Brucellosis in the United States: Current Perspectives

Clinician Outreach and Communication Activity (COCA) Conference Call

August 25, 2011

Office of Public Health Preparedness and Response
Division of Emergency Operations

Objectives

At the conclusion of this session, the participant will be able to accomplish the following:

- Describe populations at risk for brucellosis in the United States
- List brucellosis diagnostic methods available in the United States and advantages and disadvantage of each
- Discuss main causes of *Brucella* laboratory exposures and risk assessment
- Discuss treatment regimens for brucellosis and patient follow up

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TODAY'S PRESENTER

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August 25, 2011

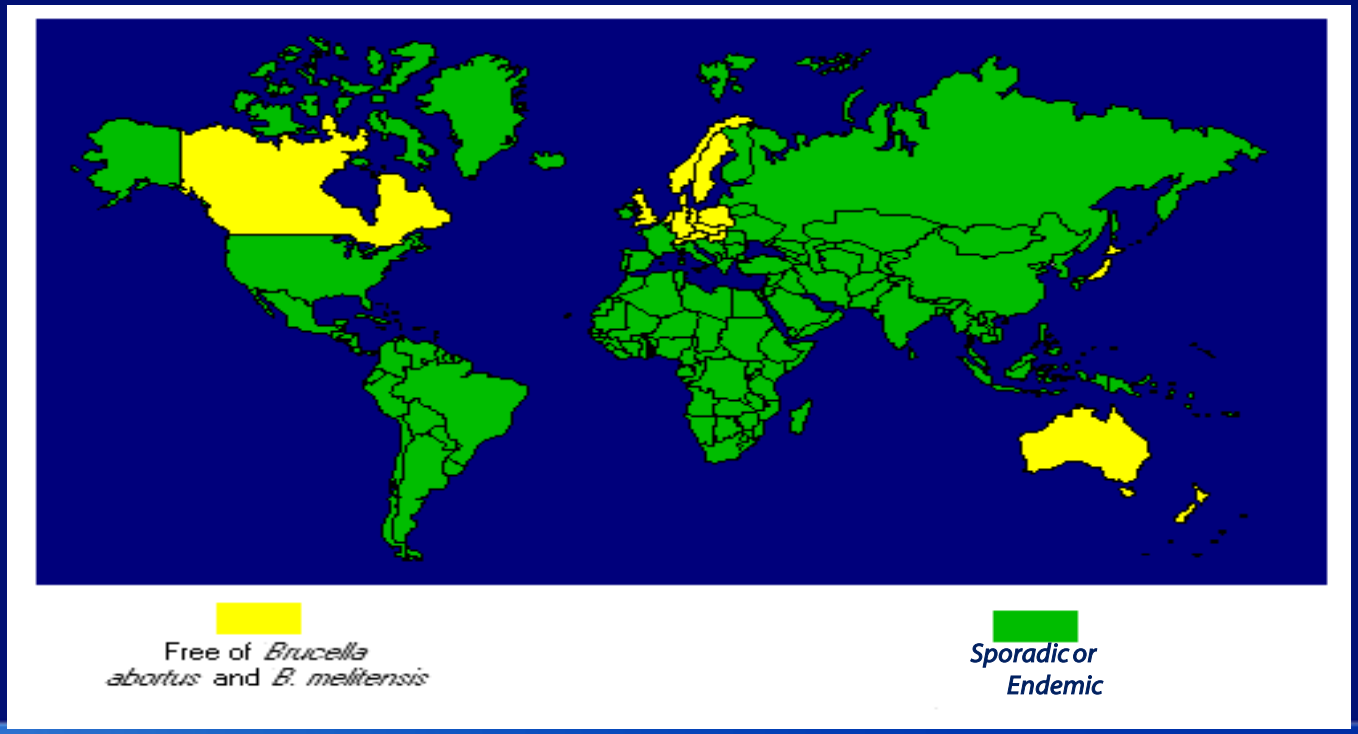
National Center for Emerging and Zoonotic Infectious Diseases
Division of High-Consequence Pathogens and Pathology

Outline

- Introduction
- History and Epidemiology
- Sources of Infection in the United States
- Surveillance
- Clinical Presentation
- Diagnosis
- Treatment
- Risk Groups
- Summary

Introduction

- **Brucellosis - worldwide zoonotic infection**
- **Economically important disease of domesticated animals**
- **Worldwide incidence of human brucellosis unknown**
  - Varies from <0.01 to >200 per 100,000 population



Identification of Species

- 1887: Bruce isolates *B. melitensis* from ill patient
- 1895: Bang identifies *B. abortus* in cattle – Denmark
- 1920: K.F. Meyer/E.B. Shaw- named changed to *Brucella* gen. nov.
- 1929: I.F. Huddleston *B. suis*
- 1956: M.B. Buddle *B. ovis*
- 1957: H.B. Stoenner *B. neotomae*
- 1968: L.M. Jones *B. canis*

Sir David Bruce

http://www.the-icsp.org/subcoms/Brucella.htm

Identification of Species

- **2001: A. Cloeckart** — *B. ceti , B. pinnipedialis*
- **2008: Scholz et al.** — *B. microti*
- **2010: Scholz et al.** — *B. inopinata*

- **Species have primary animal host preference**
  - Secondary hosts may have lesser role in maintenance and/or transmission
- **Four *Brucella* species- well known human pathogens**

http://www.the-icsp.org/subcoms/Brucella.htm

History - Steps toward Eradication in the U.S.

