SPECIAL ARTICLE

National Nosocomial Infections Surveillance (NNIS) System Report, Data Summary from January 1992-June 2001, Issued August 2001

A report from the NNIS System*
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This report is a summary of the data collected and reported by hospitals participating in the National Nosocomial Infections Surveillance (NNIS) System from January 1992 through June 2001 and updates previously published data.[1-4]

The NNIS System was established in 1970 when selected hospitals in the United States routinely began reporting their nosocomial infection surveillance data for aggregation into a national database. Hospitals participating in the NNIS System provide general medical-surgical inpatient services to adults or children requiring acute care. Identity of the more than 300 hospitals currently participating in the NNIS System is confidential.

All NNIS data are collected using standardized protocols, called surveillance components: adult and pediatric intensive care unit (ICU), high-risk nursery (HRN), and surgical patient.[5-7] The components may be used singly or simultaneously, but once selected, they must be used for a minimum of 1 calendar month. All infections are categorized into major and specific infection sites by using standard CDC definitions that include laboratory and clinical criteria.[6]

In January 1999, the hospital-wide component was eliminated from the NNIS system. This was done for several reasons. The hospital-wide component required considerable time and resources in most hospitals, particularly those that have a large and high-risk patient population, resulting in inaccurate and inadequate case-finding. More importantly, the hospital-wide component did not yield rates that were meaningful for national comparison purposes since they were not risk-adjusted.

Adult and pediatric ICU surveillance component

Infection control professionals (ICPs) collect data on all sites of nosocomial infection in patients located in ICUs, as well as ICU-specific denominator data. Site-specific infection rates can be calculated by using as a denominator the number of patients at risk, patient-days, and days of indwelling urinary catheterization, central vascular cannulation (central line), or ventilation.

HRN surveillance component

ICPs collect data on all sites of nosocomial infection in patients located in HRN, as well as HRN-specific denominator data. Site-specific infection rates can be calculated by using as a denominator the number of patients at risk, patient-days, and days of umbilical catheter/central line use or ventilation for each of 4 birth weight categories ($\leq$ 1000 gm, 1001 to 1500 gm, 1501 to 2500 gm, and > 2500 gm).

Surgical patient surveillance component

ICPs select from the NNIS operative procedure list those procedures they wish to follow and monitor the patients undergoing those procedures for all infections or surgical site infections (SSIs) only. A record on every patient undergoing the selected procedure is generated that includes information on risk factors for SSI such as wound class,[8] duration of operation, and American Society of Anesthesiology (ASA) score.[9] By using a

*See Appendix D.

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Table 1. Pooled means and percentiles of the distribution of device-associated infection rates, by type of ICU, ICU component, January 1995-June 2001

Urinary catheter-associated UTI rate*

Type of ICU	No. of units	Urinary catheter-days	Pooled mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	101	400,084	5.8	1.0	2.6	4.8	8.1	11.2
Cardiothoracic	64	465,671	3.1	0.4	1.2	2.3	3.9	5.4
Medical	134	957,786	6.6	2.4	3.9	5.8	7.6	10.3
Medical-Surgical								
Major teaching	122	850,288	5.8	1.0	3.4	5.3	7.1	10.3
All others	179	1,402,098	3.9	0.8	1.8	3.7	5.4	6.7
Neurosurgical	47	230,656	7.8	2.4	4.5	6.9	9.7	12.6
Pediatric	71	207,445	4.9	0.0	2.6	4.6	6.9	8.7
Surgical	153	1,155,280	5.2	1.2	2.8	4.4	7.2	8.9
Trauma	25	162,892	6.7	3.8	4.6	6.5	8.1	10.1
Burn	18	50,260	9.7	—	—	—	—	—
Respiratory	7	33,398	5.5	—	—	—	—	—

Central line-associated BSI rate†

Type of ICU	No. of units	Central line-days	Pooled mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	102	252,325	4.5	0.0	1.9	4.1	5.7	7.8
Cardiothoracic	64	419,674	2.9	0.9	1.5	2.4	3.6	4.7
Medical	135	671,632	5.9	1.8	3.4	5.2	7.1	10.0
Medical-Surgical								
Major teaching	123	579,704	5.3	1.1	3.2	4.9	7.0	8.8
All others	180	863,757	3.8	0.0	1.9	3.4	5.3	6.8
Neurosurgical	47	123,780	4.7	0.0	2.5	4.5	6.7	8.5
Pediatric	74	291,831	7.6	0.3	3.8	6.8	8.9	11.9
Surgical	153	900,948	5.3	1.2	2.5	4.9	7.2	9.2
Trauma	25	116,709	7.9	1.4	5.0	7.0	9.9	12.1
Burn	18	43,196	9.7	—	—	—	—	—
Respiratory	7	21,265	3.4	—	—	—	—	—

Ventilator-associated pneumonia rate‡

Type of ICU	No. of units	Ventilator-days	Pooled mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	100	173,668	8.4	0.4	4.1	7.1	11.4	16.7
Cardiothoracic	64	251,034	10.5	2.9	5.5	9.5	13.2	17.2
Medical	134	636,355	7.3	1.8	3.8	6.0	9.0	13.6
Medical-Surgical								
Major teaching	121	494,941	10.5	2.7	5.8	9.4	12.3	16.1
All others	179	674,536	8.7	1.1	4.9	7.6	10.5	13.2
Neurosurgical	46	107,820	14.9	4.2	8.5	11.9	17.2	22.8
Pediatric	75	285,607	4.9	0.0	1.4	3.9	7.7	11.1
Surgical	152	638,321	13.2	5.1	7.7	11.6	14.9	22.6
Trauma	25	106,884	16.2	9.0	10.7	15.3	22.1	28.6
Burn	18	28,935	15.9	—	—	—	—	—
Respiratory	7	24,519	4.3	—	—	—	—	—

*$\frac{\text{Number of urinary catheter-associated UTIs}}{\text{Number of urinary catheter-days}} \times 1000$

†$\frac{\text{Number of central line-associated BSIs}}{\text{Number of central line-days}} \times 1000$

‡$\frac{\text{Number of ventilator-associated pneumonias}}{\text{Number of ventilator-days}} \times 1000$

Table 2. Pooled means and percentiles of the distribution of device utilization ratios, by type of ICU, ICU component, January 1995-June 2001

Urinary catheter utilization*

Type of ICU	No. of units	Patient-days	Pooled mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	101	803,382	0.50	0.24	0.38	0.49	0.62	0.70
Cardiothoracic	64	529,928	0.88	0.70	0.80	0.91	0.95	0.97
Medical	134	1,311,534	0.73	0.54	0.63	0.75	0.82	0.87
Medical-Surgical								
Major teaching	123	1,055,482	0.81	0.61	0.72	0.80	0.86	0.91
All others	179	1,874,598	0.75	0.57	0.67	0.75	0.82	0.88
Neurosurgical	47	283,505	0.81	0.52	0.75	0.83	0.92	0.94
Pediatric	77	634,673	0.33	0.13	0.19	0.29	0.39	0.46
Surgical	153	1,364,477	0.85	0.69	0.78	0.85	0.91	0.95
Trauma	25	184,335	0.88	0.71	0.87	0.93	0.96	0.98
Burn	18	88,775	0.57	—	—	—	—	—
Respiratory	7	47,602	0.70	—	—	—	—	—

Central line utilization†

Type of ICU	No. of units	Patient-days	Pooled mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	102	803,382	0.31	0.13	0.21	0.27	0.40	0.54
Cardiothoracic	64	529,928	0.79	0.56	0.69	0.82	0.90	0.95
Medical	135	1,311,534	0.51	0.30	0.36	0.51	0.63	0.74
Medical-Surgical								
Major teaching	123	1,055,482	0.55	0.35	0.45	0.55	0.63	0.72
All others	180	1,874,598	0.46	0.25	0.33	0.46	0.57	0.63
Neurosurgical	47	283,505	0.44	0.26	0.37	0.46	0.54	0.64
Pediatric	77	634,673	0.46	0.22	0.31	0.41	0.55	0.61
Surgical	153	1,364,477	0.66	0.46	0.56	0.67	0.76	0.86
Trauma	25	184,335	0.63	0.47	0.55	0.63	0.79	0.84
Burn	18	88,775	0.49	—	—	—	—	—
Respiratory	7	47,602	0.45	—	—	—	—	—

