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Q Fever

Because symptoms are non-specific and the disease is relatively rare, diagnosing Q fever is a challenge and Q fever is likely underreported in the United States.

Background and Epidemiology

C. burnetii infects a wide variety of vertebrates. While most infected animals are asymptomatic, in ruminants such as cattle and goats *C. burnetii* can cause reproductive disorders including abortions, stillbirths, and decreased fertility. *C. burnetii* has tropism for reproductive organs and shedding from infected animals is most concentrated in amniotic fluids, placenta, and other birth products. Viable organisms can also be found in their milk, urine, and feces.

Source: cdc.gov

C. burnetii is very resilient and resistant to heat, desiccation, and common disinfectants, enabling its persistence for months to years in harsh environments. Wind currents can carry organisms for miles. This transmission pathway was implicated in major outbreaks of human cases in southern France, England, and the Netherlands, with cases detected up to 11 miles from farms with infected animals. Human cases in the United States are most frequently reported from western and Great Plains states where ranching and rearing of livestock are common. Three states report over a third of US cases – California, Texas, and Iowa. More rarely, humans acquire infection through unpasteurized dairy products, contact with contaminated clothing or animal bedding, or tick bites. Rare person-to-person transmission has been documented between sexual partners; mother and fetus; and blood or bone marrow donors and recipients.

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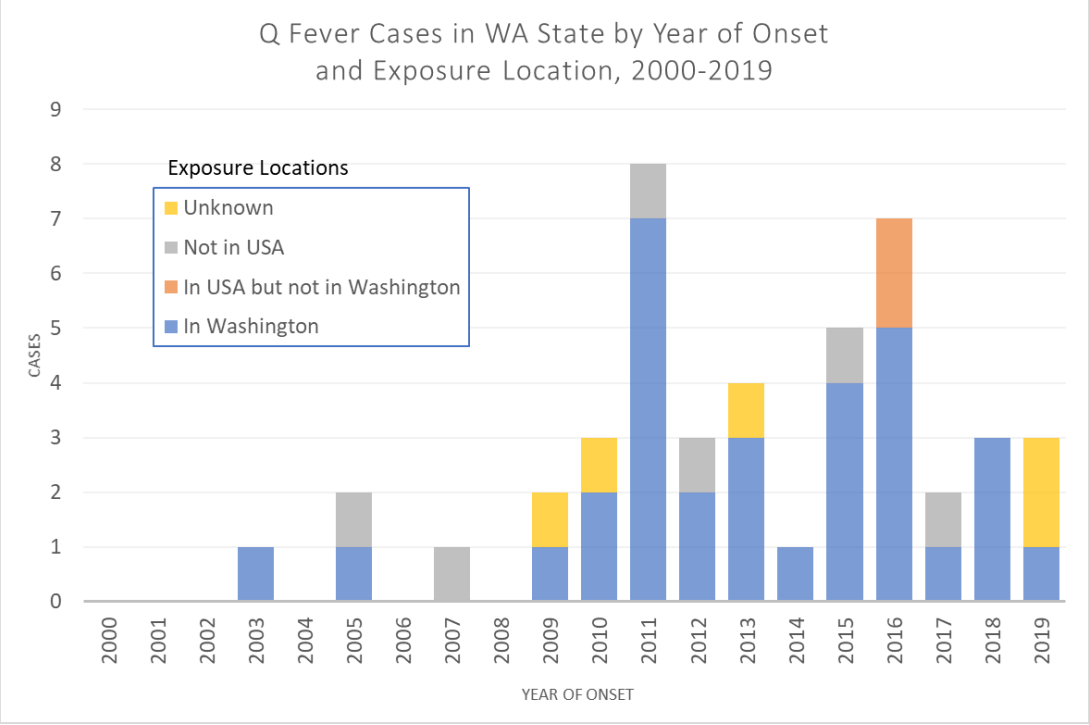
About half of humans infected with Q fever have symptoms. Acute Q fever has a mortality rate of <2%. Under <5% of acute infections become chronic, but those are most often fatal if untreated. Chronic infection can present as endocarditis, chronic hepatitis, osteomyelitis, osteoarthritis, or pneumonitis. Infection during pregnancy can increase negative birth outcomes, including stillbirth or miscarriage. A post-Q fever fatigue syndrome has been documented in up to 20% of acute Q fever patients. Both disease reports and severity increase with age. The risk of chronic infection and severe disease may also be higher for people with pre-existing endocarditis or valvulopathies or with immunosuppression including pregnancy. Q fever is reported more commonly among men, possibly because of occupations such as livestock management that place them at higher risk of exposure. Veterinarians, meat processing plant workers, livestock farm workers, and researchers at facilities housing sheep and goats, are also at higher risk of exposure to *C. burnetii*.