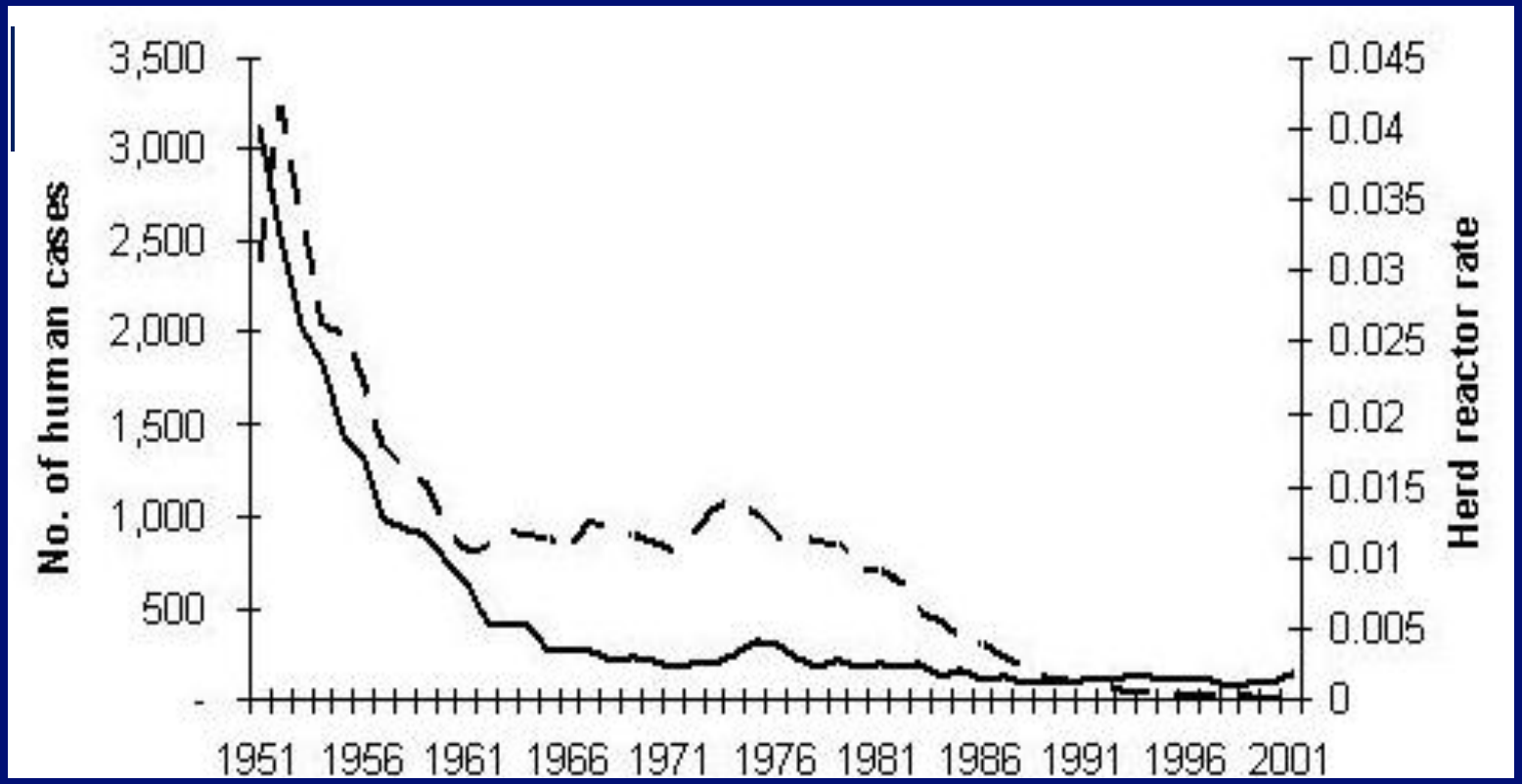
- **Brucellosis Eradication Program**
  - Implemented in 1934 in cattle
  - Expanded in 1954 and 1970s
  - 2008- no affected herds for first time (only lasted 3 months)
  - Continued surveillance by USDA and states

- **Laws regulating milk products- pasteurization**
  - Pasteurized Milk Ordinance (PMO) – 1924
  - Model regulation helping states and municipalities have an effective program to prevent milk borne disease

* Ragan, VE. Brucellosis in the United States. Past, present, and future. JAMA. 1980. 244: 2318-22

Epidemiology - Incidence and Prevalence

Annual Numbers of Reported Human Brucellosis Cases and Cattle Herd Reactor Rates in the US, 1951-2001



Glynn MK, Lynn TV. Brucellosis J Am Vet Med Assoc 2008;233(6):902

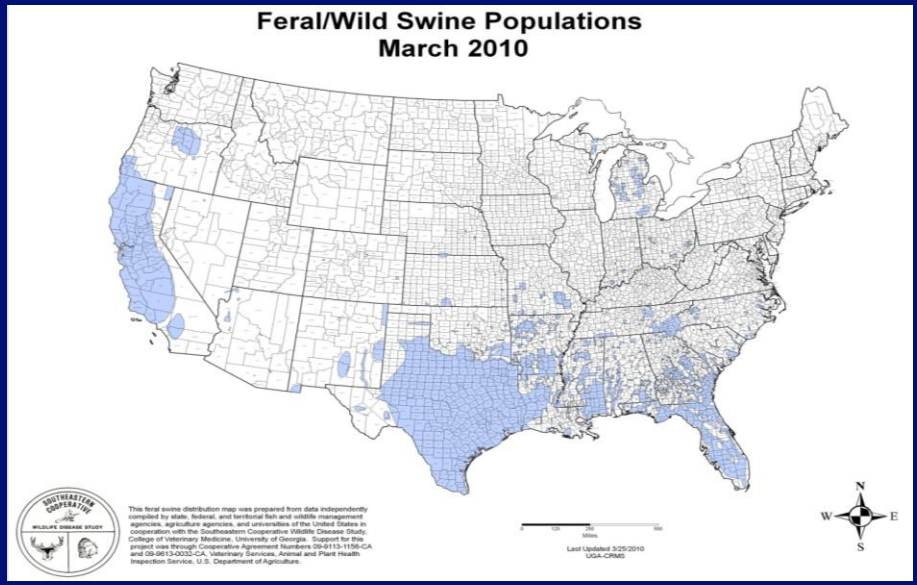
Sources of Infection in the US - *B. abortus*

- **Reproductive disease**
  - Cattle - primary host
  - Other primary hosts - bison, buffalo, elk, camels
  - Secondary hosts - goats, horses, dogs, wolves
- **Persistence in wildlife - bison and elk**
  - Present in Yellowstone Park and vicinity
  - Obstacle to eradication in US
- **Risk of importation**
  - Continued surveillance
  - Vigilance along southern border

http://www.aphis.usda.gov/animal_health/animal_diseases/brucellosis/downloads/yearly_rpt.pdf

Sources of Infection in the US - *B. suis*

- **Primary host: swine**
  - Secondary hosts- horses, caribou and reindeer (Alaska)
- **USDA Eradication Program**
  - Commercial swine
  - Expansion of the USDA cattle program to swine herds in 1972
  - Currently, only Texas not declared free of swine brucellosis

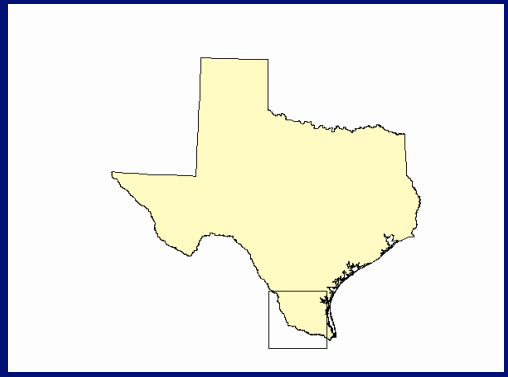


- **Brucellosis present in feral swine populations (4-5 million)**
  - Reported in 33 states
  - Largest populations in California, Texas, Florida and Hawaii
  - Range in U.S. increasing