Ventilator utilization‡

Type of ICU	No. of units	Patient-days	Pooled mean	Percentile				
				10%	25%	50% (median)	75%	90%
Coronary	101	803,382	0.22	0.08	0.12	0.20	0.28	0.36
Cardiothoracic	64	529,928	0.47	0.31	0.38	0.47	0.54	0.63
Medical	136	1,311,534	0.49	0.24	0.35	0.46	0.59	0.66
Medical-Surgical								
Major teaching	123	1,055,482	0.47	0.29	0.36	0.43	0.55	0.64
All others	180	1,874,598	0.36	0.21	0.27	0.35	0.43	0.49
Neurosurgical	47	283,505	0.38	0.19	0.26	0.38	0.46	0.54
Pediatric	78	634,673	0.45	0.18	0.30	0.42	0.48	0.58
Surgical	153	1,364,477	0.47	0.26	0.36	0.46	0.55	0.65
Trauma	25	184,335	0.58	0.45	0.56	0.60	0.71	0.76
Burn	18	88,775	0.33	—	—	—	—	—
Respiratory	7	47,602	0.52	—	—	—	—	—

*$\frac{\text{Number of urinary catheter-days}}{\text{Number of patient-days}}$

†$\frac{\text{Number of central line-days}}{\text{Number of patient-days}}$

‡$\frac{\text{Number of ventilator-days}}{\text{Number of patient-days}}$

Table 3. Pooled means and percentiles of the distribution of device-associated infection rates, by birth weight category, HRN component, January 1995-June 2001

Umbilical and central line-associated BSI rate*

Birth weight category	No. of HRNs	Central line-days	Pooled mean	Percentile 10%	25%	50% (median)	75%	90%
≤1000 g	138	438,261	11.3	4.0	7.3	11.1	14.8	18.5
1001-1500 g	136	213,351	6.9	1.1	4.3	6.7	11.0	14.6
1501-2500 g	132	163,697	4.0	0.0	1.0	3.9	5.9	8.7
>2500 g	133	231,573	3.8	0.0	0.9	2.7	5.1	7.3

Ventilator-associated pneumonia rate†

Birth weight category	No. of HRNs	Central line-days	Pooled mean	Percentile 10%	25%	50% (median)	75%	90%
≤1000 g	137	433,951	4.8	0.0	1.4	4.2	7.1	11.4
1001-1500 g	135	129,556	3.6	0.0	0.0	2.7	6.1	9.3
1501-2500 g	124	96,825	2.9	0.0	0.0	1.3	3.7	6.3
>2500 g	126	147,947	2.6	0.0	0.0	1.0	3.1	7.2

*$\frac{\text{Number of umbilical and central line-associated BSIs}}{\text{Number of umbilical and central line-days}} \times 1000$

†$\frac{\text{Number of ventilator-associated pneumonias}}{\text{Number of ventilator-days}} \times 1000$

Table 4. Pooled means and percentiles of the distribution of device utilization ratios, by birth weight category, HRN component, January 1995-June 2001

Umbilical and central line utilization ratio*

Birth weight category	No. of HRNs	Patient-days	Pooled mean	Percentile 10%	25%	50% (median)	75%	90%
≤1000 g	142	1,053,669	0.42	0.19	0.28	0.40	0.55	0.64
1001-1500 g	142	741,148	0.29	0.09	0.15	0.25	0.41	0.55
1501-2500 g	143	805,088	0.20	0.05	0.09	0.14	0.31	0.46
>2500 g	143	749,831	0.31	0.08	0.14	0.21	0.39	0.55

Ventilator utilization ratio†

Birth weight category	No. of HRNs	Patient-days	Pooled mean	Percentile 10%	25%	50% (median)	75%	90%
≤1000 g	142	1,053,669	0.41	0.23	0.30	0.40	0.49	0.62
1001-1500 g	142	741,148	0.17	0.07	0.10	0.15	0.24	0.37
1501-2500 g	143	805,088	0.12	0.03	0.05	0.09	0.17	0.32
>2500 g	143	749,831	0.20	0.04	0.08	0.13	0.24	0.34

*$\frac{\text{Number of umbilical and central line-days}}{\text{Number of patient-days}}$

†$\frac{\text{Number of ventilator-days}}{\text{Number of patient-days}}$

Table 5. Surgical site infection rates*, by operative procedure and risk index category, Surgical Patient component, January 1992-June 2001

Operative Procedure Category		Duration cutpoint (h)	Risk index category	N	Rate
CARD	Cardiac surgery	5	0	1510	0.66
CBGB	CABG-chest and donor site	5	0	1836	1.20
CBGC	CABG-chest only	4	0,1	11278	2.13
OCVS	Other cardiovascular surgery	2	0,1	7680	0.65
ORES	Other respiratory surgery	2	0,1,2,3	1522	2.69
THOR	Thoracic surgery	3	0	1178	0.34
BILI	Liver/pancreas	4	0	362	3.04
OGIT	Other digestive surgery	3	0	1128	2.30
SB	Small bowel surgery	3	0	1230	5.20
XLAP	Laparotomy	2	0	5192	1.71
NEPH	Nephrectomy	4	0,1,2,3	2657	1.13
OGU	Other genitourinary surgery	2	0	11226	0.37
PRST	Prostatectomy	4	0	2207	0.91
HN	Head and neck surgery	7	0	523	2.49
OENT	Other ENT surgery	2	0,1	3371	0.21
HER	Herniorrhaphy	2	0	9292	0.77
MAST	Mastectomy	3	0	11330	1.80
CRAN	Craniotomy	4	0	3546	0.90
ONS	Other nervous system	4	0,1,2,3	1980	1.62
VSHN	Ventricular shunt	2	0	2619	4.35
CSEC	Cesarean section	1	0	111335	2.86
HYST	Abdominal hysterectomy	2	0	29936	1.46
OOB	Other obstetrical surgery	1	0,1,2,3	1063	0.47
VHYS	Vaginal hysterectomy	2	0,1,2,3	20342	1.29
AMP	Limb amputation	1	0,1,2,3	8465	3.71
FUSN	Spinal fusion	4	0	28484	1.16
FX	Open reduction fracture	2	0	12696	0.73
HPRO	Hip prosthesis	2	0	21451	0.89
KPRO	Knee prosthesis	2	0	30533	0.84
LAM	Laminectomy	2	0	46821	0.93
OMS	Other musculoskeletal	3	0	13841	0.65
OPRO	Other prosthesis	3	0,1,2,3	2238	0.67
OBL	Other hem/lymph system	3	0,1,2,3	932	1.93
OES	Other endocrine system	3	0	1894	0.16
OEYE	Other eye surgery	2	0,1,2,3	506	0.79
OSKN	Other integumentary system	2	0,1,2,3	7039	1.25
SKGR	Skin graft	3	0	925	0.86
SPLE	Splenectomy	2	0	317	0.95
TP	Organ transplant	6	0,1	3223	4.44
VS	Vascular surgery	3	0	6099	0.89

CBGB, coronary artery bypass graft with chest and donor site incisions (eg, femoral or radial artery harvested as donor vessel for bypass graft); *CBGC*, coronary artery bypass graft with chest incision only (eg, use of internal mammary artery for bypass graft).
*per 100 operations.

composite index for predicting the risk of SSI after surgery, ICPs can calculate rates by the number of risk factors present.[4]

The periods for the data contained in this report vary depending on the table. Data from the 1980s are no longer included in any table. Each table represents NNIS data from one of the surveillance components. There are no data solely from the hospital-wide component in this report.

Tables 1 and 2 from the ICU component update previously published device-associated rates and device utilization (DU) ratios by type of ICU.[1,2] In these tables, the percentile distributions that display the infection rates and DU ratios require data from at least 20 different units. Each of the analyses of ICU data excluded rates or DU ratios for units that did not report at least 50 device-days or patient-days. Because of this, the number of units contributing data in the tables is not exactly the same.

