which might be indicated by consistent, higher-than-normal calf illness or death loss, or by heifers that calve later than 24 months of age and/or calve at sub-optimal weights.

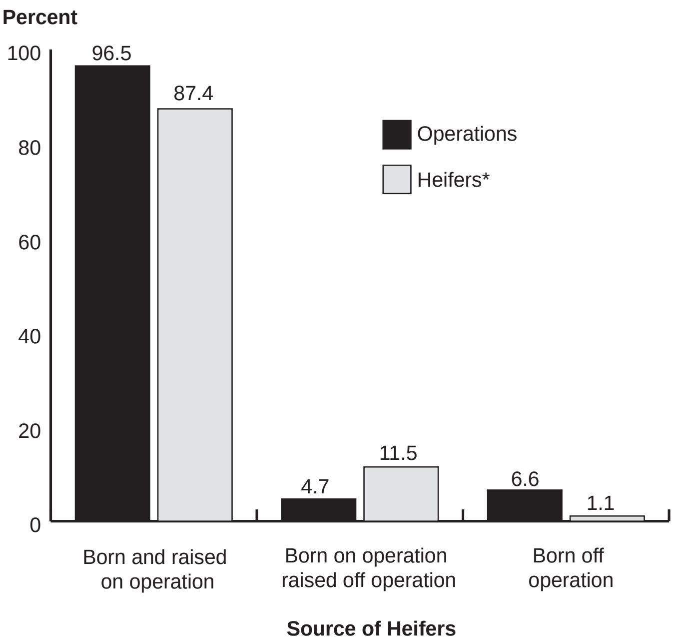
A significant disadvantage of using an off-site calf ranch is the increased risk of disease introduction into the herd stemming from commingling heifers from different operations. A previous study found that only 6 of 57 calf ranches permanently separated heifers according to farm of origin during the rearing period.[2] Other drawbacks of using calf ranches include less control over management practices used in raising heifers, transportation costs of moving heifers to the off-site facility, and issues related to entering into and meeting contract obligations.

*California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Virginia, Wisconsin, and Washington

Source of heifers

Although 4.7 percent of operations had heifers that were born on the operation but raised elsewhere, these operations accounted for 11.5 percent of all dairy heifers. Of the remaining heifers, 87.4 percent were born and raised on the operation, and nearly all operations (96.5 percent) had at least some dairy heifers that were born and raised on the operation (figure 1).

Figure 1. Percentage of Operations and Percentage of Heifers, by Source of Heifers

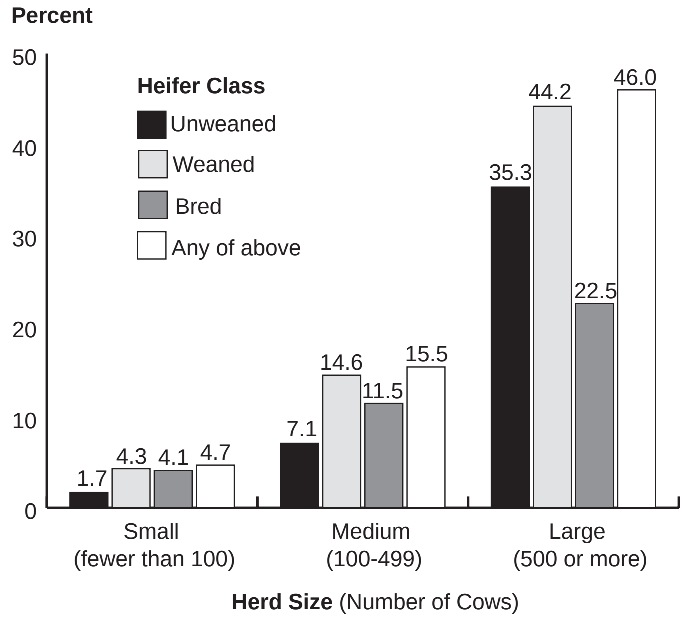


*As a percentage of January 1, 2007, inventory

Raising dairy heifers off-site

About 1 in 10 operations (9.3 percent) raised some dairy heifers off-site. The percentage of operations that raised heifers off-site increased as herd size increased for all heifer classes. Less than 5 percent of small operations raised any dairy heifers off-site, compared to 15.5 percent of medium operations and 46.0 percent of large operations. Approximately one-third of large operations (35.3 percent) raised unweaned calves off-site, compared to 7.1 percent of medium operations and 1.7 percent of small operations. Similar herd-size differences in the percentages of operations that raised heifers off-site were observed among all heifer classes—unweaned, weaned, and bred (figure 2).

Figure 2. Percentage of Operations that Raised Any Heifers Off-Site, by Heifer Class and By Herd Size



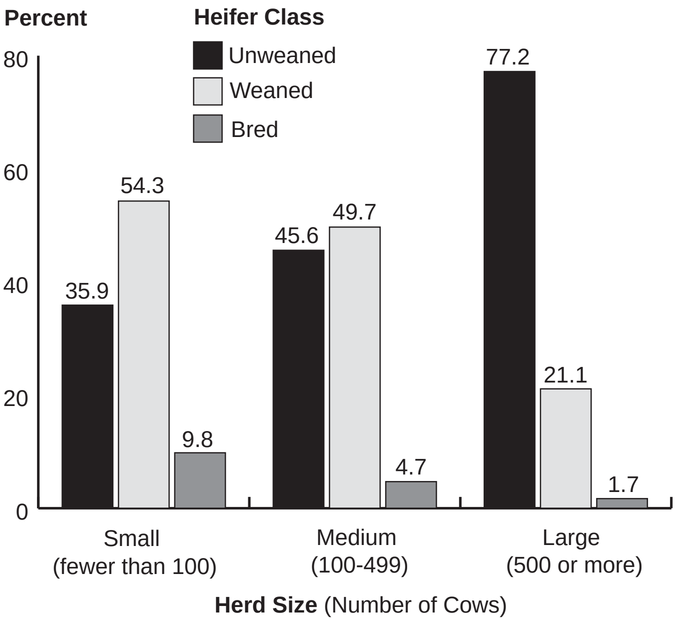
Primary class and age of heifers sent to calf ranches

Producers that sent any heifers off-site to be raised were asked to identify the primary class of dairy heifers sent off-site. Half of these operations (50.1 percent) primarily sent unweaned calves, and the operations typically sent these calves off-site at an average* age of 4.9 days. Weaned calves were the primary class of dairy heifers sent off-site for 44.1 percent of operations, and these calves were sent at an average age of 189.8 days. Only 5.8 percent of operations primarily sent bred heifers off-site to be raised; the average age at which these heifers were sent off-site was 413.8 days. The average age at which all calves—regardless of class—were moved to the off-site facility was 110.3 days.

*The average value for all operations; a single value for each operation is summed over all operations reporting divided by the number of operations reporting.

For operations that raised any heifers off the operation, small operations most commonly sent weaned heifers off-site (54.3 percent); medium operations sent similar percentages of unweaned and weaned calves off-site (45.6 and 49.7 percent, respectively); and large operations most frequently sent unweaned heifers off-site (77.2 percent) [figure 3].

Figure 3. For Operations that Raised Any Heifers Off-Site, Percentage of Operations by Primary Heifer Class Sent Off-Site and by Herd Size



Primary class and age of heifers returning from calf ranches

Of operations that sent any heifers to calf ranches, about two-thirds (67.6 percent) brought animals back to the operation primarily as bred heifers; these heifers returned to the operation at an average age of 21.6 months. About one in three operations (30.3 percent) brought back weaned heifers at an average age of 7.0 months. Just 2.1 percent of operations brought back “other” heifers (primarily heifers that had calved). The average age at which replacement heifers of all classes returned to the operation from off-site calf ranches was 17.3 months.

A higher percentage of large operations (53.4 percent) brought back weaned heifers compared with medium and small operations (27.3 and 15.1 percent, respectively). A higher percentage of small and medium operations (79.1 and 72.2 percent, respectively) brought back bred heifers compared with large operations (46.6 percent) [table 1].

Table 1. For Operations that Sent Heifers Off-Site to be Raised, Percentage of Operations by Primary Class of Heifers Arriving or Returning to the Operation, by Herd Size

	Percent Operations			
	Herd Size (Number of Cows)			
	Small (Fewer than 100)	**Medium** (100-499)	**Large** (500 or More)	**All Operations**
Heifer Class*	**Percent**	**Percent**	**Percent**	**Percent**
Weaned	15.1	27.3	53.4	30.3
Bred	79.1	72.2	46.6	67.6
Other**	5.8	0.5	0.0	2.1
Total	100.0	100.0	100.0	100.0

*No operations reported unweaned heifers returning from an off-site rearing facility.
**Heifers that had calved.

Distance to off-site rearing

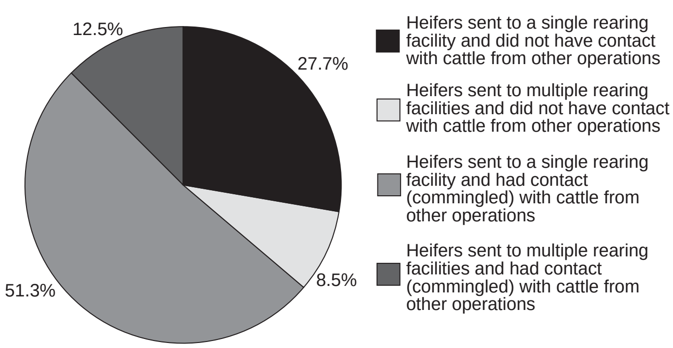
For operations that sent heifers off-site to be raised, the majority of small and medium operations transported heifers fewer than 20 miles to the off-site rearing facility, while the majority of large operations transported heifers between 5 and 50 miles. About 1 in 10 of all operations (10.6 percent) transported heifers 50 miles or more (table 2). Very few operations (4.1 percent) ever transported heifers out of State for rearing.

Table 2. For Operations that Sent Heifers Off-Site to be Raised, Percentage of Operations by Number of Miles Heifers were Transported to the Off-Site Rearing Facility, and by Herd Size

	Percent Operations			
	Herd Size (Number of Cows)			
	Small (Fewer than 100)	**Medium** (100-499)	**Large** (500 or More)	**All Operations**
Miles	**Percent**	**Percent**	**Percent**	**Percent**
Fewer than 5.0	43.5	26.0	10.1	27.6
5.0 to 19.9	35.3	47.5	37.7	40.8
20.0 to 49.9	12.8	18.8	34.5	21.0
50 or more	8.4	7.7	17.7	10.6
Total	100.0	100.0	100.0	100.0

Producers were asked to choose the description that best described their primary off-site rearing facility. Ideally, from the standpoint of disease transmission, heifer-raising facilities would house animals from only a single operation. About one-third of operations (36.2 percent) sent their cattle to rearing facilities where they did not have contact with cattle from other operations; 27.7 of these operations sent their heifers to a single facility, and 8.5 sent their heifers to multiple facilities. However, nearly two-thirds of operations that sent heifers off the operation for rearing (63.8 percent) sent them to facilities where they did have contact with cattle from other operations. Of these operations, 51.3 percent used single facilities, and 12.5 percent sent their heifers to multiple rearing facilities (figure 4).

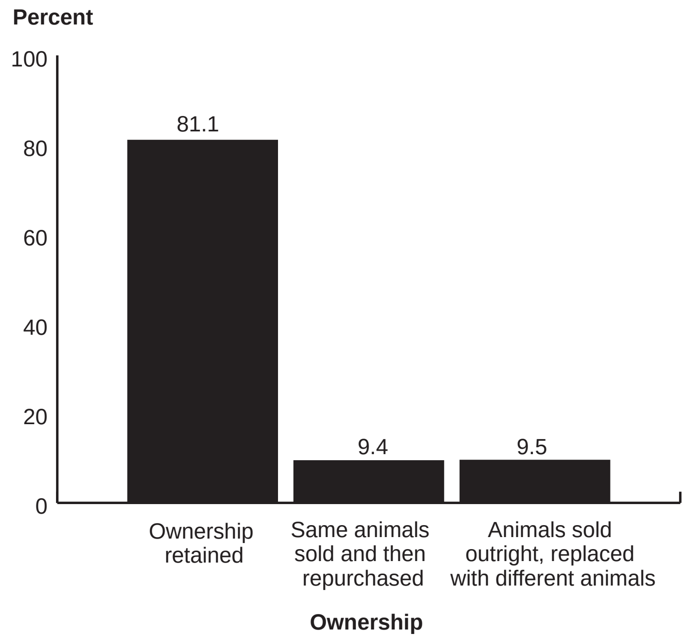
Figure 4. For Operations that Sent Heifers Off-Site to be Raised, Percentage of Operations by Primary Off-Site Rearing Facility



Ownership arrangements

Approximately 8 of 10 operations that sent dairy heifers off-site to be raised (81.1 percent) retained ownership of the heifers sent. A total of 9.4 percent of operations sold the heifers sent off-site and later repurchased the same animals, and 9.5 percent of operations sold the animals sent and replaced them with different animals (figure 5).

Figure 5. For Operations that Sent Heifers Off-site to be Raised, Percentage of Operations by Ownership of the Majority of Heifers



Summary

The decision to use off-site calf ranches should be made based on the needs and goals of the individual dairy. The producer must decide whether using on-site or off-site heifer raising is the most economical method for achieving the desired replacement heifer quality.

For more information, contact:

USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Highlights of Dairy 2007 Part I: Reference of Dairy Cattle Health and Management Practices in the United States, 2007

In 2007, the National Animal Health Monitoring System (NAHMS) conducted a study of U.S. Dairy Operations. The Dairy 2007 study collected data on dairy health and management practices from 17 of the Nation's major dairy States.* These States represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. Part 1: Reference of Dairy Cattle Health and Management Practices in the United States, 2007 is the first in a series of reports containing national information from the NAHMS Dairy 2007 study and contains information collected from 2,194 dairy operations.

Released October 2007, the report provides participants, industry, and animal-health officials with information on the Nation's dairy population that will serve as a basis for education, service, and research. The following are highlights excerpted from Part I of the Dairy 2007 study.