* http:\\www.usda.aphis.gov

Sources of Infection in the US - *B. melitensis*

- **Primary hosts- sheep and goats**
- **Secondary hosts-cattle, camels, wild ruminants**
- ***B. melitensis* -found in sheep and goats in the U.S. until the early 1970s**
- **1999- last diagnosis in US**
  - Texas border county
- **Considered FAD - foreign animal disease**



* *Brucella melitensis* in Texas, October 1999 Impact Worksheet

Sources of Infection in the US - *B. canis*

- **Dogs considered principal reservoir**
- **Cause of abortion and reproductive failures in dogs**
  - Female dogs may shed *B. canis* through vaginal discharge
  - Male dogs may shed *B. canis* in urine
- **Euthanasia versus treatment**
  - Even with repeated testing- may be difficult to conclude that dog testing negative for *B. canis* is not infected
- **Outbreaks – kennels and shelters**
- **Reportable disease- varies by state**

Hollett RB. Canine brucellosis: Outbreaks and compliance. Theriogenology. 2006; 66: 575-587

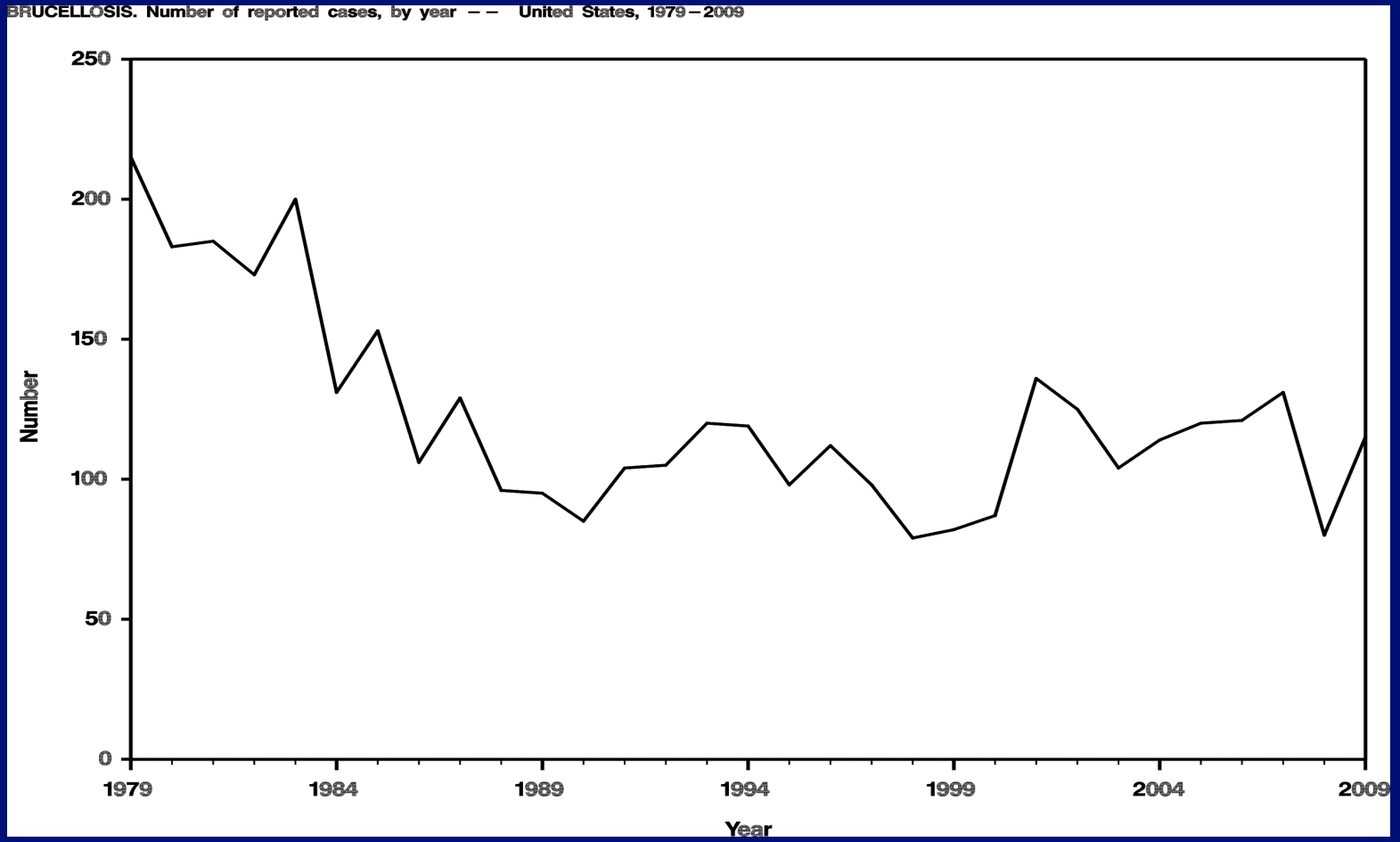
Shin S and Carmichael LE. Canine brucellosis caused by *Brucella canis* (23 Nov 1999) In: Recent Advances in Canine Infectious Diseases, L.E. Carmichael (Ed.) Publisher: International Veterinary Information Service (www.ivis.org)

Surveillance

- **Brucellosis – nationally notifiable disease**
- **Select agents - *B. abortus, suis* and *melitensis,* not *B. canis***
- **Cases reported through NNDSS - National Notifiable Diseases Surveillance System**
  - Minimal number of variables – age, sex, state of residence
  - Species not reported
  - Method of confirmation not reported