The number of units reporting data from the burn and respiratory ICUs is still insufficient to provide percentile distributions of the rates or ratios. The data for combined medical/surgical ICUs have been split into 2 groups by type of hospital: "major teaching" and "all others." The

Risk index category	N	Rate	Risk index category	N	Rate	Risk index category	N	Rate
1	25902	1.63	2,3	7881	2.54		—	—
1	246638	3.57	2	49673	5.68	3	135	9.63
2,3	4619	3.81		—	—		—	—
2	2802	1.53	3	118	4.24		—	—
	—	—		—	—		—	—
1	3926	1.17	2,3	1305	3.07		—	—
1,2,3	1320	7.58		—	—		—	—
1	1808	3.48	2,3	524	7.25		—	—
1	2812	7.33	2,3	1716	9.38		—	—
1	6073	3.29	2	3274	5.16	3	592	7.77
	—	—		—	—		—	—
1	5717	1.00	2,3	1382	3.11		—	—
1	1515	2.18	2,3	254	4.72		—	—
1	744	4.97	2,3	343	13.70		—	—
2,3	341	2.93	—	—	—		—	—
1	5617	1.90	2,3	1285	3.97		—	—
1	7045	2.48	2,3	671	3.87		—	—
1,2,3	13486	1.67		—	—		—	—
	—	—		—	—		—	—
1,2,3	6498	5.49		—	—		—	—
1	33721	4.17	2,3	3365	6.66		—	—
1	15122	2.38	2,3	3223	5.65		—	—
	—	—		—	—		—	—
	—	—		—	—		—	—
	—	—		—	—		—	—
1	15456	2.79	2,3	4034	6.42		—	—
1	20134	1.35	2	3944	2.51	3	433	4.85
1	36387	1.55	2,3	10252	2.24		—	—
1	35394	1.20	2,3	9216	2.20		—	—
1	32909	1.40	2,3	10083	2.43		—	—
1	9595	0.87	2,3	2789	1.76		—	—
	—	—		—	—		—	—
	—	—		—	—		—	—
1,2,3	1404	0.93		—	—		—	—
	—	—		—	—		—	—
	—	—		—	—		—	—
1	1599	2.00	2,3	1134	5.03		—	—
1,2,3	968	3.51					—	—
2	1207	14.42	3	36	27.78		—	—
1	50288	1.74	2,3	20319	4.51		—	—

combined medical/surgical ICUs from major teaching hospitals had significantly higher infection rates and DU ratios than combined medical/surgical ICUs from all of the other hospitals. Major teaching status is defined as a hospital that is an important part of the teaching program of a medical school and a major unit in the clinical clerkship program. Teaching affiliation was not an important factor for any other type of ICU.

For the ICU component, device-days consist of the total number of ventilator-days, central line-days, and urinary catheter-days. The DU of an ICU is one measure of the unit's invasive practices that constitutes an extrinsic risk factor for nosocomial infection.[2] As such, DU may also serve as a marker for severity of illness of patients in the unit, that is, patients' intrinsic susceptibility to infection.

Site distributions of infections for coronary care, medical, pediatric, and combined medical-surgical ICUs have been published elsewhere.[10-13]

Fig 1 shows the rates of antimicrobial resistance among selected pathogens identified from ICU patients with nosocomial infections. For each antimicrobial/pathogen pair, the pooled mean rate of resistance for January to December 2000 is displayed. Next to or overlapping this point is the average rate of resistance (± 1

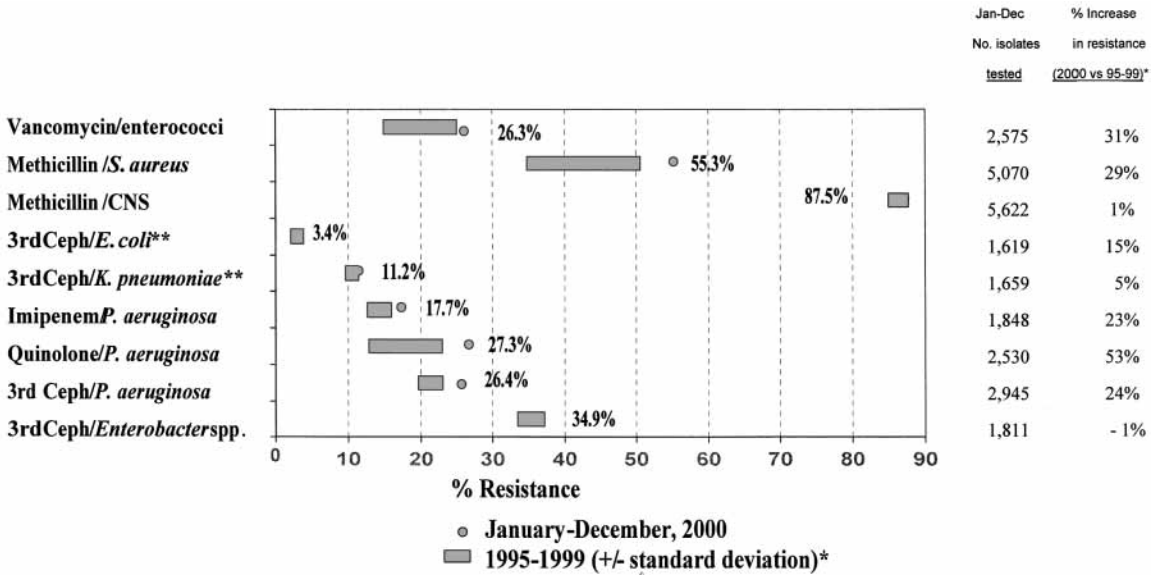

Figure 1. Selected antimicrobial resistant pathogens associated with nonsocomial infections in ICU patients,comparison of resistance rates from January-December 2000 with 1995-1999, NNIS System. *CNS*, coagulase-negative staphylococci, *3rd ceph;* resistance to 3rd generation cephalosporins (either ceftriaxone, cefotaxime, or ceftazidime), quinolone, resistance to either ciprofoxacin or ofloxacin. *Percentage (%) increase in resistance rate of current year (January-December 2000)compared with mean rate resistance over previous 5 years (1995-1999): [(2000 rate-previous 5 year mean rate)/previous 5 year mean rate] $\times$ 100. **"Resistance" for *E.coli* or *K. pneumoniae* is the rate of nonsusceptibility of these organisms to either 3rd Ceph group or aztreonam.

Table 6. Percentiles of the distribution of surgical site infection rates,* by operative procedure and risk index category,† surgical patient component, January 1992-June 2001

Operative Procedure Category		Risk index category	No. hospitals	Pooled mean rate	Percentile				
					10%	25%	50% (median)	75%	90%
CARD	Cardiac surgery	1	93	1.63	0.00	0.41	1.22	1.90	2.78
CARD	Cardiac surgery	2,3	66	2.54	0.00	0.62	1.65	3.30	6.19
CBGB	CABG-chest and donor site	1	175	3.57	1.40	2.18	3.26	4.57	6.75
CBGB	CABG-chest and donor site	2	161	5.68	2.30	3.76	5.59	7.69	9.87
CBGC	CABG-chest only	0,1	96	2.13	0.00	0.00	1.25	2.60	5.03
CBGC	CABG-chest only	2,3	49	3.81	0.00	0.26	2.72	4.47	7.72
OCVS	Other cardiovascular surgery	0,1	29	0.65	0.00	0.00	0.00	0.92	2.19
THOR	Thoracic surgery	1	33	1.17	0.00	0.00	0.27	1.92	3.00
THOR	Thoracic surgery	2,3	20	3.07	0.00	0.00	1.67	3.77	6.12
APPY	Appendectomy	0-No	44	1.39	0.00	0.00	1.03	1.90	3.03
APPY	Appendectomy	1	50	2.90	0.00	1.24	2.38	3.85	5.84
APPY	Appendectomy	2	30	4.90	0.00	0.00	3.54	6.17	7.89
CHOL	Cholecystectomy	M	81	0.46	0.00	0.00	0.00	0.52	1.16
CHOL	Cholecystectomy	0	88	0.68	0.00	0.00	0.39	1.11	1.96
CHOL	Cholecystectomy	1	73	1.93	0.00	0.00	1.46	3.65	5.29
CHOL	Cholecystectomy	2	45	3.33	0.00	0.87	3.08	4.71	7.67
COLO	Colon surgery	0	84	4.02	0.00	2.16	3.57	5.29	7.18
COLO	Colon surgery	1	97	5.76	1.24	3.28	5.21	6.99	8.55
COLO	Colon surgery	2	74	8.73	2.93	5.25	8.33	12.20	17.82
COLO	Colon surgery	3	20	11.62	2.63	7.69	12.88	19.05	20.00
GAST	Gastric surgery	0-No	24	2.79	0.00	0.00	2.56	3.77	6.29
GAST	Gastric surgery	1	34	5.02	1.52	2.22	4.55	7.12	9.28
GAST	Gastric surgery	2,3	21	10.36	3.87	5.34	9.71	18.38	21.90
SB	Small bowel surgery	0	21	5.20	0.00	1.80	4.38	6.14	12.61