Operation type

- The majority of dairy operations (63.9 percent) were conventional operations, and the majority of cows (82.2 percent) were on these operations. Grazing and organic operations accounted for only 3.1 and 1.7 percent of operations, respectively, and together represented less than 3.0 percent of cows.

Productivity

- Producers were asked to report their rolling herd average (RHA) milk production (the amount of milk [lb/cow] produced by the average cow during the last 12 months). The average of this reported number across all operations—referred to as the operation average—was 19,175 lb/cow.
- Operations with on-farm computer systems had higher operation average RHAs compared to operations using off-farm computers or no computers.
- Overall, the average age at first calving was 25.2 months. Large operations reported the earliest average age for heifers at first calving at 24.0 months (table 1).

*California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Virginia, Wisconsin, and Washington

Table 1. Average Age of Heifers at First Calving, by Herd Size

Operation Average Age (Months)			
Herd Size (Number of Cows)			
Small (Fewer than 100)	**Medium** (100-499)	**Large** (500 or More)	**All Operations**
Average	**Average**	**Average**	**Average**
25.4	24.8	24.0	25.2

- The operation average dry period on medium operations (56.3 days) was about 3 days shorter than the average on large operations (59.6 days). The overall average days dry was 57.8 days.
- For all operations, the average calving interval was 13.2 months. No differences were observed in calving intervals across herd sizes.

Heifer management

- Nearly all operations (96.5 percent) had at least some heifers that were born and raised on the operation. Almost 9 of 10 heifers (87.4 percent) were born and raised on the operation. Although 4.7 percent of operations had heifers born on the operation but raised elsewhere, these operations accounted for 11.5 percent of all heifers (table 2).

Table 2. Percentage of Operations and Percentage of Heifers, by Source of Heifers

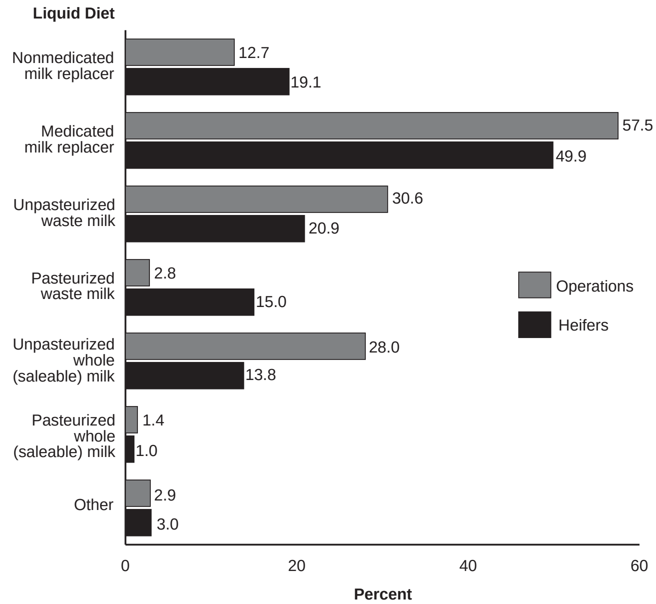
Heifer Source	Percent Operations	Percent Heifers*
Born and raised on operation	96.5	87.4
Born on operation raised off operation	4.7	11.5
Born off operation	6.6	1.1
Total		100.0

*As a percentage of January 1, 2007, heifer inventory

- Unweaned heifer deaths during 2006 accounted for the highest percentage of deaths among the animal classes at 7.8 percent, while 5.7 percent of cows and 1.8 percent of weaned heifers died.

- More than half the operations (55.9 percent) removed newborn heifer calves immediately after calving. These operations accounted for 65.6 percent of all heifer calves.
- Overall, medicated milk replacer was fed on more than half of all operations (57.5 percent). Similar percentages of operations fed unpasteurized waste milk and unpasteurized whole (saleable) milk (30.6 and 28.0 percent, respectively) (figure 1).

Figure 1. Percentage of Operations that Fed a Liquid Diet to Heifers Any Time Prior to Weaning During 2006, and Percentage of Heifers that Received a Liquid Diet Any Time Prior to Weaning, by Type of Liquid Diet



- The operation average age of heifers at weaning was 8.2 weeks, with large operations weaning calves at an older age (9.1 weeks) than medium and small operations (7.9 and 8.2 weeks, respectively).
- Preventive practices were commonly used for heifers: 94.6 percent of operations administered at least one preventive practice to heifers, and 94.6 percent of heifers were on these operations. More than 60 percent of operations vaccinated heifers against bovine viral diarrhea (BVD), infectious bovine rhinotracheitis (IBR), parainfluenza Type 3 (PI3), bovine respiratory syncytial virus (BRSV), and leptospirosis.
- During 2006, almost 9 of 10 cows and heifers (86.0 percent) delivered a calf that was alive at 48 hours. Of the calves born during 2006, 93.5 percent were alive at 48 hours, while 6.5 percent were either born dead or died prior to 48 hours of age. Almost one in five calves (17.2 percent) needed assistance during delivery.

Cow management

- The majority of operations (60.3 percent) had a tie stall/stanchion milking facility. Although just 39.5 percent of operations used parlors, 78.2 percent of cows were on operations that milked in parlors.
- Adverse reactions, which include a lump or swelling at the injection site, hives, abortion, collapse, or death, can occur following the administration of preventive or therapeutic products. Only 12.7 percent of operations had at least one adverse reaction on their operation during 2006.
- Almost all operations (95.3 percent) used some preventive practice for cows.
- A total of 15.2 percent of operations used bST on 17.2 percent of cows. As herd size increased so did the percentage of operations that used bST, ranging from 9.1 percent of small operations to 42.7 percent of large operations.
- The three most prevalent diseases reported in cows were clinical mastitis, lameness, and infertility problems (16.5, 14.0, and 12.9 percent of cows, respectively).
- Of permanently removed cows, 26.3 percent were removed for reproductive problems and 23.0 percent for udder or mastitis problems.

Biosecurity

- Almost 4 of 10 operations (38.9 percent) brought at least 1 new addition onto the operation during 2006. Approximately one in eight operations brought on bred dairy heifers, lactating dairy cows, or dairy bulls (12.2, 13.8, and 12.5 percent, respectively).
- Less than 50 percent of operations that brought cattle onto the operation during 2006 required vaccination of new additions prior to arrival. Cattle were required to be vaccinated against BVD, IBR, and leptospirosis on 42.9, 41.9, and 38.8 percent of all operations, respectively.

Visit the NAHMS Web site at: http://nahms.aphis.usda.gov for a complete copy of Part 1: Reference of Dairy Cattle Health and Management Practices in the United States, 2007.

For more information, contact:
USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Highlights of Dairy 2007 Part II: Changes in the U.S. Dairy Cattle Industry, 1991-2007

In 2007, the National Animal Health Monitoring System (NAHMS) conducted a study of U.S. Dairy Operations. The Dairy 2007 study collected data on dairy health and management practices from 17 of the Nation's major dairy States.* These States represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows.

The following highlights were excerpted from the report released in February 2008: Dairy 2007 Part II: Changes in the U.S. Dairy Cattle Industry, 1991-2007. Part II identifies changes in the dairy industry from 1991 to 2007, and specifically addresses changes identified from four NAHMS dairy studies: NDHEP 1991, Dairy 1996, Dairy 2002, and Dairy 2007.

General trends

- Approximately 4 to 7 percent of dairy operations have gone out of business each year since 1991. Since 1991, the number of dairy operations decreased by 58.4 percent, while January 1 milk cow numbers in 2007 were at 93.8 percent of 1992 numbers. In this time frame, milk per cow increased by 32.7 percent and total milk production increased by 23.1 percent.
- From 1991 through 2006, milk prices paid to producers ranged from a low of $11.00 per hundred pounds of milk from March through June 2003 to a high of $19.30 in May of 2004. On average, milk prices during this time were between $13.00 and $14.00.

Changes by State

- States in the Western United States have shown the largest growth in the number of milk cows since 1992. Arizona, California, Colorado, Idaho, Kansas, Nevada, New Mexico, Oregon, and Utah have all increased cow numbers since 1992. States in the Southeast, including Alabama, Arkansas, Louisiana, and Mississippi, had the largest percentage decline in dairy cows, but these States represented less than 5 percent of the overall dairy population. In 2007, California had the largest number of dairy cows (1.79 million) followed by Wisconsin (1.25 million) and New York (628,000).
- With the exception of Alaska, the number of dairy operations in all States has decreased since 1991. In 2006, Wisconsin had the largest number of dairy operations (14,900) followed by Pennsylvania (8,700) and New York (6,400). California reported 2,300 operations, but had the highest number of dairy cows, demonstrating a large number of cows per herd.
- Average dairy herd sizes in 2006 ranged from 20 cows in Alaska to 875 in Arizona. The U.S. average dairy herd size in 2006 was 121.5 cows, more than double the average in 1991 (53.9 cows).

Productivity

- In 2007, the average days dry at the operation level and cow level was 57.8 and 58.5 days, respectively. These averages represent a decrease of about 3 days since 1991.
- The practice of separating newborn heifer calves from their dams immediately after birth doubled from 1991 to 2007 (28.0 and 55.9 percent of operations, respectively).

Heifer management

- Operations provided calves approximately the same amount of colostrum during the first 24 hours of life from 1991 to 2007, with approximately one-quarter of operations feeding 2 quarts or less and about one-third feeding 4 or more quarts.
- The age of heifers at weaning has remained relatively steady since 1996.
- Operation use of specific preventive practices for heifers has remained stable or increased since 1991. The largest increases in the use of preventive practices were observed for vitamins A-D-E in feed and selenium in feed (figure 1).

*California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Virginia, Wisconsin, and Washington

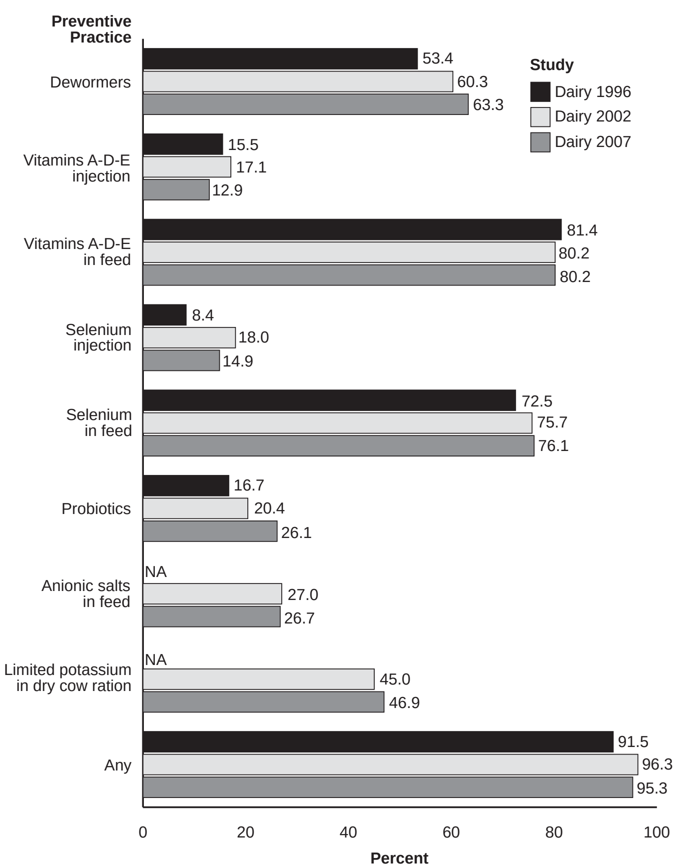
Heifer health

- The number of calves born alive as a percentage of cow inventory decreased from 93.4 percent in 1996 to 86.0 percent in 2007.
- The percentages of unweaned and weaned heifer calves that died decreased from 1996 to 2007. The percentage of unweaned calves that died decreased from 10.5 percent in 2002 to 7.8 percent in 2007. Weaned heifer calf deaths increased from 2.2 percent in 1991 to 2.8 percent in 2002 and then decreased to 1.8 percent in 2007.

Cow management

- The percentage of operations that used a parlor as a primary milking facility increased from 28.8 percent in 1996 to 39.5 percent in 2007, while the percentage of operations that used a tiestall or stanchion decreased from 69.5 to 60.3 percent during the same period. A larger shift was observed in the percentage of cows, as 54.9 percent of cows were milked in parlors in 1996 compared with 78.2 percent in 2007.
- Since 1996, the use of dewormers, selenium injections, and probiotics increased while vitamin A-D-E injections decreased. In 2007, 95.3 percent of operations administered any preventive compared with 91.5 percent in 1996 (figure 1).

Figure 1. Percentage of Operations by Preventive Practices Normally Used for Cows



Cow health

- The percentage of cows with clinical mastitis, lameness, respiratory problems, infertility problems, or displaced abomasum increased from 1996 to 2007. The percentage of cows with diarrhea for more than 48 hours or milk fever decreased from 1996 to 2007.
- The percentage of cows that died increased across herd sizes from 1996 to 2007. The overall percentage of cows that died increased from 3.8 percent in 1996 to 5.7 percent in 2007.
- The percentage of cow deaths due to lameness or injury increased from 12.7 percent in 1996 to 20.0 percent in 2007. Conversely, the percentage of cow deaths due to calving problems and other known reasons decreased from 1996 to 2007.

Biosecurity

- No changes occurred from 1996 to 2007 in the percentage of operations that vaccinated new additions for BVD, IBR, and leptospirosis before the cattle were brought onto the operation. Approximately one-third to one-half of operations vaccinated for the diseases mentioned above. The percentages of operations that vaccinated for brucellosis decreased for each herd size from 1996 to 2007.
- Brucellosis testing for new additions decreased across herd sizes between 1996 and 2007. Tuberculosis testing has also decreased for small, large, and all operations since 1996. Testing for *Mycobacterium avium* subspecies *paratuberculosis* and BVD remained unchanged from 1996 to 2007. The percentage of operations that performed any testing decreased for small, large, and all operations since 1996, with less than 1 in 4 operations that purchased new additions (23.3 percent) performing any testing during 2007.

