

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* infection⁵

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

Health Outcome ¹	<i>C. burnetii</i> Status	
	Positive Operations	Negative Operations
	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.

References

1. Woldehiwet Z. 2004. Q fever (coxiellosis): epidemiology and pathogenesis. Res. Vet. Sci. 77:93-100.
2. Rodolakis A, Berri M, Hechard C, Caudron C, Souriau A, Bodier CC, Blanchard B, Camuset P, Devillechaise P, Natorp JC, Vadet JP, Arricau-Bouvery N. 2007. Comparison of *Coxiella burnetii* shedding in milk of dairy bovine, caprine, and ovine herds. J. Dairy Sci. 90:5352-60.
3. Coetzer JAW, Tustin RC. 2004. Infectious Diseases of Livestock, 2nd ed. Oxford University Press Southern Africa. Cape Town, South Africa. 565-68.
4. Cerf O, Condrion R. 2006. For Debate: *Coxiella burnetii* and milk pasteurization: an early application of the precautionary principle? Epidemiol. Infect 134:946-951
5. <http://www.cdc.gov/ncidod/dvrd/qfever/> - Accessed October 2010.
6. Guatteo R, Beaudeau F, Joly A, Seegers H. 2007. *Coxiella burnetii* shedding by dairy cows. Vet. Res. 38:849-60.
7. Barlow J, Rauch B, Welcome F, Kim SG, Dubovi E, Schukken Y. 2008. Association between *Coxiella burnetii* shedding in milk and subclinical mastitis in dairy cattle. Vet. Res. 39:23.
8. Paiba GA, Green LE, Lloyd G, Patel D, Morgan KL. 1999. Prevalence of antibodies to *Coxiella burnetii* (Q fever) in bulk tank milk in England and Wales. Vet Rec 144:519-22
9. McQuiston JH, Nargund VN, Miller JD, Priestley R, Shaw EI, Thompson HA. 2005. Prevalence of antibodies to *Coxiella burnetii* among veterinary school dairy herds in the United States, 2003. Vector Borne Zoonotic Dis 5:90-1.
10. Kim SG, Kim EH, Lafferty CJ, Dubovi E. 2005. *Coxiella burnetii* in bulk tank milk samples, United States. Emerg Infect Dis. 11:619-21.

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>

#N579.0311

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Mention of companies or commercial products does not imply recommendation or endorsement by the USDA over others not mentioned. USDA neither guarantees nor warrants the standard of any product mentioned. Product names are mentioned solely to report factually on available data and to provide specific information.