Table 6. (continued)

Operative Procedure Category		Risk index category	No. hospitals	Pooled mean rate	Percentile				
					10%	25%	50% (median)	75%	90%
SB	Small bowel surgery	1	31	7.33	0.19	3.99	5.96	10.57	13.30
SB	Small bowel surgery	2,3	23	9.38	5.56	6.40	8.40	13.23	15.50
XLAP	Laparotomy	0	33	1.71	0.00	0.00	1.59	2.35	3.15
XLAP	Laparotomy	1	40	3.29	0.00	1.36	2.38	4.60	7.03
XLAP	Laparotomy	2	31	5.16	0.00	1.06	3.52	7.06	10.13
NEPH	Nephrectomy	0,1,2,3	27	1.13	0.00	0.00	0.51	2.14	5.05
OGU	Other genitourinary surgery	0	30	0.37	0.00	0.00	0.15	0.71	1.37
OGU	Other genitourinary surgery	1	26	1.00	0.00	0.21	0.77	1.86	2.82
PRST	Prostatectomy	0	25	0.91	0.00	0.00	0.00	0.99	2.47
HER	Herniorrhaphy	0	46	0.77	0.00	0.00	0.64	2.11	2.76
HER	Herniorrhaphy	1	47	1.90	0.00	0.00	1.53	3.07	4.44
HER	Herniorrhaphy	2,3	22	3.97	0.00	0.00	3.33	4.76	6.64
MAST	Mastectomy	0	49	1.80	0.00	0.00	0.72	1.58	3.60
MAST	Mastectomy	1	45	2.48	0.00	0.14	1.65	3.97	6.29
CRAN	Craniotomy	0	35	0.90	0.00	0.00	0.00	1.67	2.59
CRAN	Craniotomy	1,2,3	61	1.67	0.00	0.00	1.27	2.17	3.49
VSHN	Ventricular shunt	0	27	4.35	0.00	0.00	3.32	5.10	6.55
VSHN	Ventricular shunt	1,2,3	39	5.49	0.00	1.43	3.61	6.72	8.27
CSEC	Cesarean section	0	123	2.8 6	0.27	1.15	2.24	4.55	6.21
CSEC	Cesarean section	1	111	4.17	0.00	1.34	3.13	5.69	7.97
CSEC	Cesarean section	2,3	40	6.66	0.00	3.31	6.15	9.38	13.46
HYST	Abdominal hysterectomy	0	83	1.46	0.00	0.00	1.14	2.57	4.04
HYST	Abdominal hysterectomy	1	79	2.38	0.00	0.65	1.77	2.86	5.41
HYST	Abdominal hysterectomy	2,3	43	5.65	0.00	2.56	4.55	9.19	11.95
VHYS	Vaginal hysterectomy	0,1,2,3	59	1.29	0.00	0.08	1.04	2.04	3.48
AMP	Limb amputation	0,1,2,3	37	3.71	0.00	1.35	2.99	5.09	7.43
FUSN	Spinal fusion	0	89	1.16	0.00	0.00	0.73	1.36	2.43
FUSN	Spinal fusion	1	91	2.79	0.00	0.43	2.46	3.58	5.39
FUSN	Spinal fusion	2,3	52	6.42	0.00	2.33	4.35	8.06	10.49
FX	Open reduction fracture	0	64	0.73	0.00	0.00	0.11	1.10	1.92
FX	Open reduction fracture	1	74	1.35	0.00	0.00	1.01	1.60	2.43
FX	Open reduction fracture	2	43	2.51	0.00	0.00	2.63	4.08	5.91
HPRO	Hip prosthesis	0	131	0.89	0.00	0.00	0.34	1.29	2.84
HPRO	Hip prosthesis	1	165	1.55	0.00	0.00	1.12	2.22	3.58
HPRO	Hip prosthesis	2,3	119	2.24	0.00	0.00	1.80	3.41	5.42
KPRO	Knee prosthesis	0	125	0.84	0.00	0.00	0.57	1.32	2.40
KPRO	Knee prosthesis	1	151	1.20	0.00	0.00	0.96	1.85	2.96
KPRO	Knee prosthesis	2,3	104	2.20	0.00	0.00	2.00	3.51	4.90
LAM	Laminectomy	0	119	0.93	0.00	0.00	0.60	1.30	2.64
LAM	Laminectomy	1	122	1.40	0.00	0.30	1.28	2.01	3.26
LAM	Laminectomy	2,3	91	2.43	0.00	0.41	2.05	3.54	6.83
OMS	Other musculoskeletal	0	38	0.65	0.00	0.00	0.34	0.83	1.30
OMS	Other musculoskeletal	1	37	0.87	0.00	0.00	0.51	1.35	2.54
OPRO	Other prosthesis	0,1,2,3	29	0.67	0.00	0.00	0.00	0.75	2.24
OSKN	Other integumentary system	0,1,2,3	26	1.25	0.00	0.19	1.06	1.56	2.38
VS	Vascular surgery	0	61	0.89	0.00	0.00	0.00	1.88	3.79
VS	Vascular surgery	1	106	1.74	0.00	0.32	1.47	2.37	3.69
VS	Vascular surgery	2,3	94	4.51	0.98	2.99	4.65	6.63	8.85

CBGB, coronary artery bypass graft with chest and donor site incisions (eg, femoral or radial artery harvested as donor vessel for bypass graft); *CBGC*, coronary artery bypass graft with chest incision only (eg, use of internal mammary artery for bypass graft)
*Per 100 operations.
†Includes only those procedure-risk categories for which at least 20 hospitals have reported at least 20 operations

Table 7. Surgical site infection rates,* by selected operative procedure and modified risk index category incorporating laparoscope use,† Surgical Patient component, January 1992-June 2001

Operative Procedure Category		Duration Cutpoint	Risk Index (hrs)	Category	N	Risk Index Rate	Category	N
CHOL	Cholecystectomy	2	M	26,732	0.46	0	21,863	0.68
COLO	Colon surgery	3	M	420	1.67	0	12,833	4.02
APPY	Appendectomy	1	0-Yes	1644	0.73	0-No	6047	1.39
GAST	Gastric surgery	3	0-Yes	296	0.68	0-No	1969	2.79

*Per 100 operations.
†This table uses a modified risk index that incorporates the influence of laparoscope on SSI rates. The influence of scope on SSI rates was different across the 4 procedures:
For cholecystectomy and colon surgery, when the operation was done laparoscopically, 1 was subtracted from the number of risk factors present (ASA score of 3, 4, or 5; duration of surgery >75th percentile; or contaminated or dirty wound class) in the NNIS risk index. For example, when 2 risk factors were present and the procedure was done laparoscopically, the new modified risk index category is 1 (ie, 2-1=1). When no risk factors were present and the procedure was performed with a laparoscope (ie, 0-1=-1), we designated this new modified risk category as minus 1 or "M."
For appendectomy and gastric surgery, the use of a scope was important only if the patient had no other risk factors. We split patients with no other risk factors into 2 groups: "0-Yes," when laparoscope was used and "0-No" when laparoscope was not used. For gastric surgery, since there was no difference in the rates when 2 or 3 risk factors were present, the rates for categories 2 and 3 were combined into a single 2,3 category.