Visit the NAHMS Web site at: http://nahms.aphis.usda.gov for a complete copy of Part II: Changes in the U.S. Dairy Industry, 1991-2007.

For more information, contact:
USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Highlights of Dairy 2007 Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007

In 2007, the National Animal Health Monitoring System (NAHMS) conducted a study of U.S. Dairy Operations. The Dairy 2007 study collected data on dairy health and management practices from 17 of the Nation's major dairy States.[1] These States represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows.

The following highlights were excerpted from the report released in September 2008: Part III: Reference of Dairy Cattle Health and Management Practices in the United States, 2007.

Disease familiarity and biosecurity practices

- Almost half of producers (49.3 percent) knew some basics about foot-and-mouth disease, while an additional 8.9 percent were fairly knowledgeable about the disease. More than 8 of 10 producers (80.4 percent) knew some basics or were fairly knowledgeable about bovine spongiform encephalopathy (BSE). Almost 60 percent of producers (57.9 percent) were fairly knowledgeable about Johne's disease, while an additional 36.2 percent knew some basics about the disease. Additionally, more then 50 percent of producers at least knew some basics about *Mycoplasma* mastitis, bovine viral diarrhea, and *Leptospira hardjo bovis*.
- Almost all operations (93.6 percent) would very likely use a private veterinarian for information regarding a foreign animal disease outbreak in the United States.
- Most operations (98.6 percent) would contact a private veterinarian if an animal on their operation was suspected of having foot-and-mouth disease or another foreign animal disease (table 1).

Table 1. Percentage of Operations that Would Contact the Following Resources if an Animal on the Operation was Suspected of Having Foot-and-Mouth Disease or Another Foreign Animal Disease

Resource	Percent Operations
Extension agent/university	20.8
State Veterinarian's office	35.7
USDA	21.8
Private veterinarian	98.6
Feed company or milk cooperative representative	25.7
Other	4.1

- About one of three operations (30.4 percent) had guidelines regarding which visitors were allowed in animal areas, and 51.3 percent of operations had restrictions on vehicles entering animal areas. A lower percentage of small operations (22.7 percent) provided disposable or clean boots for visitors entering animal areas compared with medium operations (42.1 percent).
- Approximately the same percentages of operations (one-third) routinely, rarely, or never used the same equipment for manure and feed, and no differences were observed across herd sizes.
- Almost one in three operations (31.7 percent) participated in some type of Johne's disease control program. A higher percentage of medium operations (24.7 percent) had a unique Johne's disease program developed specifically for the operation compared with small operations (12.1 percent).
- The majority of operations (70.0 percent) used a multiple-animal calving area/pen. A lower percentage of small operations (65.6 percent) used a multiple-animal calving area compared with medium operations (79.8 percent). Approximately one-quarter of operations used an individual calving area that was either cleaned between each calving or cleaned after two or more calvings (25.5 and 26.2 percent, respectively).

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[1]**States**
California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Virginia, Washington, and Wisconsin.

Herd size (Number of Cows)
Small (Fewer than 100)
Medium (100-499)
Large (500 or More)

Source of replacements

- Approximately one-third of the dairy cow inventory (36.2 percent) was replaced (primarily by heifers that calved) during the previous 12 months.
- Almost 9 of 10 operations (88.0 percent) had cow replacements enter the milking herd that were born and raised on the operation. Off-site heifer raising of cow replacements was practiced by 13.9 percent of all operations and was highest for large operations (50.9 percent). Cow replacements were purchased directly from other dairies by 15.3 percent of operations. Purchasing cow replacements from auction markets was practiced by 7.0 percent of operations.

Disease confirmation

- More than one of five operations (22.7 percent) reported that Johne's disease was confirmed via laboratory testing during the previous 12 months.
- Across herd sizes, approximately 30 percent of operations reported that 2 percent or less of cows aborted (as a percentage of cow inventory).
- For operations that had any abortions, approximately one of eight operations (12.4 percent) submitted samples to a diagnostic laboratory to determine the cause of abortion. For operations that submitted samples, 70.2 percent submitted serum from the dam and 32.7 percent submitted the placenta (table 2).

Table 2. For Operations that Submitted Samples to Determine Cause of Abortion, Percentage of Operations by Type of Sample

Sample Type	Percent Operations
Placenta	32.7
Entire fetus	53.8
Serum of dam	70.2
Other	4.0

- The majority of operations that had any abortions but did not submit samples for diagnosis (69.6 percent) did not perceive abortion as a problem on their operation.

General management

- Operations most frequently allowed lactating cows access to pasture (50.9 percent of operations) during summer. In winter, the highest percentages of operations allowed lactating cows access to a concrete alley way or pen, dry lot, or allowed no outside access (35.0 and 28.9, and 25.2 percent, respectively) [table 3].

Table 3. Percentage of Operations by Primary Outside Area that *Lactating* Cows had Routine Access to During Summer and Winter

	Percent Operations	
	Summer	Winter
Primary Outside Area	Percent	Percent
Pasture	50.9	9.4
Concrete alleyway or pen	12.8	35.0
Dry lot	20.8	28.9
Other	2.4	1.5
None	13.1	25.2
Total	100.0	100.0

- During summer, 39.5 percent of lactating cows were on operations in which the primary outside area was a dry lot, 22.3 percent were on operations in which the primary outside area was pasture, and 19.0 percent were on operations with no outside access. In winter, similar percentages of lactating cows were on operations in which primary outside access was a concrete alleyway or pen, dry lot, or allowed no outside access (32.3, 32.7, and 29.7 percent, respectively).
- On approximately half of operations (51.1 percent), flooring for lactating cows was predominately concrete, representing 55.6 percent of cows. Pasture was the predominate flooring on 10.1 percent of operations but only 5.1 percent of cows. Dirt was the predominate flooring on 5.4 percent of operations, representing 20.0 percent of cows, which probably reflects the use of dry lots on large operations.
- The ground or flooring surface for lactating cows was usually dry on 60.3 percent of operations during summer and 49.5 percent in winter. Lactating cows usually stood in water or slurry on less than 1 percent of operations (0.6 percent).
- Approximately 8 of 10 large and medium operations (83.2 and 81.9 and percent, respectively) housed cows in freestalls, compared with about 3 of 10 small operations (27.2 percent). For operations that used freestall barns, two-row freestall barns were the predominate setup for small and large freestall operations (48.1 and 49.5 percent, respectively). The percentage of operations with six-row barns increased as herd size increased.
- For lactating cows in the summer, fans were the most common method of heat abatement provided on small and medium operations (74.3 and 77.7 of operations, respectively), while a similar percentage of large operations provided shade, sprinklers or misters, or fans (55.6, 61.6, and 61.0 percent, respectively). Overall, 94.0 percent of operations provided some form of heat abatement for lactating cows.

- For lactating cows, straw and/or hay were used on 54.1 percent of operations, representing 33.4 percent of cows. Sawdust/wood products and rubber mats were used on similar percentages of operations (35.0 and 30.2 percent, respectively), although sawdust/wood products were used for a higher percentage of cows (31.2 percent) than were rubber mats (18.5 percent). Sand was used on 21.9 percent of operations and for 30.3 percent of cows.
- For dry cows, straw and/or hay was used as bedding by more than 6 of 10 operations (62.2 percent), representing 47.2 percent of cows. Most operations (92.5 percent) provided bedding to dry cows, and most dry cows (92.7 percent) had access to bedding.
- The majority of small and medium operations fed all lactating cows the same ration (65.6 and 62.2 percent of operations, respectively), while large operations most frequently fed individuals or groups based on production or stage of lactation (70.5 percent of operations).
- The most common feedline for small operations was a tie stall (46.2 percent of operations) while post and rail was the single most common on medium operations (37.1 percent of operations). The majority of large operations (79.6 percent) used headlocks at the feedline (table 4).

Table 4. Percentage of Operations by Feedline Used for the Majority of Lactating Cows, and by Herd Size

	Percent Operations			
	Herd Size (Number of Cows)			
	Small (Fewer than 100)	**Medium** (100-499)	**Large** (500 or More)	**All Ops.**
Feedline	**Pct.**	**Pct.**	**Pct.**	**Pct.**
Tie stall	46.2	9.2	0.0	34.1
Stanchion	14.2	3.9	0.0	10.7
Post and rail	11.3	37.1	15.7	18.0
Headlocks	3.8	22.2	79.6	13.2
Elevated feed bunk in pen	17.8	20.3	0.1	17.3
Other	6.7	7.3	4.6	6.7
Total	100.0	100.0	100.0	100.0

- The percentage of operations that separated close-up cows increased as herd size increased; 57.1 percent of all operations separated close-up cows from other dry cows.
- The most common water source across all operation sizes was a water tank or trough (93.2 percent of operations).
- About one of three operations cleaned single cup/bowl for one cow or water tank/trough 13 or more times per year. No cleaning was reported on 14.2 percent of operations using a single cup/bowl for one cow, 24.2 percent of operations using single cup/bowl for multiple cows, and 4.6 percent of operations using a water tank/trough.
- Excluding those that died, one of four cows (25.8 percent) was permanently removed from dairy operations during the previous 12 months. There were no differences across herd sizes in the percentages of cows removed.
- The majority of operations that permanently removed cows (87.8 percent) sent cows to a market, auction, or stockyard.

Milk quality and milking procedures

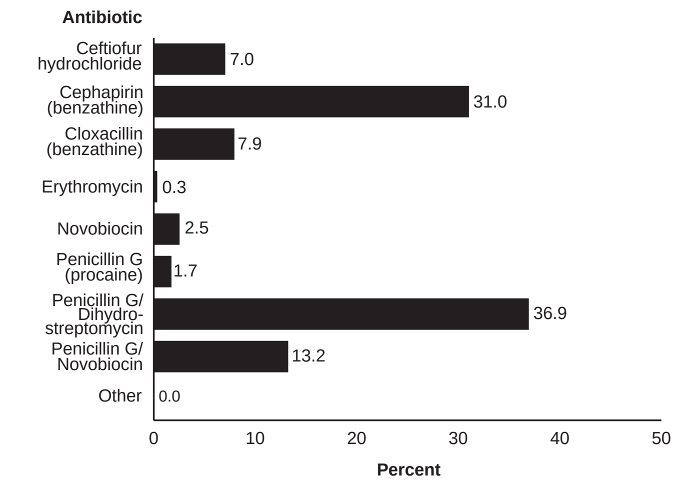
- Almost 9 of 10 operations (89.6 percent) reported an average BTSCC below 400,000 cells/ml, and 70.9 percent reported less than 300,000 cells/ml. Herd-size differences were minimal, with a lower percentage of medium operations having a BTSCC of less than 100,000 cells/ml compared to small and large operations.
- The percentage of owners/operators that milked the majority of cows decreased from 74.8 percent for small operations to 0.0 percent of large operations. Family members milked the majority of cows on 17.4 percent of small operations and 14.3 percent of medium operations. No large operations reported family members performing the majority of milking.
- More than 9 of 10 operations (91.8 percent) milked fresh cows twice daily, while less than 1 of 10 (6.2 percent) milked fresh cows 3 times daily.
- The majority of operations (92.5 percent) milked cows (other than fresh cows) twice daily.
- Nearly all operations (92.6 percent) forestripped at least some cows, and approximately one of four of these operations (27.4 percent) forestripped cows prior to teat disinfection.
- The majority of operations (about 60 percent) used iodophor compounds as predips in both summer and winter. Chlorhexidine was the next most common predip used by about 1 of 10 operations. There were no differences in summer or winter in the percentages of operations by compound used.
- Single-use paper or cloth towels were used to dry teats prior to milking on the majority of operations during summer and winter.
- The majority of operations (approximately 70 percent) used an iodophor compound as a postdip disinfectant. Chlorhexidine was used by about 13 percent of operations.
- A higher percentage of medium and large operations (76.9 and 89.5 percent, respectively) used automatic takeoffs compared with small operations (30.2 percent).
- Approximately half of operations (55.2 percent) reported milkers wore latex or nitrile gloves to milk all cows.
- More than half of all operations (52.9 percent) performed milk cultures during the previous 12 months.

- Almost 1 of 10 operations (9.9 percent) did not use any dry-cow treatment, and a percentage of these were likely organic operations where the use of antibiotics is not allowed. Some, but not all cows, were treated on 17.8 percent of operations, and all cows were treated on 72.3 percent of operations. More than 4 of 5 cows (81.7 percent) were treated at dry-off, while 5.9 percent were not treated.

Antibiotic use

- The most commonly used dry-cow antibiotics were cephapirin (31.0 percent of cows) and penicillin G (procaine)/dihydrostreptomycin (36.9 percent of cows) [see figure, below].

For Cows Treated with Dry-Cow Intramammary Antibiotics During the Previous 12 Months, Percentage of Cows Treated, by Type of Antibiotic



- Almost one of four unweaned heifers had diarrhea during the previous 12 months (23.9 percent), and 17.9 percent of all unweaned heifers were treated for diarrhea. A lower percentage of unweaned heifers had respiratory disease (12.4 percent), and 11.4 percent of heifers were treated for respiratory disease.
- More than half of operations (50.9 percent) used antibiotics in rations for weaned heifers, including 32.7 percent that used only ionophores.
- Only 5.9 percent of weaned heifers were affected with respiratory disease, and 5.5 percent of all weaned heifers were treated with antibiotics.
- Mastitis was the disease that affected the highest percentage of cows (18.2 percent), and, not surprisingly, the highest percentage of cows were treated for mastitis (16.4 percent). Lameness and reproductive diseases affected 12.5 and 10.0 percent of cows, respectively, and 7.1 and 7.4 percent of all cows were treated for lameness and reproductive diseases, respectively.

Visit the NAHMS Web site at: http://nahms.aphis.usda.gov for a complete copy of Part II: Changes in the U.S. Dairy Industry, 1991-2007.