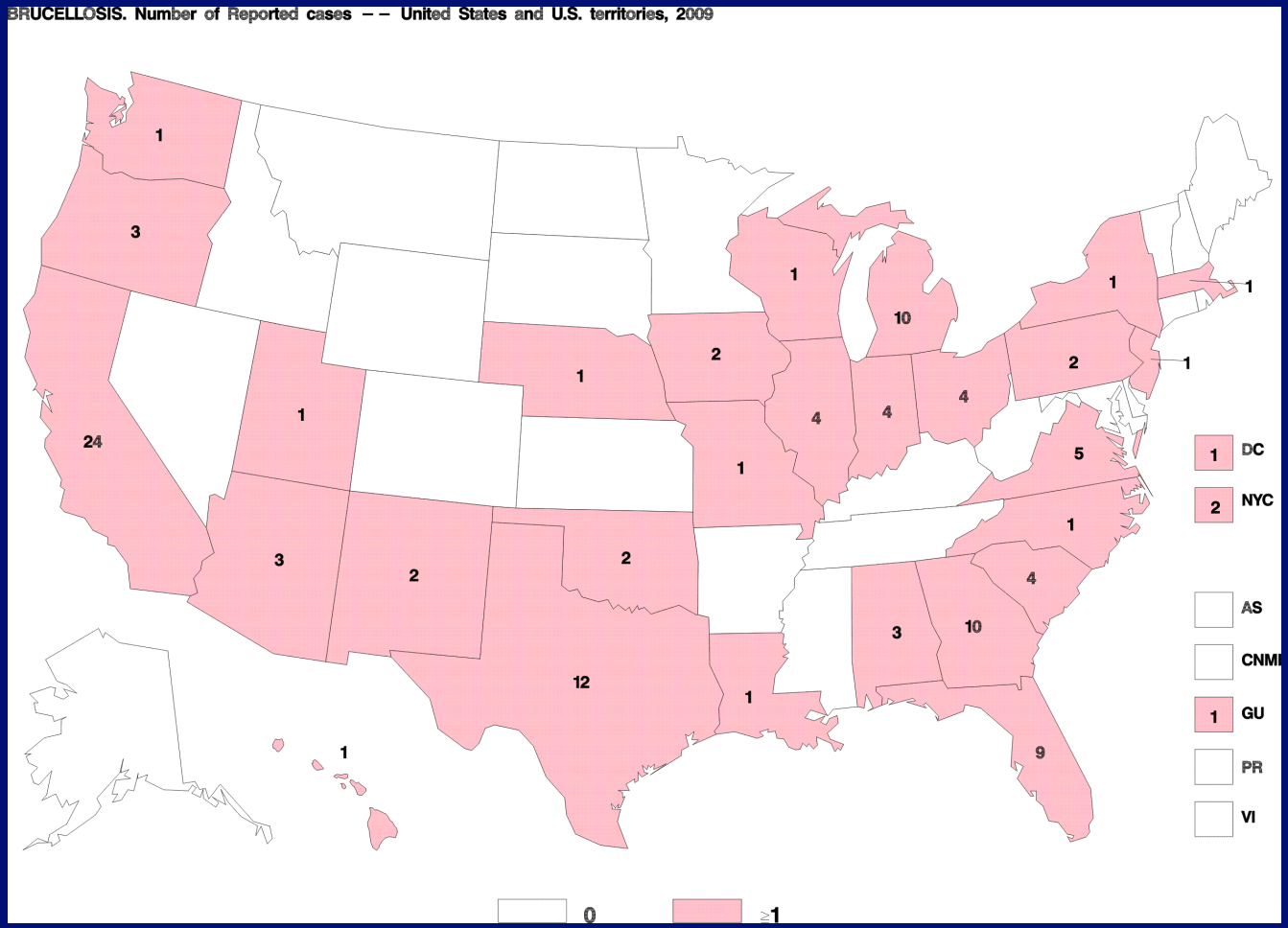
*MMWR-Summary of Notifiable Diseases- 2008

Human Cases of Brucellosis in the US 1979-2009



http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5853a1.htm?s_cid=mm5853a1_w

Human Cases of Brucellosis in the US by State- 2009



http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5853a1.htm?s_cid=mm5853a1_w

Surveillance -Revised CSTE case definition -2009

- **Clinical description**
  - An illness characterized by acute or insidious onset of fever and one or more of the following:

    night sweats, arthralgia, headache, fatigue, anorexia, myalgia, weight loss, arthritis/spondylitis, meningitis, or focal organ involvement (endocarditis, orchitis/epididymitis, hepatomegaly, splenomegaly)

http://www.cste.org/ps2009/09-ID-14.pdf

Surveillance -Revised CSTE case definition -2009

- **Laboratory criteria for diagnosis**
  - **Confirmed**
    - Culture and identification of *Brucella* spp. from clinical specimens, *or*
    - Evidence of a 4-fold or greater rise in *Brucella* antibody titer between acute- and convalescent –phase serum specimens obtained ≥ 2 weeks apart
  - **Probable**
    - *Brucella* total antibody titer ≥ 160 by standard tube agglutination test (SAT) or *Brucella* microagglutinaiton test (BMAT) in 1 or more serum specimens obtained after onset of symptoms,

      or
    - Detection of *Brucella* DNA in a clinical specimen by PCR assay

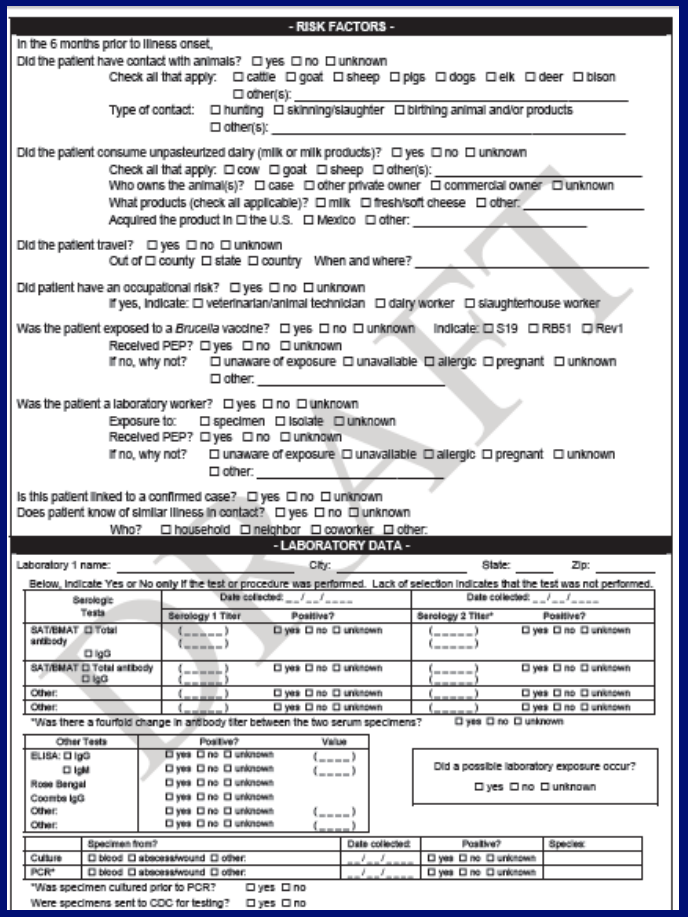
http://www.cste.org/ps2009/09-ID-14.pdf

Surveillance -Revised CSTE case definition -2009

- **Case classification**
  - Confirmed: a clinically compatible illness with definitive laboratory evidence of clinical infection
  - Probable: a clinically compatible illness with at least one of the following;
    - Epidemiologically linked to a confirmed human or animal brucellosis case
    - Presumptive laboratory evidence, but without definitive laboratory evidence, of *Brucella* infection