Table 8. Surgical site infection rates* after coronary artery bypass graft operation (CBGB), by risk index category and specific site, Surgical Patient component, January 1992-June 2001

Risk Index Category	0		1		2		3	
Infection site	**No. SSIs**	**Rate**	**No. SSIs**	**Rate**	**No. SSIs**	**Rate**	**No. SSIs**	**Rate**
Leg (Donor site)	**14**	**0.76**	**3889**	**1.58**	**1329**	**2.68**	**2**	**1.48**
Superficial incisional	10	0.54	3024	1.23	1040	2.09	2	1.48
Deep incisional	4	0.22	865	0.35	289	0.58	0	0.00
Chest	**8**	**0.44**	**4923**	**2.00**	**1490**	**3.00**	**11**	**8.15**
Superficial incisional	5	0.27	1879	0.76	573	1.15	3	2.22
Deep incisional	1	0.05	1385	0.56	396	0.80	4	2.96
Organ/space	2	0.11	1659	0.67	521	1.05	4	2.96
Total	**22**	**1.20**	**8812**	**3.57**	**2819**	**5.68**	**13**	**9.63**

*Per 100 operations.
Denominators for the risk categories are as follows:
Category 0 = 1836
Category 1 = 246,638
Category 2 = 49,673
Category 3 = 135

standard deviation) during the previous 5 years (shaded bars). Finally, the number of isolates tested from January to December 2000 and the percentage increase in the resistance rate during 2000 compared with the previous 5 years are shown in the 2 columns to the right of the graph. The continuing increase in antimicrobial resistance in US hospitals remains a concern. Of note, the proportion of *Staphylococcus aureus* isolates that were resistant to methicillin, oxacillin, or nafcillin (MRSA) continues to rise, and is more than 55%. However, the rate of increase has diminished for several pathogens, including vancomycin-resistant enterococci (VRE), which was reported as +40% in 1999 compared with +31% in 2000.[1] Although these data are limited to patients in ICUs, they are not risk-adjusted and comparisons of these rates between hospitals should be made with caution.

Tables 3 and 4 from the HRN component update the previously published, device-associated rates and DU ratios in each of 4 birth weight categories.[1,3] For the HRN component, device-days consist of the total number of ventilator-days and umbilical catheter or central line-days. Each of the analyses of HRN data excluded rates or DU ratios for units that did not report at least 50 device-days or patient-days. Because of this, the number of units contributing data in the tables is not exactly the same. Percent distributions of infections by major site of nosocomial infection and pathogens by major site, as well as other HRN analyses, have been published.[14]

Tables 5 through 8 from the Surgical Patient component update the last published rates.[1] Table 5 displays SSI rates by operative procedure and NNIS risk index category. When the SSI rates for adjacent risk categories for a particular operation were not statistically different, they were combined into a single risk category. For example, because the SSI rates for cardiac surgery with 2 or 3 risk factors were similar, the data were combined into a

Risk Index Rate	Category	N	Risk Index Rate	Category	N	Risk Index Rate	Category	N Rate
1	10115	1.93	2	3546	3.33	3	416	5.77
1	22139	5.76	2	9394	8.73	3	1343	11.62
1	7650	2.90	2	2816	4.90	3	323	8.67
1	3665	5.02	2,3	1690	10.36	—	—	—

new category 2,3. Thus, the number of risk index categories in the tables will differ depending upon the operation. The duration of operation cutpoints has not changed from the last published report.[1]

For a hospital to be represented in Table 6, it must have reported sufficient data, that is, at least 20 operations in a given risk index category for the procedure. Note that the percentile distributions are not available for every operative procedure and risk index category because percentile distributions of the procedure-specific and risk-index-specific rates required sufficient data from at least 20 hospitals.

Laparoscopes and endoscopes are being used with increasing frequency to perform operations. Table 7 lists 4 operations in which the use of a laparoscope has been incorporated into the SSI risk index. When other risk factors were controlled, cholecystectomy, colon surgery, gastric surgery, and appendectomy had lower SSI rates when a scope was used. However, there were some differences among these operations. For cholecystectomy and colon surgery, the influence of scope use was captured by subtracting one from the number of risk factors (ASA score ≥ 3; duration of surgery > 75th percentile; or contaminated or dirty wound class) present whenever the procedure was done laparoscopically. "M" indicates minus 1 (-1) in the modified risk category, where no risk factors were present and the procedure was performed with a laparoscope (ie, 0 – 1 = -1). For appendectomy and gastric surgery, the use of a scope was only important if the patient had no other risk factors. Therefore, we split the index value of zero risk factors into 0-No and 0-Yes. The percentile distributions of the 4 operative procedures with modified SSI risk index categories have not been developed at this time.

Table 8 displays SSI rates by specific site after coronary artery bypass graft (CBGB) operations in which incisions are made at both the chest and the donor vessel harvest sites.

The data in Tables 9 and 10 are from Phases 2 and 3 (January 1996-November 1999) of the Intensive Care Antimicrobial Resistance Epidemiology (ICARE) Project and the NNIS Antimicrobial Use and Resistance (AUR) component (December 1999-June 2001) and update previously published reports.[1,15,16] For the purpose of analysis, grams of antimicrobial agents were converted into number of defined daily doses (DDD) used each month in each hospital area. A DDD is the average daily dose in grams of a specific antimicrobial agent given to an average adult patient (Appendix A).[17] Table 9 shows use of selected oral and parenteral antimicrobial agents in DDD. Antimicrobial use was stratified by route of administration and hospital area. Because outpatient antimicrobial use could not be estimated reliably from hospital pharmacy records, data on outpatient antimicrobial use were not collected. Finally, antimicrobial agents with similar spectrum or clinical indications were grouped in Appendix A. Based on detailed analysis, antimicrobial use rates were found to vary by type of ICU, so use rates and percentiles are shown for each type of ICU for which at least 20 units reported data. The number of burn, respiratory, and trauma ICUs reporting data is insufficient to provide percentile distributions for these types of ICUs. The number of neurosurgical ICUs and hematology/oncology/transplant wards is insufficient to provide percentile distributions; only pooled mean use rates are displayed. Table 10 shows ICARE/AUR resistance data for selected antimicrobial-resistant bacteria based on reported antimicrobial susceptibility test results on all nonduplicate clinical isolates processed by the laboratory during each study month. A duplicate isolate was defined as an isolate of the same species of bacteria with the same antimicrobial susceptibility pattern in the same patient in the same month, regardless of the site of isolation. All isolates, whether responsible for hospital-acquired or community-acquired infection or for colonization, were reported to ICARE/AUR by participating hospitals. Hospitals used National Committee for Clinical Laboratory Standards interpretive standards for minimum inhibitory concentration or zone diameter testing standards to report numbers of susceptible, intermediate, or resistant organisms. A minimum of 10 isolates must be tested in a hospital area for resistance rates to be calculated for that area. Resistance data have been combined for all ICU types because

Table 9. Pooled means and percentiles of the distribution of antimicrobial usage rates (DDD* rates†), by non-ICU inpatient areas and various types of ICU, ICARE/AUR component, January 1998 – June 2001

Non-ICU inpatient areas (n = 68)

			Percentile				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Penicillin group	91,536	9.4	0.8	3.2	5.8	9.8	16.2
Ampicillin group	653,436	66.9	37.6	49.9	62.9	84.6	110.8
Antipseudomonal penicillins	177,068	18.1	2.6	8.2	17.1	29.6	47.9
Antistaphylococcal penicillins	148,059	15.2	2.8	4.5	11.6	18.3	26.9
First-generation cephalosporins	773,646	79.2	45.6	59.6	76.6	106.7	138.9
Second-generation cephalosporins	392,378	40.2	13.7	21.8	32.1	52.2	74.9
Third-generation cephalosporins	889,363	91.0	34.4	51.8	81.1	120.3	150.3
Carbapenem group	55,153	5.6	0.3	1.6	4.5	9.0	14.5
Aztreonam	24,146	2.5	0.1	0.7	1.7	4.0	7.0
Fluoroquinolones	610,392	62.5	24.8	40.2	61.9	103.2	161.5
Trimethoprim/ sulfamethoxazole	457,577	46.8	1.0	17.9	27.3	43.8	112.2
Vancomycin (oral)	18,897	1.9	0.1	0.5	1.3	2.3	4.2
Vancomycin (parenteral)	281,998	28.9	12.7	17.0	23.6	40.3	60.9

Coronary Care Unit (n = 31)