For more information, contact:
USDA–APHIS–VS–CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Highlights of Dairy 2007 Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007

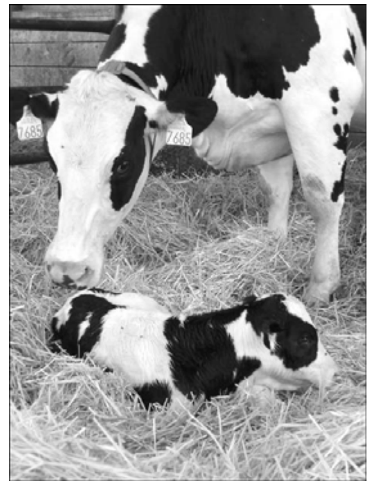


Photo courtesy of Dr. Jason Lombard

In 2007, the National Animal Health Monitoring System (NAHMS) conducted a study of U.S. dairy operations. The Dairy 2007 study collected data on dairy health and management practices from 17 of the Nation's major dairy States.* These States represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. The operations were divided into 3 herd-size categories based on the number of milk cows present: small (fewer than 100 cows), medium (100 to 499 cows), and large (500 or more cows).

The following highlights were excerpted from the report Dairy 2007 Part IV: Reference of Dairy Cattle Health and Management Practices in the United States, 2007, released in February 2009.

Reproduction

- The operation average voluntary waiting period was 54.8 days. The length of the voluntary waiting period did not differ by herd size.
- The most common method used to detect estrus on operations during the previous 12 months was visual observation, with 93.0 percent of all operations using this practice.
- For operations with a set number of times per day to observe cows for estrus, the operation average number of minutes per day that cows were observed was 62.5 minutes.
- More than one-half of operations used artificial insemination (AI) to natural estrus for first service for the majority of heifers and cows (57.1 and 54.7 percent, respectively) during the previous 12 months.
- More than one-half of operations (57.6 percent) used timed-AI programs for at least some cows during the previous 12 months and about one-fourth (25.4 percent) used timed-AI programs for at least some heifers.
- Approximately one-third of operations (32.4 percent) used a controlled internal drug release insert during the previous 12 months.
- More than one-half of operations (54.9 percent) had cattle pregnancies conceived through natural service (bull breeding). Almost 9 of 10 operations (88.4 percent) had pregnancies conceived via AI, and about 1 of 10 operations (9.9 percent) had pregnancies via embryo transfer. A higher percentage of large operations (71.8 percent) used natural service compared with small operations (51.2 percent).
- On average, 72.5 percent of pregnancies were conceived by AI—either after detected estrus or timed—during the previous 12 months.
- On operations with any pregnancies conceived through AI during the previous 12 months, the owner/operator performed the majority of AI services on 51.0 percent of operations, while an AI service/technician performed the majority of these services on 40.7 percent of operations.
- Almost 9 of 10 operations (89.5 percent) used a private veterinarian to perform the majority of pregnancy exams during the previous 12 months.

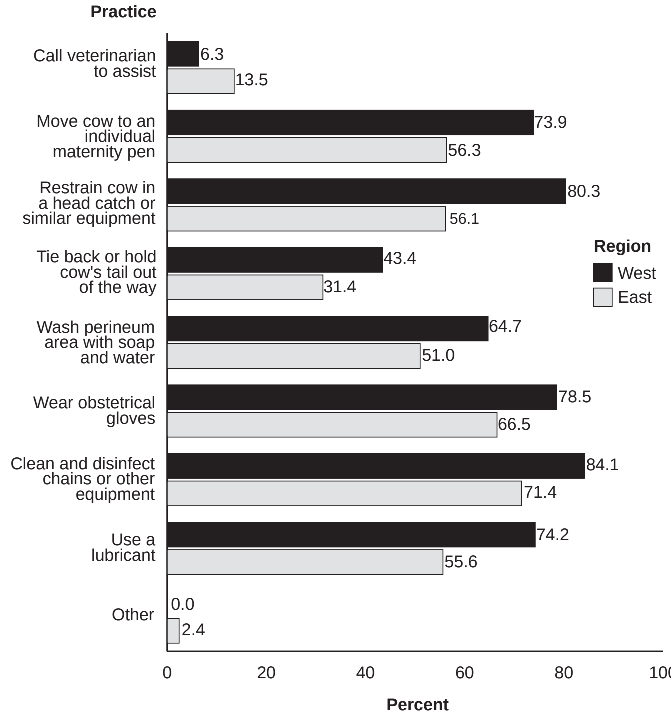
* **States/Regions:**
- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

- The majority of operations (85.7 percent) routinely used rectal palpation to perform pregnancy exams. More than one-fourth of operations (27.4 percent) routinely used ultrasound to determine pregnancy status.

Calving practices

- Approximately 6 of 10 operations had guidelines on when to intervene during calving for heifers (60.7 percent), cows (60.5 percent), or both (60.5 percent).
- Females close to calving were observed more frequently during the day than at night. About one-half of operations (47.2 percent) allowed less than 3 hours, on average, to pass between observations during the day, with 17.6 percent of operations allowing 5 hours or more between observation periods. During the night, 18.7 percent of operations allowed less than 3 hours to pass between observations, and 53.9 percent of operations let 5 hours or more pass between observation periods.
- The majority of operations (63.1 percent for heifers and 61.9 percent for cows) reported that they would examine or assist an animal before 5 hours elapsed if she shows signs of stage 1 labor without subsequent straining.
- A higher percentage of operations in the West region than in the East region would generally move the cow to an individual maternity pen (73.9 and 56.3 percent, respectively), restrain the cow in a head catch or similar equipment (80.3 and 56.1 percent, respectively), or use a lubricant (74.2 and 55.6 percent, respectively) [figure 1].
- Overall, 8.1 percent of calves were stillborn during the previous 12 months, with no difference in percentage of stillbirths by herd size.
- On 80.7 percent of operations, a calf that experienced a difficult birth would receive nostril stimulation to initiate breathing. Hanging the calf upside down would be performed on 66.3 percent of operations. Three of the practices that are simple to perform and do not require special equipment or materials—positioning the calf on its sternum, drying the calf manually with towels or a hair dryer, and trying to elicit a suckle response—were performed by at least one-half of operations.

Figure 1. Percentage of Operations by Practice Generally Implemented Once a Decision is Made to Intervene in Calving, by Region



Surgical procedures

- Overall, 94.0 percent of operations routinely dehorned heifer calves during the previous 12 months, and 17.7 percent of these operations used analgesics or anesthetics during the dehorning procedure.
- For operations that routinely dehorned heifer calves, more than two-thirds (69.1 percent) used a hot iron; 28.2 percent used a tube, spoon, or gouge; and 16.3 percent used saws, wire, or Barnes dehorners.
- The majority of heifer calves on operations that routinely dehorned calves were dehorned by hot iron (67.5 percent of calves) at an average age of 7.6 weeks.
- About one-half of operations (50.3 percent) routinely removed extra teats from heifer calves.
- Almost one-half of operations (48.6 percent) had one or more tail-docked cows. A higher percentage of operations in the West region (81.3 percent) had no tail-docked cows than in the East region (48.5 percent of operations).
- The majority of operations that had tail-docked cows most commonly used a band to dock tails (87.2 percent); these operations represented 90.4 percent of tail-docked cows.

- About two-fifths of operations (40.5 percent) routinely castrated bull calves.
- Bands were used most commonly to castrate calves on 60.8 percent of operations, with 26.9 percent of operations using a knife and 12.2 percent using a burdizzo.

Hoof health

- Approximately 1 of 10 bred heifers (11.4 percent) and 1 of 4 cows (23.9 percent) were lame at least once during the previous 12 months.
- About 3 of 10 operations (28.7 percent) had at least 1 case of digital dermatitis in bred heifers while 70.2 percent of operations had at least 1 case in cows.
- Of the 38.9 percent of operations that used footbaths, 20.3 percent of operations used a footbath throughout the year.
- For operations that used footbaths, the majority (66.6 percent) used copper sulfate most commonly as the footbath medication; these operations accounted for the majority of cows (63.6 percent).
- More than 80 percent of operations performed at least some hoof trimming, with a higher percentage of large operations and medium operations (99.4 and 95.6 percent, respectively) performing some trimming than small operations (79.4 percent).
- The majority of cows (80.1 percent) were on operations where cows' hooves were trimmed by a professional hoof trimmer during the previous 12 months.

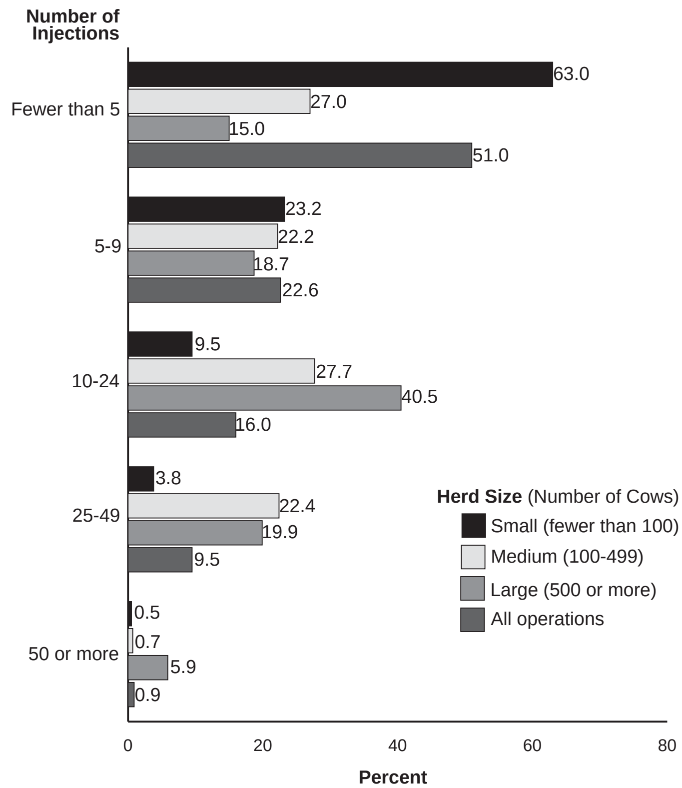
Hemorrhagic bowel syndrome (HBS)

- Overall, one-fifth of operations (19.7 percent) had at least one cow with signs of HBS on the operation during the previous 5 years.
- Almost one-third of operations that had cows with signs consistent with HBS during the previous 5 years (31.1 percent) had implemented preventive measures during that time specifically to reduce or eliminate HBS.

Treatment practices

- The operation average number of injections typically received by a cow was 13.8, or an average of slightly more than 1 injection per month.
- The number of injections a cow received increased with herd size; 63.0 percent of small operations gave fewer than five injections, compared with 27.0 percent of medium operations and 15.0 percent of large operations (figure 2).

Figure 2. Percentage of Operations by Number of Injections a Cow Typically Received During the Previous 12 Months, and by Herd Size

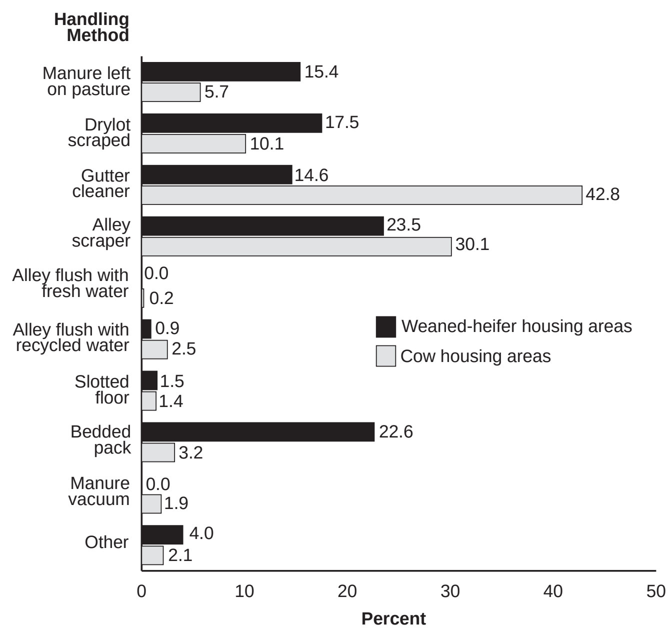


- Almost all operations (97.4 percent) administered intramuscular (IM) injections during the previous 12 months. Subcutaneous and intravenous injections were administered on 69.1 and 70.3 percent of operations, respectively.
- The primary locations for IM injections were hind leg (45.3 percent) and neck (34.2 percent).
- About one of seven operations (13.6 percent) used a new needle for every injection during the previous 12 months; these operations represented 9.8 percent of all cows.
- About three-fifths of operations (58.2 percent) reported keeping a written or computerized record for each cow that received a treatment requiring a withdrawal time.

Nutrient management

- Of the 92.3 percent of operations that housed weaned heifers, about one-third housed the heifers primarily in a multiple-animal inside area (34.6 percent), while one-fourth housed weaned heifers in a drylot/multiple-animal outside area (22.9 percent).
- Almost one-half of operations (49.2 percent) housed lactating cows primarily in a tie stall/stanchion facility. About one of three operations (32.6 percent) housed cows in freestalls.
- About one-fourth of operations (23.5 percent) used an alley scraper to handle the majority of manure in weaned-heifer housing areas, while 22.6 percent of operations used bedded pack (manure pack), 17.5 percent scraped the drylot, 15.4 percent left manure on pasture, and 14.6 percent used a gutter cleaner.
- In areas used to house cows, more than two-fifths of operations (42.8 percent) used a gutter cleaner to handle the majority of manure, while 30.1 percent used an alley scraper (figure 3).

Figure 3. Percentage of Operations by Method Used to Handle the Majority of Manure in Weaned-heifer* and Cow Housing Areas



*For operations that housed weaned heifers.