Surveillance

- **New Case Report Form developed**
- **Capture additional information:**
  - *Brucella* species – etiology
  - Risk factors
  - Mode of transmission
  - Demographics-ethnicity
  - History of travel



- RISK FACTORS -

In the 6 months prior to illness onset,

Did the patient have contact with animals? ☐ yes ☐ no ☐ unknown
Check all that apply: ☐ cattle ☐ goat ☐ sheep ☐ pigs ☐ dogs ☐ elk ☐ deer ☐ bison ☐ other(s): _____
Type of contact: ☐ hunting ☐ skinning/slaughter ☐ birthing animal and/or products ☐ other(s): _____

Did the patient consume unpasteurized dairy (milk or milk products)? ☐ yes ☐ no ☐ unknown
Check all that apply: ☐ cow ☐ goat ☐ sheep ☐ other(s): _____
Who owns the animal(s)? ☐ case ☐ other private owner ☐ commercial owner ☐ unknown
What products (check all applicable)? ☐ milk ☐ fresh/soft cheese ☐ other: _____
Acquired the product in ☐ the U.S. ☐ Mexico ☐ other: _____

Did the patient travel? ☐ yes ☐ no ☐ unknown
Out of ☐ county ☐ state ☐ country When and where? _____

Did patient have an occupational risk? ☐ yes ☐ no ☐ unknown
If yes, indicate: ☐ veterinarian/animal technician ☐ dairy worker ☐ slaughterhouse worker

Was the patient exposed to a *Brucella* vaccine? ☐ yes ☐ no ☐ unknown Indicate: ☐ S19 ☐ RB51 ☐ Rev1
Received PEP? ☐ yes ☐ no ☐ unknown
If no, why not? ☐ unaware of exposure ☐ unavailable ☐ allergic ☐ pregnant ☐ unknown ☐ other: _____

Was the patient a laboratory worker? ☐ yes ☐ no ☐ unknown
Exposure to: ☐ specimen ☐ isolate ☐ unknown
Received PEP? ☐ yes ☐ no ☐ unknown
If no, why not? ☐ unaware of exposure ☐ unavailable ☐ allergic ☐ pregnant ☐ unknown ☐ other: _____

Is this patient linked to a confirmed case? ☐ yes ☐ no ☐ unknown
Does patient know of similar illness in contact? ☐ yes ☐ no ☐ unknown
Who? ☐ household ☐ neighbor ☐ coworker ☐ other:

- LABORATORY DATA -

Laboratory 1 name: _____ City: _____ State: _____ Zip: _____

Below, indicate Yes or No only if the test or procedure was performed. Lack of selection indicates that the test was not performed.

Serologic Tests	Date collected: __/__/____ Serology 1 Titer	Positive?	Date collected: __/__/____ Serology 2 Titer*	Positive?
SAT/BMAT ☐ Total antibody ☐ IgG	(____) (____)	☐ yes ☐ no ☐ unknown	(____) (____)	☐ yes ☐ no ☐ unknown
SAT/BMAT ☐ Total antibody ☐ IgG	(____) (____)	☐ yes ☐ no ☐ unknown	(____) (____)	☐ yes ☐ no ☐ unknown
Other:	(____)	☐ yes ☐ no ☐ unknown	(____)	☐ yes ☐ no ☐ unknown
Other:	(____)	☐ yes ☐ no ☐ unknown	(____)	☐ yes ☐ no ☐ unknown

*Was there a fourfold change in antibody titer between the two serum specimens? ☐ yes ☐ no ☐ unknown

Other Tests	Positive?	Value
ELISA: ☐ IgG	☐ yes ☐ no ☐ unknown	(____)
☐ IgM	☐ yes ☐ no ☐ unknown	(____)
Rose Bengal	☐ yes ☐ no ☐ unknown	
Coombs IgG	☐ yes ☐ no ☐ unknown	
Other:	☐ yes ☐ no ☐ unknown	(____)
Other:	☐ yes ☐ no ☐ unknown	(____)

Did a possible laboratory exposure occur? ☐ yes ☐ no ☐ unknown

	Specimen from?	Date collected:	Positive?	Species:
Culture	☐ blood ☐ abscess/wound ☐ other:	__/__/____	☐ yes ☐ no ☐ unknown	
PCR*	☐ blood ☐ abscess/wound ☐ other:	__/__/____	☐ yes ☐ no ☐ unknown	

*Was specimen cultured prior to PCR? ☐ yes ☐ no

Were specimens sent to CDC for testing? ☐ yes ☐ no

DRAFT

http://www.cste.org/ps2009/09-ID-14.pdf

Routes of Transmission

- **Foodborne**
  - Ingestion of unpasteurized dairy products
- **Direct or indirect exposure of organism to broken skin or mucous membranes**
  - Aborted fetuses, placental fluid and tissues
  - Contaminated fomites
  - Inoculation with animal vaccine
  - Slaughtering and butchering process

- **Aerosol transmission**
  - Inhalation or conjunctival inoculation

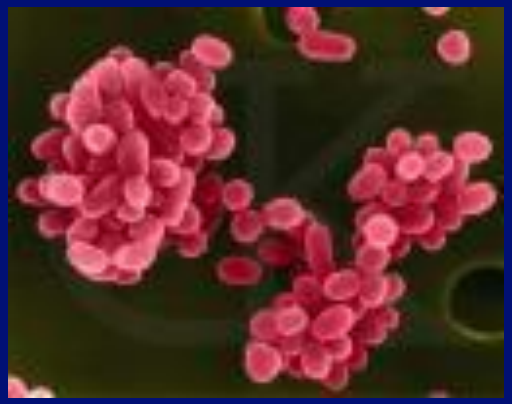
- **Person-to-person transmission very rare**

Transmission Potential

- **Products of parturition and abortion infectious**
  - Can contain up to 10^{10} bacteria/ml
- ***Brucellae* viable in placental tissues for 20 weeks**
- **Infectious dose (aerosol): 10^2-10^3 organisms**