			Percentile				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Penicillin group	592	4.7	0.0	0.2	1.6	8.6	17.6
Ampicillin group	4955	39.1	10.4	20.7	37.0	65.8	87.6
Antipesudomonal penicillins	3870	30.5	0.0	2.4	21.7	46.6	60.0
Antistaphylococcal penicillins	2253	17.8	0.0	2.8	12.0	34.1	49.2
First-generation cephalosporins	6636	52.4	9.0	27.8	37.5	54.8	104.9
Second-generation cephalosporins	4359	34.4	2.5	9.2	23.2	34.6	53.9
Third-generation cephalosporins	15,694	123.8	33.8	47.3	120.3	143.8	187.1
Carbapenem group	1067	8.4	0.0	0.0	6.1	10.2	26.7
Aztreonam	718	5.7	0.0	0.0	2.0	12.4	14.9
Fluoroquinolones	8864	69.9	9.7	16.3	39.9	89.7	136.7
Trimethoprim/sulfamethoxazole	4443	35.1	0.0	6.7	17.1	34.1	106.4
Vancomycin (oral)	468	3.7	0.0	0.0	0.0	1.1	6.7
Vancomycin (parenteral)	6356	50.2	11.2	19.0	35.1	86.7	105.9

Cardiothoracic ICU (n = 20)

			Percentile				
Antimicrobial agent	**No. DDD***	**Pooled mean**	**10%**	**25%**	**50% (median)**	**75%**	**90%**
Penicillin group	398	4.6	0.0	0.0	0.7	4.7	10.0
Ampicillin group	2779	32.4	3.7	7.4	27.1	37.2	57.0
Antipesudomonal penicillins	2269	26.5	0.1	4.3	16.7	37.5	51.8
Antistaphylococcal penicillins	1386	16.2	0.0	0.0	5.0	19.3	28.4
First-generation cephalosporins	25,674	299.5	54.9	213.0	268.3	483.5	709.0
Second-generation cephalosporins	6155	71.8	3.5	10.6	33.3	102.3	554.7

Table 9. (continued)

Non-ICU inpatient areas (n = 68)

Antimicrobial agent	No. DDD*	Pooled mean	Percentile 10%	25%	50% (median)	75%	90%
Third-generation cephalosporins	10,300	120.1	18.4	44.5	82.8	131.1	207.7
Carbapenem group	1547	18.0	0.0	0.3	8.8	21.3	49.8
Aztreonam	673	7.8	0.0	0.4	1.4	5.6	21.6
Fluoroquinolones	5024	58.6	7.4	14.0	45.2	120.5	171.2
Trimethoprim/sulfamethoxazole	1065	12.4	0.0	0.8	7.8	14.0	61.1
Vancomycin (oral)	469	5.5	0.0	0.0	0.0	0.8	15.0
Vancomycin (parenteral)	10,891	127.0	23.8	60.0	104.1	192.3	277.2

Hematology/Oncology/Transplant Wards (n = 17)

Antimicrobial agent	No. DDD*	Pooled mean	10%	25%	50% (median)	75%	90%
Penicillin group	605	6.2					
Ampicillin group	5204	53.2					
Antipseudomonal penicillins	3134	32.0					
Antistaphylococcal penicillins	1429	14.6					
First-generation cephalosporins	4060	41.5					
Second-generation cephalosporins	2709	27.7					
Third-generation cephalosporins	30,937	316.2					
Carbapenem group	1706	17.4					
Aztreonam	816	8.3					
Fluoroquinolones	13,802	141.1					
Trimethoprim/sulfamethoxazole	3768	38.5					
Vancomycin (oral)	442	4.5					
Vancomycin (parenteral)	9416	96.2					

Medical ICU (n = 34)

			Percentile 10%	25%	50% (median)	75%	90%
Penicillin group	1189	7.2	0.0	1.3	4.6	9.4	20.3
Ampicillin group	15,348	92.6	37.2	56.2	72.8	98.0	140.6
Antipesudomonal penicillins	12,371	74.6	9.6	26.5	68.9	112.9	128.7
Antistaphylococcal penicillins	5909	35.6	0.0	5.4	21.3	39.2	58.5
First-generation cephalosporins	4886	29.5	8.8	16.4	30.4	40.5	59.5
Second-generation cephalosporins	6088	36.7	2.7	11.5	26.5	56.3	69.0
Third-generation cephalosporins	51,294	309.4	92.2	110.1	190.4	311.5	386.1
Carbapenem group	5721	34.5	0.0	7.9	24.7	37.2	98.3
Aztreonam	1330	8.0	0.0	2.1	6.6	13.4	17.6
Fluoroquinolones	20,772	125.3	29.5	56.8	86.9	137.6	276.2
Trimethoprim/sulfamethoxazole	12,249	73.9	1.9	17.6	33.7	58.7	97.8
Vancomycin (oral)	264	1.6	0.0	0.0	0.8	1.7	6.6
Vancomycin (parenteral)	19,838	119.7	42.9	58.5	74.1	151.4	227.3

Medical-Surgical ICU (n = 55)

Antimicrobial agent	No. DDD*	Pooled mean	Percentile 10%	25%	50% (median)	75%	90%
Penicillin group	2178	6.3	0.0	0.5	2.0	6.6	19.5
Ampicillin group	28,356	81.7	19.8	36.3	73.2	124.3	139.7
Antipseudomonal penicillins	26,777	77.2	19.8	36.9	66.9	92.0	139.7
Antistaphylococcal penicillins	7452	21.5	1.0	4.7	11.5	22.7	44.4
First-generation cephalosporins	40,301	116.2	25.1	61.4	85.1	132.8	209.2
Second-generation cephalosporins	17,498	50.4	4.7	13.0	33.5	65.3	105.4

Table 9. (continued)

Antimicrobial agent	No. DDD*	Pooled mean	Percentile 10%	25%	50% (median)	75%	90%
Third-generation cephalosporins	75,429	217.4	85.0	122.9	199.4	270.0	322.1
Carbapenem group	10,661	30.7	3.4	6.4	21.3	40.2	56.5
Aztreonam	3619	10.4	0.0	1.7	6.5	15.3	25.3
Fluoroquinolones	49,358	142.3	38.8	64.4	120.9	215.8	284.9
Trimethoprim/sulfamethoxazole	14,517	41.8	0.0	9.8	18.7	46.1	100.7
Vancomycin (oral)	2054	5.9	0.0	0.0	2.5	5.9	10.4
Vancomycin (parenteral)	26,563	76.6	30.0	50.3	66.6	105.4	137.4

Neurosurgical ICU (n = 11)

Antimicrobial agent	No. DDD*	Pooled mean
Penicillin group	351	6.6
Ampicillin group	2658	49.8
Antipseudomonal penicillins	2412	45.2
Antistaphylococcal penicillins	3289	61.6
First-generation cephalosporins	6458	121.0
Second-generation cephalosporins	1162	21.8
Third-generation cephalosporins	11,574	216.9
Carbapenem group	1460	27.4
Aztreonam	77	1.4
Fluoroquinolones	3797	71.2
Trimethoprim/sulfamethoxazole	2399	44.9
Vancomycin (oral)	74	1.4
Vancomycin (parenteral)	5301	99.3

Surgical ICU (n = 32)

No. Antimicrobial agent	Pooled DDD*	Pooled mean	Percentile 10%	25%	50% (median)	75%	90%
Penicillin group	1578	9.0	0.0	0.8	3.7	10.0	14.5
Ampicillin group	17,565	100.6	31.5	53.2	85.3	147.0	165.1
First-generation cephalosporins	35,022	200.6	66.4	110.9	168.0	324.8	475.2
Second-generation cephalosporins	8858	50.7	3.7	26.7	51.1	77.7	96.1
Third-generation cephalosporins	33,247	190.4	73.3	115.1	144.3	178.4	222.8
Carbapenem group	8284	47.4	1.2	7.7	21.5	53.2	71.5
Antipseudomonal penicillins	9662	55.3	4.3	22.6	47.6	81.8	105.7
Antistaphylococcal penicillins	4998	28.6	0.7	3.8	13.8	32.7	55.3
Aztreonam	1362	7.8	1.4	5.2	7.5	12.3	19.3
Fluoroquinolones	18,116	103.7	34.2	45.9	84.2	106.5	166.1
Trimethoprim/sulfamethoxazole	7943	45.5	4.6	12.7	24.0	45.1	92.3
Vancomycin (oral)	880	5.0	0.0	0.1	1.4	3.3	11.3
Vancomycin (parenteral)	32,471	186.0	54.8	65.3	101.7	155.9	186.9

Pediatric ICU (n = 16)