- Almost all operations applied manure—solid or liquid or both—to land either owned or rented (99.1 percent).
- More than 9 of 10 operations (91.5 percent) used a broadcast/solid spreader to apply manure to land.
- About one-fourth of operations analyzed manure for nitrogen, phosphorus, or potassium during the previous 12 months.
- Operations spread liquid or slurry manure more often during spring or fall than summer or winter; operations also spread solid manure more commonly in spring or fall than summer or winter.
- About one-half of operations (52.2 percent) applied manure to pasture or hay crops during the growing season.
- Of the operations that had a written nutrient management plan, 9 of 10 operations (89.2 percent) developed the plan in cooperation with the USDA Natural Resource Conservation Service or a local conservation district.

For more information, contact:

USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Highlights of Dairy 2007 Part V: Changes in Dairy Cattle Health and Management Practices in the United States, 1996–2007

In 2007, the National Animal Health Monitoring System (NAHMS) conducted a study of U.S. dairy operations. The Dairy 2007 study collected data on dairy health and management practices from 17 of the Nation's major dairy States.* These States represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. The operations were divided into 3 herd-size categories based on the number of milk cows present: small (fewer than 100 cows), medium (100 to 499 cows), and large (500 or more cows).

The following highlights were excerpted from the report Dairy 2007 Part V: Changes in Dairy Cattle Health and Management Practices in the United States, 2007. Released in July 2009, Part V identifies changes in the dairy industry from 1996 to 2007, and specifically addresses changes identified from three NAHMS dairy studies: Dairy 1996, Dairy 2002, and Dairy 2007.

Disease familiarity and biosecurity practices

- The percentage of operations fairly knowledgeable about Johne's disease, *Mycoplasma* mastitis, and HBS increased from 2002 to 2007. However, the majority of producers were unfamiliar with heartwater, screwworm, bluetongue, vesicular stomatitis, and hemorrhagic bowel syndrome
- Most producers in 2002 and 2007 indicated they would contact their private veterinarian for disease information if a foreign animal disease outbreak occurred in the United States.
- Almost all producers in 2002 and 2007 (97.9 and 98.6 percent, respectively) would contact their private veterinarian if they suspected that an animal on their operation had a foreign animal disease.
- The percentage of operations that had employees increased from 47.2 percent in 2002 to 75.7 percent in 2007. The percentage of small operations with employees doubled from 32.2 percent in 2002 to 65.6 percent in 2007.
- The majority of operations maintained a closed herd during 2002 and 2007. Nearly one-half of all operations limited cattle contact with other livestock, elk, and deer, and controlled access to feed by other livestock and wildlife, or had a closed herd.
- The percentage of operations participating in a Johne's disease control or certification program has increased for each herd size category and for all operations since 1996. Less than 1 percent of operations participated in a Johne's disease control or certification program in 1996 compared with 11.2 percent in 2002 and 31.7 percent in 2007.
- The percentage of operations that tested for Johne's disease increased across herd sizes from 1996 to 2002 and for all operations from 1996 to 2007; 13.1 percent of operations tested for Johne's in 1996, 25.7 percent tested in 2002, and 35.3 percent tested in 2007.

General management

- Overall, the percentage of operations that used concrete as the predominate flooring type for cattle decreased from 85.8 percent in 2007 to 51.1 percent in 2007.
- The use of any milk urea nitrogen testing increased from 22.3 percent of operations in 2002 to 49.8 percent in 2007.

Milk quality and milking procedures

- The percentage of operations that forestripped all cows increased from 44.5 percent in 2002 to 58.9 percent in 2007.
- Iodophors were the predominant predip and postdip compounds used during summer and winter in 2002 and 2007.
- The percentage of operations in which milkers wore gloves to milk all cows increased from 32.9 percent in 2002 to 55.2 percent in 2007. The percentage of cows on operations in which milkers wore gloves increased from 48.7 in 2002 to 76.8 percent in 2007.
- Although there were no changes by herd size from 2002 to 2007 in the percentage of operations that used automatic takeoffs, the percentage of all operations increased from 36.0 percent in 2002 to 45.4 percent in 2007.
- In 2002 and 2007, about 4 of 10 operations vaccinated for coliform mastitis and about 1 of 10 vaccinated for *Salmonella*.

* **States**
California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Virginia, Washington, and Wisconsin

- More than 8 of 10 cows in 2002 and 2007 were on operations that dry treated 100.0 percent of cows.

Antibiotic use

- A higher percentage of preweaned heifers were affected with diarrhea or other digestive problem in 2007 (23.9 percent) compared with 2002 (15.3 percent).
- Excluding ionophores, antibiotic use in weaned heifer rations remained the same between 2002 and 2007.
- Respiratory disease was the most common disease or disorder affecting weaned heifers; however, the percentage of weaned heifers affected was less than 6 percent during 2002 and 2007.
- The percentage of cows affected with a specific disease and treated with antibiotics did not change between 2002 and 2007.
- For mastitis treatment, the percentage of operations that used cephalosporin increased from 2002 to 2007 (33.3 and 44.5 percent, respectively), while the use of noncephalosporin beta-lactam and macrolide antibiotics to treat mastitis decreased from 2002 to 2007.

Surgical procedures

- In 2007, 94.0 percent of operations still dehorned calves. The percentage of large operations that dehorned calves decreased from 88.9 percent in 1996 to 64.3 percent in 2007, which might be due to the increase in operations that have calves raised off-site.
- The use of hot iron/electric dehorners increased from 40.2 percent of operations in 1996 to 64.4 percent in 2007. In contrast, the use of tube, spoon, or gouge, and saws, wire, or Barnes dehorners decreased by about one-half in the same period.
- About one-half of operations tail-docked cows in 2002 and 2007.

Hoof health

- The percentage of operations with cases of lameness in bred heifers increased from 36.5 percent in 2002 to 58.7 percent in 2007.
- From 1996 to 2007, almost all operations had at least 1.0 percent of cows affected by lameness during the previous 12 months.
- Between 1996 and 2007, the percentage of operations that used footbaths for cows throughout the year increased from 13.6 percent to 20.3 percent.
- Hoof trimming increased from 75.9 percent of operations in 1996 to 84.8 percent in 2007.

Nutrient management

- There were no changes between 2002 and 2007 in methods used to handle the majority of manure in weaned-heifer housing or cow housing areas. In weaned-heifer housing, more than 9 percent of operations left manure on pasture, scraped the drylot, used a gutter cleaner, alley scraper, or bedded pack to handle the majority of manure. In cow-housing areas, gutter cleaners or alley scrapers were used by more than 30 percent of operations as the method or handling the majority of manure.
- The only change in the use of waste-storage or treatment systems between 2002 and 2007 was the increase in the percentage of operations that used compost (4.3 and 11.1 percent, respectively).
- Between 1996 and 2007, approximately 9 of 10 operations used a broadcast/solid spreader to apply manure to land. The percentage of operations that used surface application of liquid manure increased each study year. The percentage of operations that used subsurface application of liquid manure increased from 4.3 percent in 1996 to 8.8 percent in 2007.

For more information, contact:

USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

#561.0709

Passive Transfer Status of Heifer Calves on U.S. Dairies, 1991–2007

The U.S. Department of Agriculture's (USDA) National Animal Health Monitoring System (NAHMS) conducted the Dairy 2007 study in 17 major dairy States.[1] One objective of the study was to describe dairy calf health and nutrition from birth to weaning and to evaluate heifer disease prevention practices. As part of this objective, blood was collected from newborn heifer calves to evaluate the transfer of maternal immunity (passive transfer) to calves.

NAHMS last measured passive transfer status on U.S. dairies in 1991–92 during the National Dairy Heifer Evaluation Project (NDHEP), which was conducted in 28 States.[2] This information sheet compares findings on passive transfer as reported in the NDHEP 1991–92 study and the Dairy 2007 study.

Importance of colostrum

Since maternal antibodies (immunoglobulins) do not cross the placenta, calves are born without adequate immunity. Calves receive these critical antibodies by ingesting and absorbing immunoglobulin-rich colostrum (predominantly immunoglobulin G [IgG]) from their dams, a process known as passive transfer of immunity. An example of the importance of colostrum to newborn calves can be found in the NDHEP study, which found that 22.0 percent of total calf deaths in 1991–92 might have been avoided if the animals had received adequate colostrum.

Four attributes of colostrum management that increase the probability that calves will acquire adequate levels of antibodies have been proposed:

1. **Quality—**Quality colostrum has an IgG concentration of at least 50 g/L.
2. **Quantity—**Calves should receive a minimum of 100 g of IgG and ideally 150 g. To account for variability in colostrum quality, a minimum of 4 quarts (3.8 L) of colostrum is recommended.
3. **Quickness—**Colostrum should be fed as soon as possible following birth as practical, preferably within 1 to 2 hours.
4. **Cleanliness—**Proper hygiene should be used when collecting and handling colostrum to decrease bacterial contamination, which may cause disease in calves. In addition, if colostrum is not fed within 1 to 2 hours of collection, it should be refrigerated or frozen.

Sample collection

For the NDHEP 1991–92 study, blood samples were collected from 2,177 heifer calves aged 24 to 48 hours to determine IgG concentration. For the Dairy 2007 study, blood samples were collected from 1,816 heifer calves aged 1 to 7 days to determine IgG concentration. For the NDHEP 1991–92 study, calves were sampled whether or not they had received colostrum. For the Dairy 2007 study, only healthy calves that had received colostrum were sampled.

Passive transfer estimates

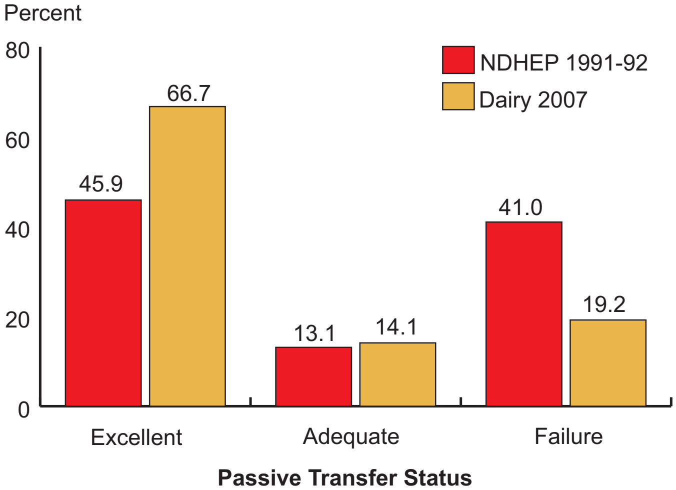
Although the level at which serum IgG provides adequate protection to calves varies by management situation (nutritional status, exposure to pathogens, etc.), a serum IgG concentration of 1,000 mg/dL is the minimum recommended. A calf's passive transfer status is excellent if its serum IgG level is 1,500 mg/dL or more and adequate if its serum IgG level is 1,000 to 1,499 mg/dL. A calf has failure of passive transfer if its serum IgG level is below 1,000 mg/dL.

In the NDHEP 1991–92 study, 45.9 percent of tested heifer calves had excellent passive transfer; 13.1 percent had adequate passive transfer; and 41.0 percent had failure of passive transfer. In the Dairy 2007 study, 66.7 percent of heifer calves had excellent passive transfer; 14.1 percent had adequate passive transfer; and 19.2 percent had failure of passive transfer (figure 1).

[1]California, Idaho, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New Mexico, New York, Ohio, Pennsylvania, Texas, Vermont, Virginia, Washington, and Wisconsin.

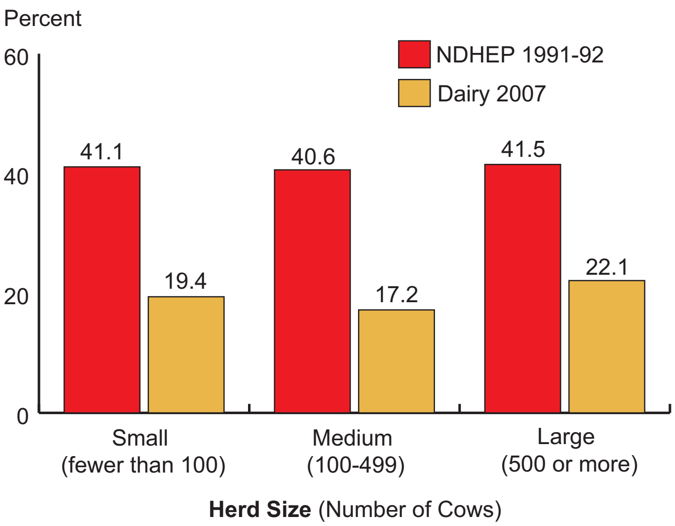
[2]Alabama, California, Colorado, Connecticut, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, Nebraska, New Hampshire, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, Tennessee, Vermont, Virginia, Washington, and Wisconsin.

Figure 1. Percentage of Heifer Calves by Passive Transfer Status



The percentage of heifer calves with failure of passive transfer decreased substantially across all herd sizes from 1991 to 2007 but did not vary by herd size within each study year (figure 2).

Figure 2. Percentage of Heifer Calves with Failure of Passive Transfer, by Herd Size



Effects of nursing on passive transfer

In 2007, heifer calves that were allowed to nurse their dams were more likely to have failure of passive transfer than calves not allowed to nurse (see table). There are several possible explanations for this finding. The quantity and quality of the colostrum suckled are unknown, and calves that suckle colostrum are likely to ingest less colostrum than the recommended 4 quarts at first feeding. Additionally, the ability of calves to absorb IgG decreases with time, and some calves do not nurse quickly enough.

Percentage of Heifer Calves with Failure of Passive Transfer in 2007, by Whether or not the Calves Nursed

Percent Calves	
No Nursing	**Nursed Dam**
16.9	25.8

Summary

The percentage of calves with failure of passive transfer decreased by about one-half from 1991 to 2007. Part of this decrease may be due to the fact that only healthy calves from 1 to 7 days old that had received colostrum were tested in the Dairy 2007 study, whereas calves between 24 and 48 hours of age and any health status—regardless of colostrum intake—were eligible to participate in the NDHEP 1991–92 study. Although the age of the calf at time of sampling was not associated with failure of passive transfer in 2007, the other differences in sampling between the studies could not be adjusted for. Overall, it appears that producers have improved passive transfer status in heifer calves.