Pathogen Characteristics

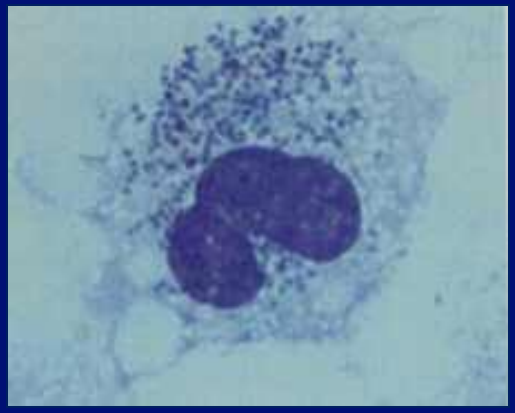
- **Small, aerobic, nonmotile, nonsporulating, Gram-negative coccobacilli**
- **Slow-growing in culture**
- **Intracellular pathogen**
- **Lipopolysaccharide is main antigen**
  - Smooth = more pathogenic
  - Rough = less pathogenic



B. abortus

Pathogenesis of Disease

- **Systemic infection – can involve most organs**
- **Initially localize in regional lymph nodes**
- **Bacteremic phase (2-8 weeks)**
- **May localize in:**
  - Spleen
  - Liver
  - Bone marrow
  - Joints
  - Reproductive organs
- **Severity in humans:** ***B. melitensis > B. suis > B.>abortus > B. canis***



***B. melitensis* inside macrophage**

Clinical Presentation

- **Incubation period variable: 2-4 weeks**
  - (range: 5 days to 5 months)
- **Clinical presentations:**
  - Fever - undulant, periodic
  - Often presents as fever of unknown origin (FUO)
  - Nonspecific- muscle aches , chills, fatigue, headache, night sweats
  - Arthritis, meningitis, osteomyelitis, endocarditis
  - Relapse and chronic disease can occur
  - Often difficult to recognize, diagnose, and treat

Chronic Manifestations I

- **Undulant fever (continuous or intermittent)**
- **Localized infections in 30% of patients**
- **Hepatomegaly or splenomegaly (20-30%)**
- **Osteoarticular complications (20-60%)**
  - Sacroilitis - most common, spondylitis
- **Genito-urinary complications (2-20%)**
  - Orchitis and epididymitis- most common

Chronic Manifestations II

- **Endocarditis (2-3%)**
  - Primary cause of mortality
- **Neurobrucellosis- rare**
- **Neuropsychiatric symptoms**
  - Depression
  - Difficulty concentrating
  - Sleep disturbance

Diagnosis I

- **Culture – diagnostic gold standard**
  - Best yield from blood, bone marrow
    - Occasionally from tissues, cerebrospinal fluid, joint aspirate, urine if focal infection present
    - May require prolonged incubation
  - Sample obtained before antimicrobial treatment
  - Species identification – reference laboratory
  - PCR- performed after isolation
  - Select agent - must be reported (not *B. canis*)

Diagnosis II

- **Serology- most common method of diagnosis**
  - Acute-phase serum specimens- as soon as possible after fever onset
  - Convalescent-phase specimens- 14-21 days after symptom onset
- **Serum agglutination test (SAT)- standard**

Serodiagnostic Tests

- **Serum agglutination test (SAT)**
  - Measures agglutinating antibodies
  - Detects IgM, IgG1&2, IgA
- **Rose bengal plate test (RBT)**
  - Useful for screening, highly sensitive
  - Detects IgG1

Serodiagnostic Tests

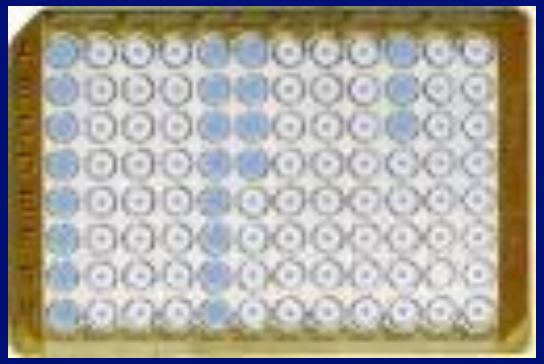
- **Complement fixation test (CFT)**
  - Useful for confirmation, highly specific
  - Detects IgM & IgG1
- **Anti-globulin Coombs test**
  - Detects IgG2
  - Confirmatory, useful when SAT is positive and CFT inconclusive

Serodiagnostic Tests

- **Enzyme-linked immunoassay (ELISA)**
  - Commercially available
  - Cross-reactivity with *Yersinia enterocolitica* Y0:9
  - Positive results confirmed by second method
  - Not useful for screening

Serodiagnostic Tests

- ***Brucella* microscopic agglutination test (BMAT)**
  - Performed at CDC
  - Uses less antigens, shorter incubation time
  - More sensitive
  - Useful for testing large number of specimens (up to 70-100 specimens in a single run)
  - Use 2-mercaptoethanol and rivanol tests to separate IgM and IgG agglutinating antibodies



Diagnostics - Issues

- **Serology – primary method of diagnosis**
  - Commercially available tests not validated
  - IgM tests result in increased number of false negatives
  - Need acute and convalescent samples
  - BMAT and other agglutination tests may not diagnose chronic infections
  - Lack of awareness that available serological tests cannot diagnose *B. canis* infections
  - Qualitative versus quantitative tests
- **Culture and isolation**
  - High rate of laboratory exposures
  - Identification of species performed at Laboratory Response Network (LRN) laboratories
  - PCR performed on isolates, not clinical specimens

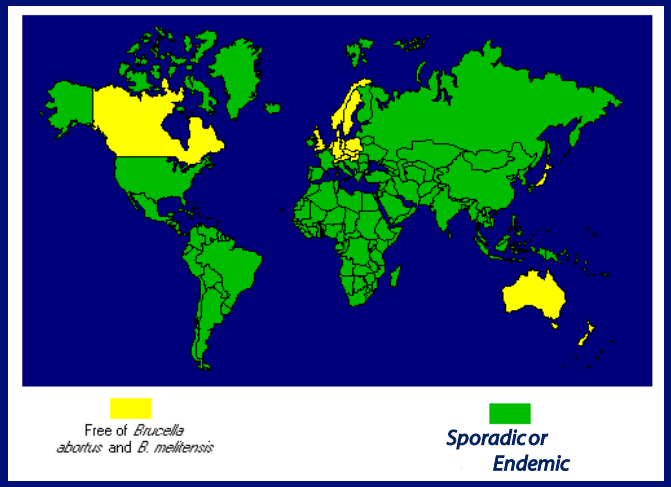
Treatment

- **Uncomplicated brucellosis**
  - Doxycycline 100mg bid + rifampin 600- 900 mg/day (for 6 weeks)
  - Doxycycline 100mg bid (6 weeks) + streptomycin 1g/day (for first 2-3 weeks)
- **Pediatric patients (uncomplicated)**
  - Doxycycline + rifampin (children >8 yrs)
  - Trimethoprim-sulfamethoxazole + rifampin (6 weeks)
- **Relapses**
  - Late initiation of therapy
  - Premature discontinuation of therapy

Ariza et al. Perspectives for the treatment of brucellosis in the 21st century: the Ioannina recommendations. PLoS Med. 2007.; 4:1872-8.
Al-Tawfiq. Therapeutic options for human brucellosis. Expert Rev Anti Infect Ther. 2008: 6:109-20.