Antimicrobial agent	No. DDD*	Pooled mean
Penicillin group	295	6.0
Ampicillin group	2120	43.4
Antipseudomonal penicillins	604	12.4
Antistaphylococcal penicillins	1356	27.8
First-generation cephalosporins	2294	47.0
Second-generation cephalosporins	1733	35.5
Third-generation cephalosporins	9846	201.7

Table 9. cont'd

Antimicrobial agent	No. DDD*	Pooled mean
Carbapenem group	329	6.7
Aztreonam	90	1.8
Fluoroquinolones	405	8.3
Trimethoprim/sulfamethoxazole	659	13.5
Vancomycin (oral)	157	3.2
Vancomycin (parenteral)	2926	59.9

*Defined daily dose (DDD) of antimicrobial agent is calculated by dividing the total grams of the antimicrobial agent used in a hospital area by the number of grams in an average daily dose of the agent given to an adult patient.
†DDD per 1,000 patient-days = $\frac{\text{DDD of specific agent used}}{\text{Total number of patient-days}} \times 1000$

Table 10. Pooled means and percentiles of the distribution of antimicrobial resistance rates,* by all ICUs combined, non-ICU inpatient units, and by outpatients, ICARE/AUR component, January 1998–June 2001

All ICUs combined

Antimicrobial-resistant pathogen	No. units	No. tested	Pooled mean rate	Percentile				
				10%	25%	50% (median)	75%	90%
Methicillin-resistant *Staphylococcus aureus*	142	16,911	50.5	21.4	30.0	44.9	58.5	66.7
Methicillin-resistant CNS	127	10,647	75.5	53.8	68.0	75.2	81.0	88.2
Vancomycin-resistant *enterococcus* spp	126	10,923	12.5	0.0	2.9	13.0	23.7	37.5
Ciprofloxacin/ofloxacin-resistant *Pseudomonas aeruginosa*	121	10,495	36.0	7.7	16.7	27.8	41.7	55.5
Levofloxacin-resistant *P aeruginosa*	51	3177	37.0	8.4	18.2	27.3	41.4	57.1
Imipenem-resistant *P aeruginosa*	109	9077	19.3	3.8	8.7	13.9	26.9	38.6
Ceftazidime-reisistant *P aeruginosa*	114	9732	13.4	0.0	5.0	10.8	17.4	25.0
Piperacillin-resistant *P aeruginosa*	106	8844	17.0	2.4	6.6	14.2	19.5	31.7
Cef3-resistant *Enterobacter* spp	98	3734	25.7	7.7	18.6	23.9	35.7	47.4
Carbapenem-resistant *Enterobacter spp*	80	3150	0.9	0.0	0.0	0.0	0.0	4.7
Cef3-resistant *Klebsiella pneumoniae*	105	5735	6.1	0.0	0.0	1.3	8.0	21.9
Cef3-resistant *Escherichia coli*	127	9340	1.1	0.0	0.0	0.0	2.4	6.7
Quinolone-resistant *E coli*	122	9139	5.4	0.0	0.0	2.3	5.6	12.8
Penicillin-resistant pneumococci	41	915	20.2	0.0	5.4	15.8	30.8	52.6
Cefotaxime/ceftriaxone-resistant pneumococci	28	584	8.4	0.0	0.0	4.7	10.3	29.4

Non-ICU inpatient areas

Antimicrobial-resistant pathogen	No. units	No. tested	Pooled mean rate	Percentile				
				10%	25%	50% (median)	75%	90%
Methicillin-resistant *Staphylococcus aureus*	50	26,544	39.9	23.2	28.3	40.7	49.5	57.7
Methicillin-resistant CNS	48	16,394	63.6	52.1	56.5	63.0	69.6	75.0
Vancomycin-resistant *Enterococcus spp*	49	21,669	12.0	1.8	3.5	7.1	12.8	18.6
Ciprofloxacin/ofloxacin-resistant *Pseudomonas aeruginosa*	49	15,191	26.4	12.8	17.9	26.7	32.5	39.0
Levofloxacin-resistant *P aeruginosa*	23	4728	27.6	14.4	18.0	27.2	31.3	33.3
Imipenem-resistant *P aeruginosa*	47	11,476	12.8	3.6	6.6	9.9	14.3	20.1
Ceftazidime-reisistant *P aeruginosa*	47	13,507	8.1	1.6	3.8	5.6	10.6	12.8
Piperacillin-resistant *P aeruginosa*	46	11,748	11.3	2.7	5.5	8.9	13.3	17.9
Cef3-resistant *Enterobacter* spp	45	4934	20.0	5.7	13.3	20.0	25.7	28.6
Carbapenem-resistant *Enterobacter* spp	41	3633	1.2	0.0	0.0	0.0	1.1	3.2
Cef3-resistant *Klebsiella pneumoniae*	49	9531	5.7	0.0	0.0	1.3	4.4	10.2
Cef3-resistant *Escherichia coli*	49	26,771	1.0	0.0	0.0	0.4	1.1	3.0
Quinolone-resistant *E coli*	50	26,747	4.5	0.4	1.2	2.7	4.5	7.0
Penicillin-resistant pneumococci	36	2603	19.2	0.0	5.7	11.6	20.3	33.3
Cefotaxime/ceftriaxone-resistant pneumococci	27	1504	7.8	0.0	1.4	4.8	10.5	14.3

Table 10. (continued)

Outpatient areas

Antimicrobial-resistant pathogen	No. units	No. tested	Pooled mean	Percentile 10%	25%	50% (median)	75%	90%
Methicillin-resistant *Staphylococcus aureus*	46	22,017	24.1	13.3	18.3	24.0	29.2	36.2
Methicillin-resistant CNS	45	11,086	46.7	36.8	41.5	47.4	53.2	61.2
Vancomycin-resistant *Enterococcus* spp	43	15,474	4.9	0.0	1.2	3.5	5.9	9.1
Ciprofloxacin/ofloxacin-resistant *Pseudomonas aeruginosa*	44	10,187	22.9	12.2	15.9	24.3	30.1	40.2
Levofloxacin-resistant *P aeruginosa*	23	4728	27.6	14.4	18.0	27.2	31.3	33.3
Imipenem-resistant *P aeruinosa*	47	11,476	12.8	3.6	6.6	9.9	14.3	20.1
Ceftazidime-reisistant *P aeruginosa*	43	8681	4.4	0.0	2.2	3.8	5.9	7.7
Piperacillin-resistant *P aeruginosa*	38	7444	5.5	0.0	1.9	4.1	6.0	10.6
Cef3-resistant *Enterobacter* spp	40	3685	9.3	2.1	5.4	9.5	13.7	17.4
Carbapenem-resistant *Enterobacter* spp	36	2237	0.7	0.0	0.0	0.0	0.0	2.4
Cef3-resistant *Klebsiella pneumoniae*	43	10,076	1.6	0.0	0.0	0.8	1.9	5.7
Cef3-resistant *Escherichia coli*	46	59,352	0.3	0.0	0.0	0.1	0.6	0.9
Quinolone-resistant *E coli*	45	56,202	2.1	0.3	0.9	2.0	2.9	5.6
Penicillin-resistant pneumococci	37	3169	19.0	0.0	5.1	10.7	20.5	31.5
Cefotaxime/ceftriaxone-resistant pneumococci	33	2188	5.6	0.0	0.0	2.9	7.3	26.3

CNS, Coagulase-negative staphylococci; *Cef3,* ceftazidime, cefotaxime, or ceftriaxone; *Quinolone,* ciprofloxacin, floxacin, or levofloxacin; *Carbapanem*, imipenem or meropenem

*For each antimicrobial agent and pathogen combination resistance rates were calculated as $\frac{\text{number of resistant isolates}}{\text{number of isolates tested}} \times 100$.

detailed analysis demonstrated that, in general, resistance rates (% prevalence) did not differ by type of ICU. Also, these data show that for most antimicrobial-resistant bacteria, resistance rates are highest in the ICU areas, followed by non-ICU inpatient areas, with lowest rates in the outpatient areas.

If you would like to compare your hospital's rates and ratios with those in this report, you must first collect information from your hospital in accordance with the methods described for the NNIS System.[5-7] You should also refer to Appendices B and C for further instructions. Appendix B discusses the calculation of infection rates and DU ratios for the ICU or HRN surveillance components. Appendix C gives a step-by-step method for interpretation of percentiles of infection rates or DU ratios. A high rate or ratio (> 90th percentile) does *not* necessarily define a problem; it only suggests an area for further investigation. Similarly, a low rate or ratio (< 10th percentile) may be the result of inadequate infection detection.