Ensuring timely and adequate intake of high-quality colostrum is an important part of getting dairy heifer calves off to a good start. Although progress has been made in the last 15 years, about one of five calves still has failure of passive transfer. Producers can refer to educational materials[3] for assistance in improving colostrum management and the transfer of maternal immunity to calves.

[3]Alliance on Management and Nutrition. "A Guide to Colostrum and Colostrum Management for Dairy Calves." 2001. Available at: http://nahms.aphis.usda.gov/dairy/bamn/BAMNColostrum.pdf Accessed 12/09.

For more information, contact:

USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Reproduction Practices on U.S. Dairy Operations, 2007

Reproduction practices on dairy operations are crucial to maintaining consistent milk production and creating replacement heifers. The goals of a reproduction program should be to have heifers at a proper weight and height for the breed and calve at about 22 to 24 months of age (age at first calving) with healthy calves.[1] Subsequently, cows should produce a healthy calf every 12 to 13 months[2] (referred to as calving interval) or longer for higher-producing cows. The current industry averages for age at first calving (25.2 months) and calving interval (13.2 months) indicate that these goals are not easily achieved.[3] To achieve reproductive goals, breeding management programs must focus on multiple aspects of growth, health, and reproduction. Heifers must be monitored for growth and bred at the proper size; postpartum diseases must be minimized; and cows must be bred at the proper time of the estrous cycle, conceive, and produce a healthy calf.

This information sheet provides baseline information about reproduction practices on U.S. dairy operations collected during the Dairy 2007 study, conducted by the National Animal Health Monitoring System (NAHMS). The study was conducted in 17 of the Nation's major dairy States,* which represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows. The operations were divided into 3 herd-size categories based on the number of milk cows present: small (fewer than 100 cows), medium (100 to 499 cows), and large (500 or more cows).

Voluntary waiting period and estrus (heat) detection methods

The time between calving and subsequent rebreeding is referred to as the voluntary waiting period (VWP). This period of time allows uterine involution, including the clearing of material and bacteria associated with parturition and return of the uterus to its prepregnancy size. Normally, uterine involution occurs within 20 to 30 days of parturition.[4] In addition, it has been reported that 20 to 30 percent of cows are not cycling at 60 days in milk.[5] Increasing the VWP may increase fertility but can also result in increased days open. The Dairy 2007 study showed that the average VWP was 54.8 days and did not differ by herd size.

Decreasing the calving interval will result in more calves and greater milk production over a cow's lifetime. Detecting estrus or heat is a first step in breeding cows and can greatly affect the calving interval. Estrus detection is important in artificial insemination programs that do not rely on timed insemination. Research has shown that the duration of estrus in dairy cows decreases as milk production increases.[6] Additionally, cows that spend a majority of time on concrete flooring are less likely to display normal estrous behavior. Methods to monitor estrus include visual observation; electronic pedometers that measure increased activity, which is typical of cows in estrus; and electronic systems such as HeatWatch®, a device glued to the tailhead that detects the pressure of a mounting animal and transmits information about mounting activity.

Data from Dairy 2007 showed that 93.0 percent of operations used visual observation to detect heat, followed by bulls (40.3 percent); tail chalk or paint (34.7 percent); and pressure devices, such as Kamar® (14.4 percent) [figure 1].

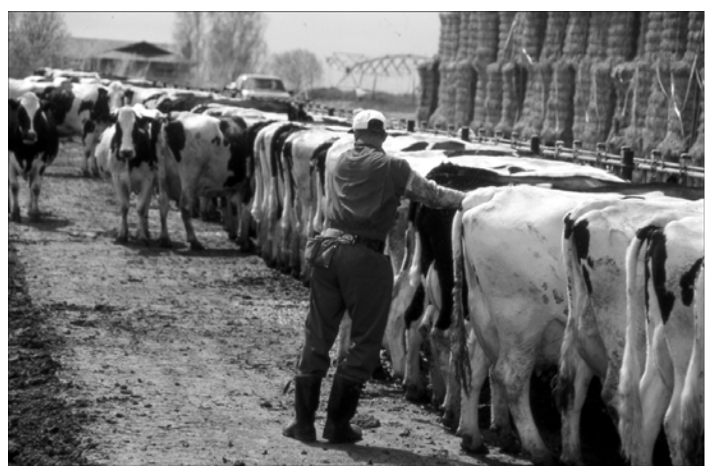
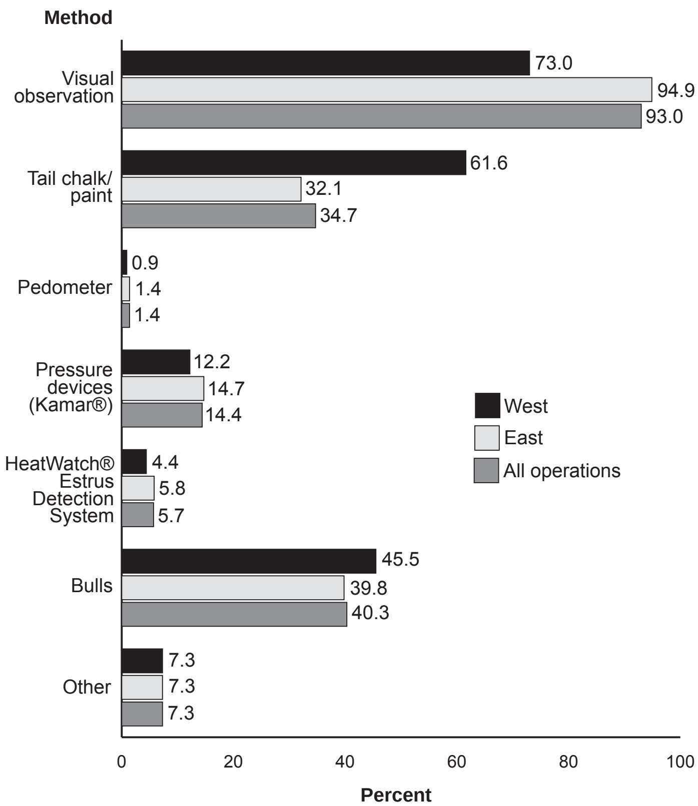


Photo courtesy of "Dairy Herd Management"/"Bovine Veterinarian"

***States/Regions:**
- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

Electronic methods for heat detection, such as pedometers and Heatwatch, were used on only 1.4 and 5.7 percent of operations, respectively. A higher percentage of operations in the East region than in the West region (94.9 and 73.0 percent, respectively) used visual observation to detect heat. Conversely, tail chalk/paint was used by a higher percentage of operations in the West region than in the East region (61.6 and 32.1 percent, respectively).

Figure 1. Percentage of Operations by Method Used to Detect Heat (Estrus) During the Previous 12 Months, and by Region



Visual detection of heat can be accomplished in two general ways: the owner or employees, while performing other tasks, can observe cows for signs of heat, or a person(s) can be designated to watch the cows at a set time every day and for a specified amount of time.

Optimally, visual detection of heat requires observation of the cows for 30 minutes twice daily. The Dairy 2007 study indicated that 59.7 percent of operations using visual observation had a person designated to detect heat; there were no differences by herd size or region. Of operations that used visual observation for heat detection, 37.9 percent had a set number of times and duration per day for observing estrus. There were no regional or herd-size differences. The operation average total time dedicated to visually detecting estrus was 62.5 minutes per day. Almost one of four operations (22.9 percent) observed for estrus for 20 minutes or fewer per day, while a similar percentage (21.0 percent) observed for 81 minutes or more.

Breeding practices

Advances in technology and increases in knowledge of cattle reproductive biology have enabled development of new methods of breeding cattle. Better understanding of dairy cattle reproduction has made it possible to induce estrus and ovulation. These two advances have enabled operations to breed cows and heifers at specific times rather than waiting for the cows to show natural estrus.[7] Presynch protocols involve the administration of prostaglandins to induce heat by lysing the corpus luteum when present, and Ovsynch protocols use prostaglandins and gonadotropin-releasing hormone (GnRH) to induce ovulation.

Artificial insemination (AI) to natural estrus was used for first-service breeding for the majority of heifers on 57.1 percent of operations and the majority of cows on 54.7 percent of operations during the previous 12 months. Natural service (use of bulls for breeding) was the second most common practice used at first service for the majority of heifers and cows (33.2 and 21.7 percent of operations, respectively). Individual timed-AI protocols, such as Ovsynch or a combination of Presynch/Ovsynch, were used for first-service breeding on the majority of females by less than 7 percent of operations and were more frequently used on cows than on heifers.

For the second or greater service, AI to natural estrus was used to breed the majority of heifers on 46.5 percent of operations and the majority of cows on 39.6 percent of operations during the previous 12 months. Bulls were used for the second or greater service for heifers on 35.1 percent of operations and for cows on 22.2 percent of operations. A higher percentage of operations used AI to induced estrus after Ovsynch or Resynch (Ovsynch's first GnRH started 1 week prior to, or at, pregnancy diagnosis, followed by prostaglandin and second GnRH injection) or timed AI for the second or greater service in cows than in heifers.

Timed-AI programs were used to manage reproduction in at least some of the heifers and/or cows by 58.2 percent of operations, and a higher percentage of operations used timed AI for cows (57.6 percent) than heifers (25.4 percent). Timed-AI programs for cows and either heifers or cows were used on a higher percentage of operations in the East region (59.9 and 60.3 percent, respectively) than the West region (34.3 and 35.6 percent, respectively). More than 6 of 10 operations (61.0 percent) had used timed AI for 5 years or more. Regarding reasons for using timed AI, the highest percentage of operations (48.8 percent) used timed AI occasionally during the previous 12 months to catch up on nonpregnant cows, and the reason timed AI was used by the second highest percentage of operations was to control all first and subsequent services (27.7 percent).

Controlled internal drug release (CIDR) inserts are progesterone-containing products that are used to synchronize estrus in cattle. About one-third of operations (32.4 percent) had used CIDR inserts during the previous 12 months. The highest percentages of operations used CIDR inserts to treat anestrous females (65.7 percent of operations), to treat cystic females (43.5 percent), and to synchronize estrus as part of a herd program (34.3 percent).

For operations with pregnancies conceived through AI during the previous 12 months, the majority of AI services were performed by the owner/operator on 51.0 percent of operations and by an AI service/technician on 40.7 percent of operations. A higher percentage of large operations (18.1 percent) had the herdsman perform AI compared with small operations (3.2 percent), while the owner/operator performed the majority of AI on a higher percentage of small and medium operations (53.2 and 52.8 percent, respectively) than large operations (19.9 percent). The person responsible for the majority of AI services was formally trained via lecture and/or laboratory exercises on almost all operations (95.9 percent).

For operations with pregnancies conceived via AI during the previous 12 months, sexed semen was used to inseminate 11.4 percent of heifers and 3.5 percent of cows. Because sexed semen costs more and contains fewer viable sperm per straw than unsexed semen, it is recommended that sexed semen be used only in heifers, which generally are more fertile than cows.

For operations with pregnancies conceived through AI during the previous 12 months, and for cows in which AI was unsuccessful, AI was attempted on a cow three to six times on 70.9 percent of operations before the cow was designated for a different strategy (e.g., moved to a bull pen, sold, etc.).

On average, 72.5 percent of pregnancies were conceived by AI—either after detected estrus or timed—during the previous 12 months (figure 2). About one-fourth of pregnancies (26.8 percent) were conceived through natural service. Embryo transfer was used on 11.5 percent of operations and accounted for 0.7 percent of pregnancies.

Pregnancy diagnosis

Pregnancy exams are important in evaluating the reproductive status of heifers and cows. The primary advantage of performing pregnancy exams is identifying animals that are not pregnant so that they can be managed for rebreeding in a short period of time.[8] Additional benefits of pregnancy exams include detection of uterine or ovarian disease, diagnosis of twins, and estimation of conception dates for animals in herds with unobserved natural service.

About two-thirds of all operations (67.0 percent) performed pregnancy exams monthly or more frequently (figure 3). The majority of large operations (75.0 percent) performed pregnancy exams weekly or every 2 weeks, while 50.2 percent of small operations performed exams on a monthly basis and 69.3 percent of medium operations performed exams once or twice a month.