Risk Groups
Dairy Consumers

- **Ingestion of unpasteurized dairy products (soft, fresh cheeses, e.g. queso fresco)**
- ***Brucella melitensis***
- **Persons at risk**
  - Immigrants from endemic countries
  - Travelers to endemic countries



Interventions/Collaborations

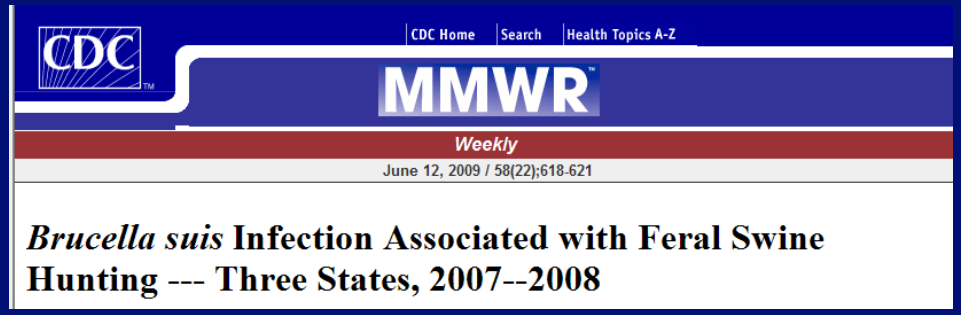
- Collaboration with Border Infectious Disease Surveillance Program (CDC), US border states and Mexico
- Development of educational materials for US Hispanic population
- Assessment of seroprevalence of brucellosis among Iraqis immigrating to the US
- Collaboration with USDA to assess risk of *B. melitensis* in US- sheep and goat farms, ethnic markets

Risk Groups
Hunters

- **Contact with meat and other tissues from infected animals**
- ***Brucella suis***
- **Persons at risk:**
  - Consumers of infected wild game
  - Hunters
- **<u>Feral swine</u> – important source of human brucellosis infection through field dressing and butchering**

Interventions/Collaborations

- Investigation of cases of brucellosis in feral swine hunters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CDC

MMWR

Weekly

June 12, 2009 / 58(22);618-621

***Brucella suis* Infection Associated with Feral Swine Hunting --- Three States, 2007--2008**

- Development of educational brochure with USDA for hunters

http://www.cdc.gov/nczved/divisions/dfbmd/diseases/brucellosis/brucellosis_and_hoghunters.pdf

Risk Groups
Dog Breeders / Kennel Workers

- **Exposure to *B. canis* – materials associated with birthing process**
- **First human cases – 1968**
- **Considered mild disease, <u>but</u> reported human cases of:**
  - **osteomyelitis**
  - **endocarditis**

Symptom	% with symptom (n=32)	
Fever	66%	(21)
Fatigue	34%	(11)
Headache	31%	(10)
Chills	28%	(9)
Weight loss	28%	(9)
Malaise	22%	(7)
Sweats	22%	(7)
Vomiting	16%	(5)
Cough	13%	(4)
Diarrhea	6%	(2)

Compiled data of symptoms from 32 human cases reported in the literature

Interventions/Collaborations

- **National Association of State Public Health Veterinarians (NASPHV) - assembled working group during CSTE 2010 mtg. to study *B. canis***
- **Goals:**
  - Increase awareness of diagnostic issues
  - Develop and standardize guidelines for public health investigations
  - Explore options for development of diagnostic tests
- **CDC assisting in survey led by IA and WI PH veterinarians to collect information on *B.canis* among state health departments and laboratories**

Risk Groups
Populations Working with Marine Mammals

- **Marine *Brucella* species- few reports of human cases of neurobrucellosis**
- **Populations at risk:**
  - American Indian/Alaska Native- hunt marine mammals
  - Marine mammal rescue workers
  - Wildlife researchers
  - Veterinary staff

Interventions/Collaborations

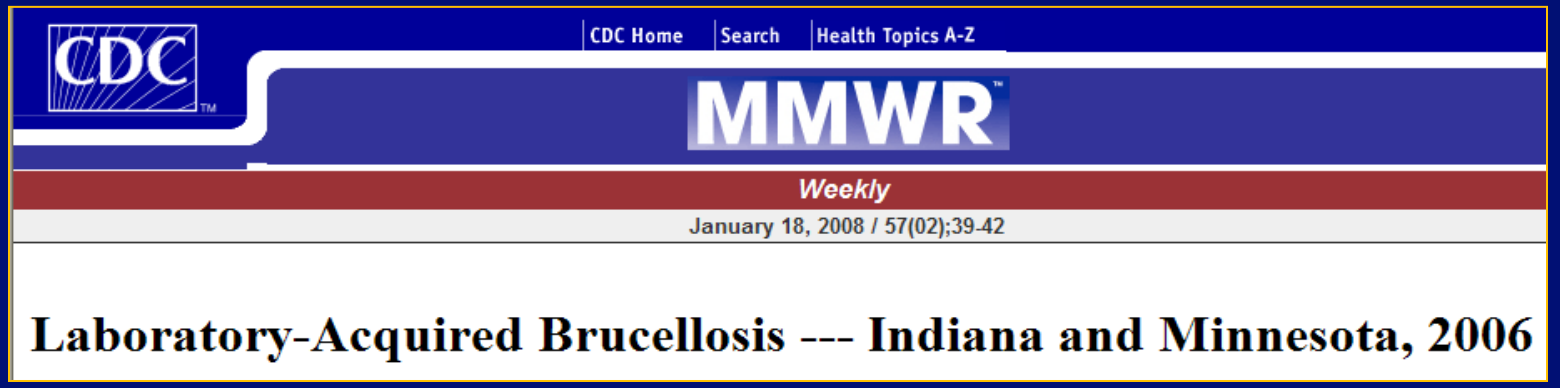
- **Collaboration with Alaska state health dept. and CDC Arctic Investigations Program**
  - Assessment of laboratory submissions
  - Serological survey among AI/AN population
- **Collaboration with National Institute of Occupational Safety and Health (NIOSH) and CDC Rickettsial Zoonoses Branch**
  - Serological survey of persons working with marine mammals at a rescue and rehabilitation facility