Hospitals should use these data to guide local improvement efforts aimed at reducing infection rates as much as possible.

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APPENDIX A. Defined daily dose (DDD) of antimicrobial agents, by class and group

Class	Group	Antimicrobial agent	DDD
β-Lactams	Penicillin group	Penicillin G	12×10^6 U
		Procaine penicillin G	2.4×10^6 U
		Penicillin G benzathine	1.2×10^6 U
		Penicillin V	1 g
	Ampicillin group	Ampicillin (parenteral)	4 g
		Ampicillin (oral)	2 g
		Ampicillin/sulbactam	6 g
		Amoxicillin (oral)	1.5 g
		Amoxicillin/Clavulanic acid (oral	1.5 g
	Antistaphylococcal penicillins (Methicillin group)	Nafcillin	4 g
		Oxacillin	4 g
		Dicloxacillin (oral)	2 g
	Antipseudomonal penicillins	Piperacillin	18 g
		Piperacillin/Tazobactam	13.5 g
		Ticarillin	18 g
		Ticarillin/Clavulanic acid	12.4 g
	1st-generation cephalosporins	Cefazolin	3 g
		Cephalothin	4 g
		Cefadroxil (oral)	2 g
		Cephalexin (oral)	2 g
	2nd-generation cephalosporins	Cefotetan	2 g
		Cefmetazole	4 g
		Cefoxitin	4 g
		Cefuroxime	3 g
		Cefuroxime axetil (oral)	1 g
		Cefaclor (oral)	1 g
		Cefprozil (oral)	1 g
	3rd-generation cephalosporins	Cefotaxime	3 g
		Ceftazidime	3 g
		Ceftizoxime	3 g
		Ceftriaxone	1 g
		Cefixime (oral)	0.4 g
		Cefipime	4 g
	Carbapenems	Meropenem	3 g
		Imipenem cilastatin	2 g

Appendix A. cont'd

Class	Group	Antimicrobial agent	DDD
Other β-Lactams		Aztreonam	4 g
Glycopeptides		Vancomycin (parenteral)	2 g
		Vancomycin (oral)	1 g
Fluoroquinolones		Ciprofloxacin (parenteral)	0.8 g
		Ciprofloxacin (oral)	1.5 g
		Ofloxacin (parenteral)	0.8 g
		Ofloxacin (oral)	0.8 g
		Levofloxacin (parenteral)	0.5 g
		Levofloxacin (oral)	0.2 g
		Trovafloxacin (parenteral)	0.2 g
		Trovafloxacin (oral)	0.2 g
		Sparfloxacin (oral)	0.2 g
		Norfloxacin (oral)	0.8 g
		Lomefloxacin	0.4 g
Trimethoprim/		Trimethoprim component (oral)	0.32 g
Sulfamethoxazole		Trimethoprim compound (parenteral)	0.84 g

Adapted from Amsden GW, Schentagg JJ. Tables of antimicrobial agent pharmacology. In: Mandell GL, Bennett JE, Dolin R, editors. Principles and practice of infectious diseases. 4th ed. New York: Churchill Livingstone; 1995. P. 492-528.

APPENDIX B.

HOW TO CALCULATE A DEVICE-ASSOCIATED INFECTION RATE AND DEVICE UTILIZATION RATIO WITH ICU AND HRN COMPONENT DATA

Calculation of Device-associated Infection Rate

Step 1: Decide upon the time period for your analysis. It may be a month, a quarter, 6 months, a year, or some other period.

Step 2: Select the patient population for analysis (ie, the type of ICU or a birthweight category in the HRN).

Step 3: Select the infections to be used in the numerator. They must be site-specific and must have occurred in the selected patient population. Their date of onset must be during the selected period.

Step 4: Determine the number of device-days which is used as the denominator of the rate. Device-days are the total number of days of exposure to the device (central line, ventilator, or urinary catheter) by all of the patients in the selected population during the selected period.

Example: Five patients on the first day of the month had one or more central lines in place; five on day 2; two on day 3; five on day 4; three on day 5; four on day 6; and four on day 7. Adding the number of patients with central lines on days 1 through 7, we would have 5 + 5 + 2 + 5 + 3 + 4 + 4=28 central line-days for the first week. If we continued for the entire month, the number of central linedays for the month is simply the sum of the daily counts.

Step 5: Calculate the device-associated infection rate (per 1000 device-days) by using the following formula:

$$\text{Device-associated Infection Rate} = \frac{\text{Number of device-associated infections for a specific site}}{\text{Number of device-days}} \times 1000$$

Example: Central line-associated BSI rate per 1000 central line-days =

$$\frac{\text{Number of central line-associated BSI}}{\text{Number of central line-days}} \times 1000$$

Calculation of Device Utilization (DU) Ratio

Steps 1,2,4: Same as device-associated infection rates plus determine the number of patient-days which is used as the denominator of the DU ratio. Patient-days are the total number of days that patients are in the ICU (or HRN) during the selected period.

Example: Ten patients were in the unit on the first day of the month; 12 on day 2; 11 on day 3; 13 on day 4; 10 on day 5; 6 on day 6; and 10 on day 7; and so on. If we counted the patients in the unit from days 1 through 7, we would add 10 + 12 + 11 + 13 + 10 + 6 + 10 for a total of 72 patient-days for the first week of the month. If we continued for the entire month, the number of patient-days for the month is simply the sum of the daily counts.

Step 5: Calculate the DU ratio with the following formula:

$$\text{DU Ratio} = \frac{\text{Number of device-days}}{\text{Number of patient-days}}$$

With the number of device-days and patient-days from the examples above, DU = 28/72 = 0.39 or 39% of patient-days were also central line-days for the first week of the month.

Step 6: Examine the size of the denominator for your hospital's rate or ratio. Rates or ratios may not be good estimates of the "true" rate or ratio for your hospital if the denominator is small, (ie, < 50 device-days or patient-days).

Step 7: Compare your hospital's ICU/HRN rates or ratios with those found in the tables of this report. Refer to Appendix C for interpretation of the percentiles of the rates/ratios.

APPENDIX C.

INTERPRETATION OF PERCENTILES OF INFECTION RATES OR DEVICE UTILIZATION RATIOS

Step 1: Evaluate the rate (ratio) you have calculated for your hospital and confirm that the variables in the rate (both numerator and denominator) are identical to the rates (ratios) in the table.

Step 2: Examine the percentiles in each of the tables and look for the 50th percentile (or median). At the 50th percentile, 50% of the hospitals have lower rates (ratios) than the median and 50% have higher rates (ratios).

Step 3: Determine if your hospital's rate (ratio) is above or below this median.

Determining whether your hospital's rate or ratio is a HIGH outlier

Step 4: If it is above the median, determine whether the rate (ratio) is above the 75th percentile. At the 75th percentile, 75% of the hospitals had lower rates (ratios) and 25% of the hospital had higher rates (ratios).

Step 5: If the rate (ratio) is above the 75th percentile, determine whether it is above the 90th percentile. If it is, then the rate (ratio) is a high outlier which *may* indicate a problem.

Determining whether your hospital's rate or ratio is a LOW outlier

Step 6: If it is below the median, determine whether the rate (ratio) is below the 25th percentile. At the 25th percentile, 25% of the hospitals had lower rates (ratios) and 75% of the hospitals had higher rates (ratios).

Step 7: If the rate (ratio) is below the 25th percentile, determine whether it is below the 10th percentile. If the rate is, then it is a low outlier which may be due to underreporting of infections. If the ratio is below the 10th percentile, it is a low outlier and may be due to infrequent and/or short duration of device use.

Note: Device-associated infection rates and device utilization ratios should be examined together so that preventive measures may be appropriately targeted. For example, you find that the ventilator-associated pneumonia rate for a certain type of ICU is consistently above the 90th percentile and the ventilator utilization ratio is routinely between the 75th and 90th percentile. Since the ventilator is a significant risk factor for pneumonia, you may want to target your efforts on reducing the use of ventilators or limiting the duration with which they are used on patients in order to lower the ventilator-associated pneumonia rate in the unit.

APPENDIX D.

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