For operations that had pregnancy exams performed during the previous 12 months, a private veterinarian performed the exams on 89.5 percent of operations. Nonveterinarian employees performed the exams on a higher percentage of large operations (10.3 percent) compared with small or medium operations (0.4 and

Figure 2. Operation Average Percentage of Cattle Pregnancies Conceived During the Previous 12 Months by Breeding Method, and by Herd Size

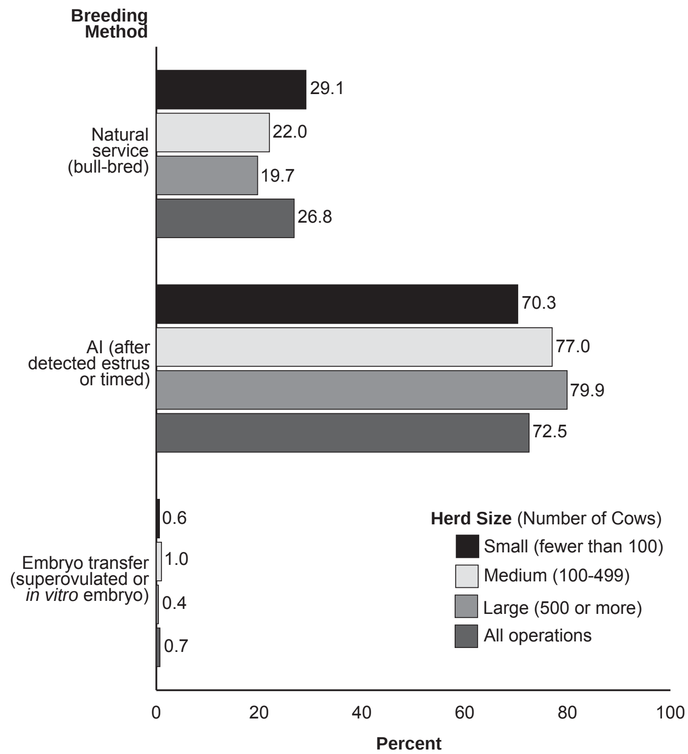
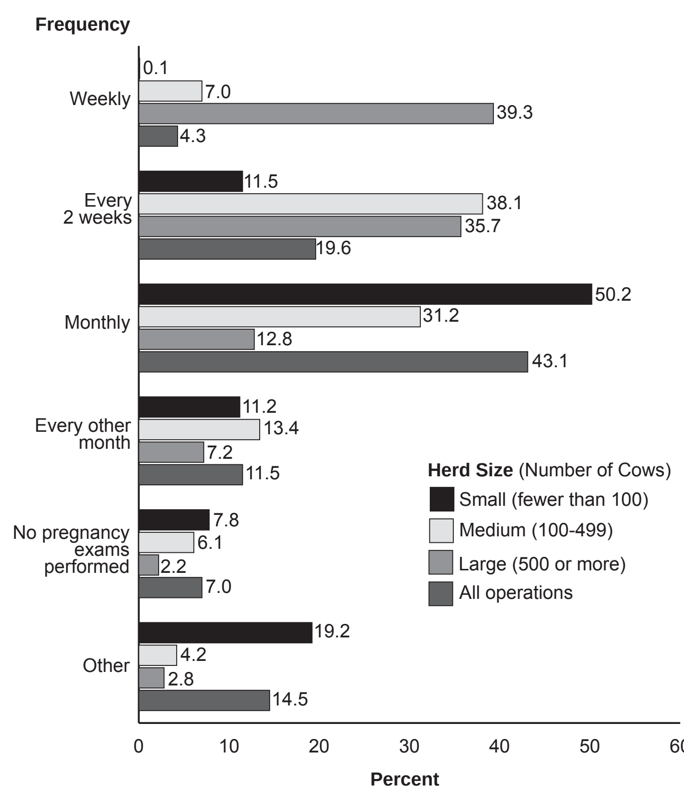


Figure 3. Percentage of Operations by Frequency with Which Pregnancy Exams Were Performed During the Previous 12 Months, and by Herd Size



0.0 percent, respectively). A higher percentage of operations in the East region than in the West region (91.5 percent and 68.6 percent, respectively) had a veterinarian perform pregnancy exams.

Rectal palpation was the method used routinely to determine pregnancy status by 85.7 percent of operations (table 1). Rectal palpation was used to detect pregnancy on 96.3 percent of operations in the West region and 84.7 percent of operations in the East region. Ultrasound was used to evaluate pregnancy status on about one-fourth of operations (27.4 percent). A higher percentage of operations in the East region than in the West region (28.6 percent and 14.0 percent, respectively) used ultrasound to detect pregnancy.

Table 1. For Operations That Had Pregnancy Exams Performed, Percentage of Operations by Method Used to Detect Pregnancy During the Previous 12 Months, and by Region:

	Percent Operations		
Method	**West**	**East**	**All Operations**
Rectal palpation	96.3	84.7	85.7
Ultrasound	14.0	28.6	27.4
Blood test	2.6	4.3	4.1

The reproductive performance of a herd is typically evaluated by use of interrelated reproductive parameters.[9] Conception rate (percentage of pregnant cows divided by percentage of cows naturally or artificially bred) and pregnancy rate (product of conception rate times heat detection rate) were the reproductive parameters that 56.9 and 52.9 percent of operations, respectively, considered to be very important in evaluating reproductive performance.

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For more information, contact:
USDA:APHIS:VS:CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

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Salmonella and *Campylobacter* on U.S. Dairy Operations, 1996–2007

Salmonella and *Campylobacter* organisms are recognized as the two most common bacterial causes of foodborne illness in humans in the United States. Each year in the United States, *Salmonella* spp. are estimated to cause 1.4 million cases of disease with 500 deaths and *Campylobacter* spp. are estimated to cause 2.5 million cases of disease with 100 deaths.[1] Both of these pathogens can cause fever, abdominal cramping, and diarrhea in humans. Severe cases can result in systemic infections and death.

Salmonella spp. also can cause disease, occasionally leading to death, in cattle. Clinical signs of salmonellosis in cattle include fever, diarrhea, anorexia, abortion, and decreased milk production.[2] Cattle can shed *Salmonella* in their feces during and after episodes of clinical disease or without showing any clinical signs.

Campylobacter data presented in this report are for *C. jejuni* and *C. coli,* which are most commonly associated with human disease. These *Campylobacter* species are not important as disease-causing organisms in cattle. In the past, foodborne transmission of *Campylobacter* to humans was attributed primarily to handling and consumption of contaminated poultry meat.[3] Molecular subtyping suggests, however, the role of nonpoultry sources of human infection is underestimated.[4]

NAHMS Dairy 2007 study

The National Animal Health Monitoring System (NAHMS) studied *Salmonella* and *Campylobacter* as part of the Dairy 2007 study. Goals of the Dairy 2007 study relating to *Salmonella* and *Campylobacter* were to

- Describe occurrence of *Salmonella* and *Campylobacter* and associated antimicrobial resistance on dairy operations in the United States, and
- Evaluate strategies for detection of *Salmonella* by comparing pooled and environmental samples with samples from individual cattle.

The Dairy 2007 study represented 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows and was conducted in 17 of the Nation's major dairy States.*

Salmonella prevalence and antimicrobial susceptibility

Prior to the Dairy 2007 study, NAHMS examined *Salmonella* occurrence in cows on dairy operations in two studies: Dairy 1996 and Dairy 2002. Table 1 presents results from these three NAHMS studies. In each study, fecal samples were collected from cows that were healthy, sick, or soon-to-be-culled at the time of sampling. The results in table 1 are limited to healthy cows because these populations were comparable across the three studies. In Dairy 1996, about 40 healthy cows were sampled on each of 90 operations (from 19 States), and in Dairy 2002, about 40 healthy cows were sampled on each of 97 operations (from 21 States). In Dairy 2007, approximately 30 healthy cows were sampled on each of 121 dairy operations (from 17 States). Samples were collected from the end of February through July for Dairy 1996, from the end of March through September for Dairy 2002, and from the end of February through August for Dairy 2007.

Table 1. Comparison of *Salmonella* Fecal-culture Results from Three NAHMS Dairy Studies[1]

	Positive for *Salmonella* / Total Sampled	
Study	**Operations[2]**	**Cows**
Dairy 1996	19/90 (21.1 percent)	198/3,640 (5.4 percent)
Dairy 2002	30/97 (30.9 percent)	259/3,645 (7.1 percent)
Dairy 2007	48/121 (39.7 percent)	523/3,804 (13.7 percent)

[1]Only cows healthy at the time of collection are included.
[2]Operations with at least one positive cow were considered positive.

For Dairy 2007, the percentage of positive operations was almost double that of Dairy 1996, and the percentage of positive cows more than doubled over the same time period. Slight differences in sampling methodology, such as the number of operations sampled, might account for some of the differences among the three studies. *Salmonella* might be becoming more common on U.S. dairies, however.

* **States/Regions**
- **West:** California, Idaho, New Mexico, Texas, and Washington
- **East:** Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

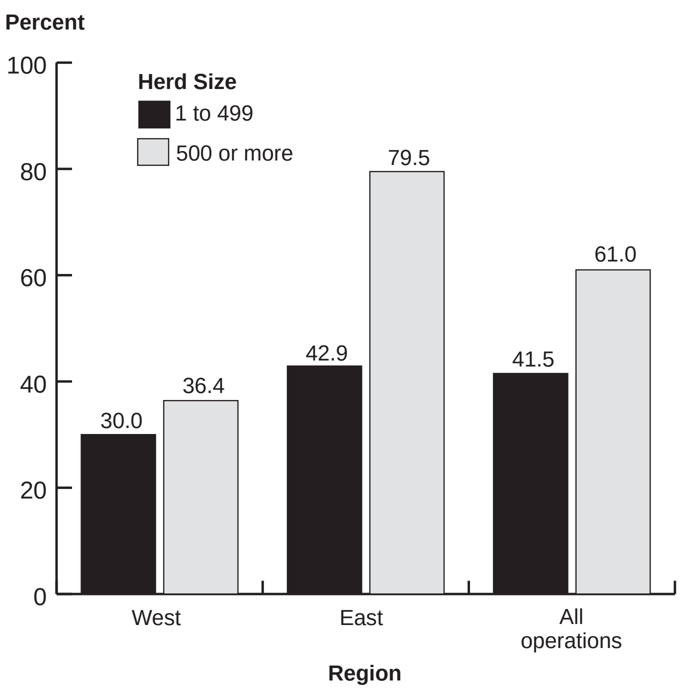
To evaluate strategies for detection of *Salmonella* in Dairy 2007, field personnel collected individual fecal samples from up to 35 cows (with up to 10 samples from sick and to-be-culled cows) and 6 samples from the dairy environment (environmental samples) on 116 operations. Samples from individual cows were also pooled at the laboratory, with each pool representing up to five cows. On an additional set of operations, only environmental samples were collected. Of the 265 operations with any of these types of samples taken for *Salmonella* testing, 47.2 percent were positive.

In 2007, the three sample types performed similarly in identifying operations with *Salmonella,* but environmental sampling identified a slightly higher percentage of positive operations. Among the 116 operations with all 3 sample types, the percentage of positive operations by testing method was as follows.

- Pooled: 39.7 percent
- Individual: 41.4 percent
- Environmental: 49.1 percent.

The percentage of operations on which *Salmonella* shedding was detected differed by herd size (see figure). Herd-size differences were more pronounced in the East region than in the West region. In the East region, almost 80 percent of operations with 500 or more cows had a least 1 *Salmonella*-positive sample, compared with only 42.9 percent of operations with fewer than 500 cows. In the West region, operations with fewer than 500 cows were just as likely to be *Salmonella*-positive as large operations. Overall, large operations were more likely to be *Salmonella*-positive, with 61.0 percent of operations with 500 or more cows being *Salmonella*-positive compared with 41.5 percent of operations with fewer than 500 cows.

For Dairy 2007, Percentage of Operations with any *Salmonella*-positive Samples (n=265) by Herd Size*, and by Region



*Number of milk cows present on January 1, 2007.

The six most common serotypes identified from at least one sample from participating operations for each of the three NAHMS dairy studies are listed in table 2. Three serotypes—Meleagridis, Montevideo, and Mbandaka—ranked in the top six for each of the three NAHMS dairy studies. Of these three serotypes, *S.* Montevideo has been among the top 10 serotypes identified from humans in every year from 1996 through 2006, the last year for which results are available.[5] *S.* Meleagridis and *S.* Mbandaka were not among the top 10 serotypes in humans for any year from 1996 through 2006.

Table 2. Most Common *Salmonella* Serotypes Identified from at Least One Sample from Participating Operations from Three NAHMS Dairy Studies

Rank	Dairy 1996	Dairy 2002	Dairy 2007
1	Montevideo	Kentucky/ Montevideo	Cerro/ Kentucky
2	Meleagridis		
3	Cerro/ Mbandaka/ Typhimurium	Mbandaka/ Meleagridis/ Newport	Montevideo/ Muenster
4			
5			Meleagridis
6	Anatum	Senftenberg	Mbandaka/ Newport
7	Give/Kentucky/ Muenchen/ Senftenberg	Agona/Anatum/ Muenster/ Typhimurium	

Salmonella isolates from the three NAHMS Dairy studies have shown relatively little resistance to antimicrobial agents. Of all *Salmonella* isolates tested for antimicrobial susceptibility, 88.9, 83.0, and 92.8 percent of isolates were susceptible to all antimicrobials tested in Dairy 1996, Dairy 2002, and Dairy 2007, respectively (table 3). In each study, about 5 percent of *Salmonella* isolates were resistant to two or more antimicrobials.

Table 3. Percent of *Salmonella* Isolates by Number of Antimicrobials to Which Resistance* was Observed, by NAHMS Study (n=number of isolates)

Susceptibility	Dairy 1996 (n=758)	Dairy 2002 (n=294)	Dairy 2007 (n=1,282)
Susceptible to all antimicrobials	88.9	83.0	92.8
Resistant to a single antimicrobial	6.6	12.2	1.7
Resistant to two or more antimicrobials	4.5	4.8	5.5
Total	100.0	100.0	100.0

*Intermediate isolates were classified as susceptible.

Resistance to tetracycline was most commonly observed in each of the three NAHMS Dairy studies (table 4). Resistance to amikacin, ciprofloxacin, and nalidixic acid was not observed in any of the studies. Dairy 2007 was the first study in which resistance to ceftriaxone was observed, but it was observed in only a single isolate. Resistance to ceftriaxone in cattle is of interest because it is commonly used to treat severe *Salmonella* infections in children.[6]

Table 4. Percent of Resistant* Isolates from all *Salmonella* Isolates Tested for Antimicrobial Susceptibility, by NAHMS Study and Antimicrobial (n=number of isolates)

Antimicrobial (Abbreviation)	Dairy 1996 (n=758)	Dairy 2002 (n=294)	Dairy 2007 (n=1,282)
Amikacin (AMI)	0.0	0.0	0.0
Amoxicillin-Clavulanic acid (AMO)	1.1	4.8	4.5
Ampicillin (AMP)	4.1	4.4	5.5
Apramycin (APR)	0.0	N/A	N/A
Cefoxitin (FOX)	N/A	3.7	4.2
Ceftiofur (TIO)	0.0	4.4	4.7
Ceftriaxone (AXO)	0.0	0.0	0.1
Cephalothin (CEP)	1.7	4.8	N/A
Chloramphenicol (CHL)	1.6	4.4	5.0
Ciprofloxacin (CIP)	0.0	0.0	0.0
Gentamicin (GEN)	0.1	0.7	0.1
Kanamycin (KAN)	1.7	0.7	0.7
Nalidixic Acid (NAL)	0.0	0.0	0.0
Streptomycin (STR)	4.1	9.5	5.4
Sulfamethoxazole** (SUL)	2.9	3.7	5.3
Tetracycline (TET)	8.0	11.9	6.6
Ticarcillin (TIC)	3.6	N/A	N/A
Trimethoprim-Sulfamethoxazole (TRI)	0.1	0.0	0.6

*Intermediate isolates were classified as susceptible.
**Sulfisoxazole replaced Sulfamethoxazole in 2007.