Risk Groups
Laboratory Workers

- **Brucellosis - one of 10 most frequently reported lab-acquired infections (LAIs) in the US***
- **Transmission can occur via:**
  - Inhalation
  - Direct or indirect exposure of organism to broken skin or mucous membranes
- **Infections due to:**
  - Direct handling of organism or close vicinity to handling
  - Routine clinical laboratory procedures completed outside of a Biological safety Cabinet**
  - Accidents- e.g. malfunction of centrifuge

*Harding AL, Byers KB. Laboratory-associated infections: summary and analysis of 3921 cases. In: Fleming DO, Hunt DL, eds. Biological Safety: Principles and Practices. 4th ed. Washington DC: ASM Press; 2006:53-77.
**Pike RM. Laboratory-associated infections: incidence, fatalities, causes, and prevention. Annu Rev Microbiol 1979;33:41-66.

CDC Guidelines: Laboratory Exposure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MMWR

Weekly

January 18, 2008 / 57(02);39-42

Laboratory-Acquired Brucellosis --- Indiana and Minnesota, 2006

- **Multi-state multi-laboratory exposure - 2006**
- **Demonstrated need for published guidelines**
  - Tracking of isolate through laboratories
  - Risk assessment for potentially exposed laboratory workers
  - Recommendations for post-exposure prophylaxis

CDC. Laboratory-acquired brucellosis--Indiana and Minnesota, 2006. MMWR Morb Mortal Wkly Rep 2008;57:39-42.

Assistance to States with Laboratory Exposures

- **Follow up requires information on:**
  - number of exposed laboratory workers
  - demographics
  - pregnancy status
  - risk assessment
  - PEP compliance
  - serological results
  - development of disease
- **Information reviewed at CDC from three sources:**
  - Requests for assistance from state health departments
  - National Select Agent Registry reports (forms 3 & 4)
  - Sera and isolate submissions to CDC laboratory for ID or confirmation
- **Workers assessed as high or low risk based on exposure**
  - Serological monitoring
  - Post-exposure prophylaxis
- **Information analyzed to evaluate program efficacy**

Laboratory Exposure Incidents January 2008 – June 2011

Year	Exposure Incidents	Laboratories Involved	States
2008	12	15	10
2009	49	56	23
2010	58	72	27
2011 Jan-June	17	17	10
Total	136	160	44

Exposure Incidents

- **Of cases reported to CDC:**
  - 2008: 12 of 80 (15%) had associated exposures
  - 2009: 49 of 115 (43%) had associated exposures
  - 2010: 58 of 115 (50%) had associated exposures
  - 2011: 17 of 32 (53%) had associated exposures
- ***B. melitensis*** **and** ***B. suis*** **- most common species identified**
- **CDC processed 2,728 serum samples—2008 - June 2011**
  - 1,090 *Brucella*-exposed laboratory workers in 21 states

CDC.Morbid Mortal Wkly Rep MMWR, 2011: 60(26);892-905.

*

5 Laboratory-acquired Infections Jan. 2008 – June 2011

Case	Risk	Date of Exposure	Date Onset	Began PEP	Incubation
A	Unk	Unk	8/15/08	NA	Unk
B	High	7/14/09	11/27/09	7/27/09	19 wks
C	High	12/2009	~5/25/10	NA	~22 wks
D	Unk	12/2009	~3/14/10	NA	~12 wks
E	High	6/2/10	~10/1/10	NA	~17 wks

Interventions/Recommendations

- **No changes to the current recommendations**
  - Consider obtaining additional serum samples from 8-24 weeks
  - Recommendations may require revision
- **Prevent exposures**
  - Increase physician awareness of brucellosis
  - Laboratory training
    - Proper handling of the organism
    - Use of personal protective equipment (PPE)
    - Use of Biological Safety Cabinets (BSL-3)
- **Prevent infection after an exposure**
  - Early identification of the exposure
  - Risk assessment of exposure for each worker
  - Use of antimicrobial PEP as indicated

Summary

- **Source of infection**
  - Historically - an occupational disease – caused by *B. abortus*
    - Veterinarians, livestock/abattoir workers, dairy farmers
  - Currently - most frequent sources of infection - *B. melitensis* and *B. suis*
    - *B. melitensis* from unpasteurized dairy products
    - *B. suis* associated with feral swine hunting
- **Surveillance**
  - Case definition and laboratory criteria updated
  - Utilization of new Case Report Form - capture of additional data to:
    - Characterize risk factors
    - Identify trends
    - Identify *Brucella* species

Summary – cont'd

- **Laboratory exposure intervention**
  - **Increase in reporting of laboratory exposures**
    - 50% increase of reported cases from 2008 to 2009
    - >300% increase of reported laboratory exposures
    - Increased number or increased recognition?
  - **Lab-acquired infections demonstrate the need for:**
    - Prompt identification and assessment of an exposure incident; prompt prophylaxis of workers
    - Adherence to CDC recommendations for PEP and monitoring
    - Banking of isolates from case patients for comparison if an exposed person develops brucellosis
  - **Role of clinicians, veterinarians**
  - **Role of laboratorians**

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The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the Centers for Disease Control and Prevention

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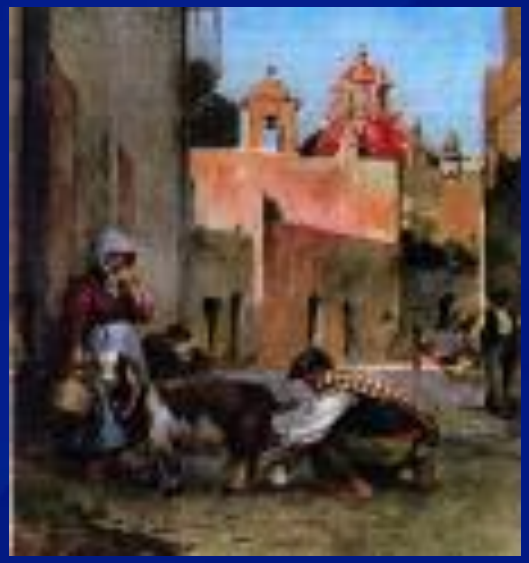

Thank you

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http://emergency.cdc.gov/coca/calls/2011/callinfo_082511.asp

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