Of the 1,282 isolates tested in 2007, 65 isolates were resistant to multiple drugs. One resistance pattern (AMO, AMP, FOX, TIO, CHL, STR, SUL, TET) was found in *Salmonella* Newport isolates from three different operations. For one of these operations, this resistance pattern was also found in *S.* Reading and *S.* Montevideo isolates from the operation. In Dairy 1996 and Dairy 2002, more *S.* Typhimurium isolates were resistant to multiple drugs than other serotypes. In Dairy 2007, however, only one multidrug-resistant *S.* Typhimurium was observed. Dairy 2007 is the first NAHMS Dairy study in which multidrug resistance has been observed in *S.* Montevideo, which has been one of the top three serotypes identified in each of the previous NAHMS studies (table 2).

Campylobacter prevalence and antimicrobial susceptibility

Previous NAHMS studies have found *Campylobacter* to be present on most U.S. dairy operations. In Dairy 1996, *Campylobacter* was detected in at least one healthy cow on all sampled operations, based on detection by a multiplex polymerase chain reaction (PCR) assay (table 5). In Dairy 2002, culture methods found that 97.9 percent of operations sampled had at least one healthy cow shedding *Campylobacter* in its feces. In Dairy 2007, culture methods found that 92.6 percent of 121 operations had at least 1 healthy cow shedding *Campylobacter* in its feces, and all positive operations had at least 1 healthy cow shedding *C. jejuni*. Of the 1,885 healthy cows tested in Dairy 2007, 635 (33.7 percent) were positive for *Campylobacter*.

Table 5. Comparison of *Campylobacter* Fecal-culture Results from Three NAHMS Dairy Studies[1]

	Positive for *Campylobacter* / Total Sampled	
Study	Operations[2]	Cows
Dairy 1996	31/31 (100.0 percent)	Not available
Dairy 2002	95/97 (97.9 percent)	730/1,424 (51.3 percent)
Dairy 2007	112/121 (92.6 percent)	635/1,885 (33.7 percent)

[1]Only cows healthy at the time of collection are included.
[2]Operations with at least one positive cow were considered positive.

Antimicrobial-resistance testing was conducted on *Campylobacter* isolates from Dairy 2002 and Dairy 2007; because of the small number of *C. coli* isolates, results are presented only for *C. jejuni*. In Dairy 2002, one-half of the *C. jejuni* isolates were susceptible to all antimicrobials against which they were tested, while in Dairy 2007, 36.6 percent of the *C. jejuni* isolates were susceptible to all antimicrobials (table 6).

Table 6. Percent of *C. jejuni* Isolates by Number of Antimicrobials to Which Resistance* was Observed, by NAHMS Study (n=number of isolates)

Susceptibility	Dairy 2002 (n=473)	Dairy 2007 (n=623)
Susceptible to all antimicrobials tested	49.5	36.6
Resistant to a single antimicrobial	46.9	61.2
Resistant to two or more antimicrobials	3.6	2.2
Total	100.0	100.0

*Intermediate isolates were classified as susceptible.

Of the antimicrobials in table 7, ciprofloxacin and erythromycin are especially important because they are often used to treat humans infected with *Campylobacter*.[7] Very few of the *C. jejuni* isolates were resistant to ciprofloxacin or erythromycin in the Dairy 2002 and Dairy 2007 studies. Tetracycline had the highest percentages of resistant isolates, with 47.4 percent and 62.9 percent of the *C. jejuni* isolates from Dairy 2002 and Dairy 2007, respectively, showing resistance.

Table 7. Percent of Resistant* Isolates from all *C. jejuni* Isolates Tested for Antimicrobial Susceptibility, by NAHMS Study and Antimicrobial (n=number of isolates)

Antimicrobial	Dairy 2002 (n=473)	Dairy 2007 (n=623)
Azithromycin	1.1	0.3
Ciprofloxacin	0.0	1.6
Chloramphenicol	2.5	N/A
Clindamycin	0.8	0.2
Erythromycin	0.4	0.3
Florfenicol	N/A	0.0
Gentamicin	0.2	0.0
Nalidixic Acid	4.0	1.9
Telithromycin	N/A	0.0
Tetracycline	47.4	62.9

*Intermediate isolates were classified as susceptible.

Conclusions

The percentage of *Salmonella*-positive dairy operations, based on individual culture of feces from healthy cows, has increased with each NAHMS Dairy study, from 21.1 percent in 1996 to 39.7 percent in 2007. The percentage of *Salmonella*-positive cows also has increased, from 5.4 percent in 1996 to 13.7 percent in 2007. Each NAHMS dairy study has had different objectives with regard to *Salmonella*, and sampling and culture techniques have differed slightly among studies. Results suggest, however, that *Salmonella* occurrence is increasing.

Salmonella isolates have shown relatively little resistance to antimicrobial agents in the three NAHMS Dairy studies. Most U.S. dairy operations were observed to have *Campylobacter*-positive cows in each of the three NAHMS Dairy studies. *C. jejuni* isolates collected during NAHMS studies have shown little resistance to antimicrobials, with the exception of tetracycline.

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For more information, contact:

USDA–APHIS–VS–CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov

#562.0709

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Prevalence of *Salmonella* and *Listeria* in Bulk Tank Milk and In-line Filters on U.S. Dairies, 2007

In 2007, the U.S. Department of Agriculture's (USDA) National Animal Health Monitoring System (NAHMS) conducted the Dairy 2007 study. In all, 17 of the Nation's major dairy States* representing 79.5 percent of U.S. dairy operations and 82.5 percent of U.S. dairy cows participated in the study. One goal of Dairy 2007 was to estimate the prevalence of *Salmonella* and *Listeria* in bulk tank milk and in-line milk filters.

Salmonella and *Listeria* are bacteria commonly found in livestock and dairy environments and can cause disease in cattle and serious foodborne illness in humans. Bulk tank milk can become contaminated with *Salmonella* or *Listeria* directly from the udder or through contact with manure during milking. Consuming raw or improperly pasteurized milk or milk products can lead to illness in humans caused by *Salmonella*, *Listeria,* and other pathogens.

NAHMS first estimated the prevalence of *Salmonella* and *Listeria* in bulk tank milk during its Dairy 2002 study. The study reported that 1.7 percent of single bulk-tank-milk samples tested by culture were positive for *Salmonella* and 3.8 percent were positive for *Listeria monocytogenes.*

The Dairy 2007 study estimated the prevalence of *Salmonella* by Real Time Polymerase Chain Reaction (RT-PCR) and the prevalence of *Listeria* by culture. Samples were taken from bulk tank milk, in-line milk filters, or both. Samples positive for *Salmonella* via RT-PCR were subsequently cultured for *Salmonella* in selective culture media to determine serotype.

Salmonella

Infections caused by *Salmonella* in cattle (salmonellosis) are characterized by a wide variety of clinical signs, including: diarrhea in adult cattle and, in calves, severe blood infections (septicemia) resulting in diarrhea, pneumonia, and arthritis. It should be noted that many animals infected with *Salmonella* show no clinical signs of disease.

In humans, *Salmonella* is a primary cause of many cases of foodborne illnesses. Infections can be acquired by consuming contaminated meat or unpasteurized milk, or by coming into contact with animals shedding *Salmonella*. Some *Salmonella* strains isolated from cattle and human outbreaks have shown resistance to multiple antibiotics, which limits the spectrum of antimicrobial agents that can be used to successfully treat the infection.

During Dairy 2007, samples from 538 operations were tested by RT-PCR for the presence of *Salmonella* in bulk tank milk, in-line filters, or both. *Salmonella* was present in at least one sample on 28.1 percent of operations (see table below).

The percentage of *Salmonella*-positive operations did not differ between study regions*: 35.8 percent of operations in the West region and 27.3 percent in the East region had at least one sample positive for *Salmonella.* However, there were differences by herd size. *Salmonella* was present on a higher percentage of large operations compared with small operations (50.9 and 24.3 percent, respectively). Broken down by sample type, *Salmonella* was detected by RT-PCR in 10.8 percent of bulk-tank-milk samples and in 24.7 percent of in-line milk filters. In comparison, Dairy 2002 reported that 11.9 percent of bulk-tank-milk samples tested by RT-PCR were positive for *Salmonella.* Milk filters were not collected during the 2002 study.

Twenty-two *Salmonella* serotypes were identified from cultured samples during the 2007 study. The top five serotypes found were Cerro, Kentucky, Muenster, Anatum, and Newport.

Percentage of Operations in which Bulk Tank Milk and/or Milk Filters Tested RT-PCR Positive for *Salmonella,* by Herd Size

Herd size (Number of Dairy Cows)	**Percent Operations**
Small (fewer than 100 head)	24.3
Medium (100-499 head)	32.7
Large (500 or more head)	50.9
All Operations	28.1

* **States/Regions:**
West: California, Idaho, New Mexico, Texas, and Washington
East: Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, Vermont, Virginia, and Wisconsin

Listeria

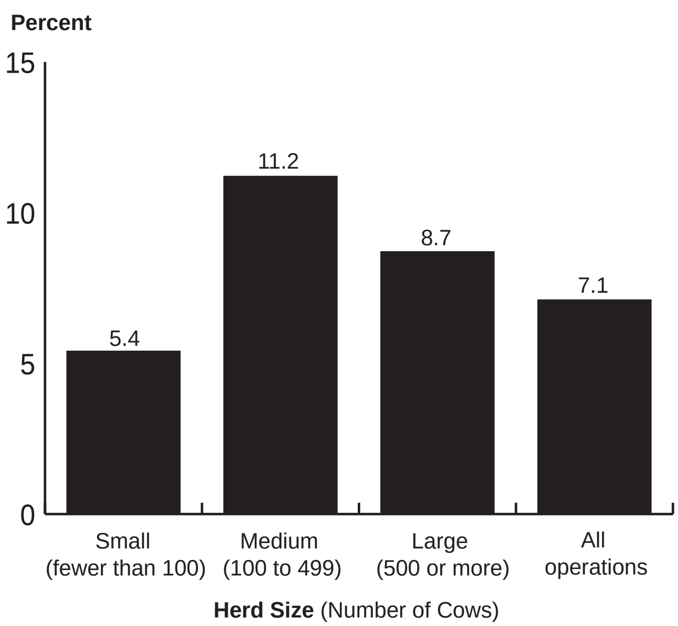
The genus *Listeria* is composed of several bacterial species and subspecies, most of which are nonpathogenic for animals and humans. However, *Listeria monocytogenes* can cause abortion, encephalitis, and septicemia in humans and animals. Numerous outbreaks of human listeriosis have been traced to milk and dairy products contaminated with *Listeria monocytogenes. Listeria monocytogenes* mainly affects immunocompromised individuals.

In 2007, nearly one-third of operations (32.1 percent) were positive for *Listeria* based on bulk tank milk or in-line milk filter cultures. By sample type, in-line milk filters had a higher percentage of samples test positive for *Listeria* species compared with bulk tank milk (28.3 and 9.0 percent, respectively)

Listeria monocytogenes was detected in samples from 7.1 percent of operations. By sample type, a similar percentage of samples from in-line milk filters (5.1 percent) tested positive for *Listeria monocytogenes* compared with 3.7 percent of bulk-tank-milk samples.

The difference in the percentages of operations in the West and East regions that tested positive for *Listeria monocytogenes* was not statistically significant (10.6 and 6.7 percent, respectively). Also, the apparent differences between the percentage of positive operations by herd size were not statistically significant (see figure below).

Percentage of Operations in which Bulk Tank Milk and/or Milk Filters Tested Positive for a *Listeria monocytogenes*, by Herd Size



Summary

In Dairy 2007, 10.8 percent of operations were positive for *Salmonella* in bulk-tank-milk samples tested by RT-PCR. In contrast, when in-line milk filters were included for testing in addition to bulk-tank-milk samples, 28.1 percent of operations were positive for *Salmonella.*

In 2002, 10.4 percent of operations tested positive for *Listeria* species when a single bulk-tank-milk sample was cultured,[1] compared with 9.0 percent in 2007. With the addition of in-line milk filter testing in 2007, 32.1 percent of operations tested positive for *Listeria* species.

In 2002, 3.8 percent of U.S. dairies tested positive for *Listeria monocytogenes* in bulk tank milk compared with 3.7 percent of dairies in 2007. However, when in-line filters were added as part of the 2007 study, *Listeria* was detected on 7.1 percent of operations.

The above comparisons indicate that testing of in-line milk filters in addition to bulk tank milk increases the sensitivity of detecting *Salmonella* and *Listeria* species. In-line milk filters entrap and concentrate pathogens from gallons of milk in one sample, which makes them a more sensitive and suitable sample for screening pathogens compared to bulk tank milk alone.

Although the widespread distribution of *Salmonella* and *Listeria monocytogenes* in the dairy environment hampers the control of both bacteria, there are factors associated with their presence in bulk tank milk that dairy farmers should monitor in order to eliminate these bacteria from milking systems. Implementing recommended milking hygiene practices, such as ensuring that teats are clean and using a teat disinfectant prior to milking, should decrease contamination of milk with these pathogens. Additionally, testing new replacement heifers before they are incorporated into the herd, proper sanitation of maternity and calf rearing areas, and control of birds and rodents are practices that may help decrease *Salmonella* prevalence on dairy operations. Practices that help decrease the prevalence of *Listeria monocytogenes* include feeding cattle good quality silage, preventing contact with manure from infected animals, and thorough cleaning and disinfection of bulk tanks.[2]

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For more information, contact:
USDA-APHIS-VS-CEAH
NRRC Building B, M.S. 2E7
2150 Centre Avenue
Fort Collins, CO 80526-8117
970.494.7000
E-mail: NAHMS@aphis.usda.gov
http://nahms.aphis.usda.gov
#N528.0709