Q Fever in Washington State

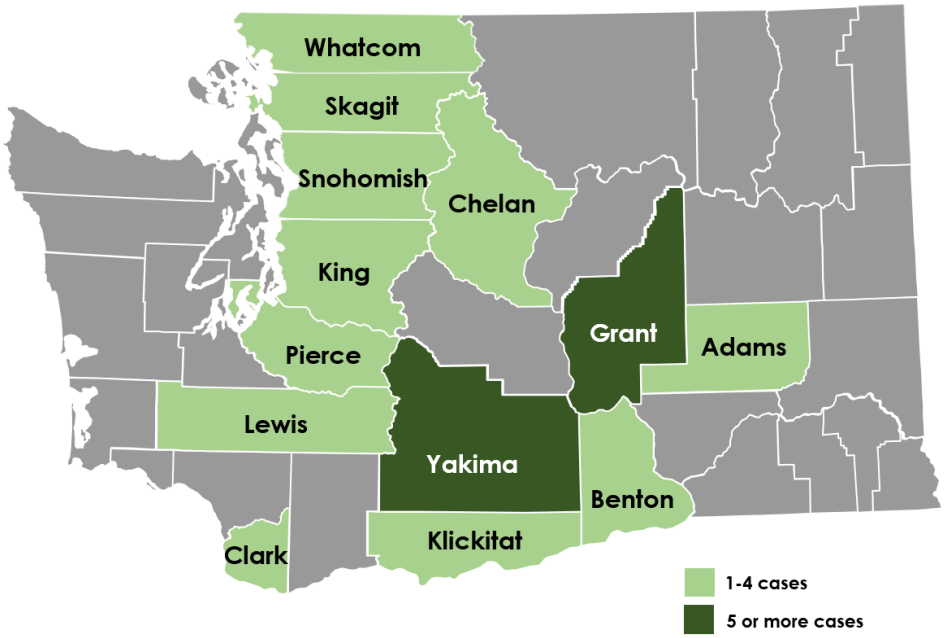
Between 2000 and 2010, 0 to 3 cases of Q fever were reported in Washington each year; in the last decade, there have been 1 to 5 cases annually (Figure 1). There is also a rise in cases nationally, which may be due to an actual increase in incidence or improved clinician awareness or reporting.

Figure 1: Q Fever Cases in Washington State, by year of onset and exposure location, 2000-2019



The majority of Washington cases did not report direct animal contact and were likely exposed by inhaling airborne contaminated dust. Most cases with Washington exposure originate from regions in eastern Washington where ranching is common, such as Grant and Yakima counties (Figure 2). Washington's largest known outbreak of Q fever in 2011 involved goat farms in Washington and Montana. The seven cases reported in 2016 occurred sporadically, without common exposures.

Figure 2: Q Fever Cases by County of Exposure, Washington, 2000-2019



Diagnosing Q Fever

Several aspects of Q fever make diagnosis and treatment challenging. Symptoms of acute infection are non-specific and variable, and serologic testing can be negative early in disease. The vast majority of cases in this country are in persons with occupations that are not considered high-risk. If healthcare providers suspect Q fever, they should treat based on clinical suspicion alone and not wait for confirmatory testing. Prompt diagnosis and treatment can mitigate the risk of severe complications. With chronic Q fever, early treatment may be lifesaving.

Polymerase chain reaction (PCR) can provide confirmatory laboratory evidence for infection with *C. burnetii*. Genetic material may be detectable only in specimens collected within 2 weeks of acute symptom onset and prior to or within 24-48 hours of antibiotic administration. Chronic Q fever can cause a recurrent bacteremia, and PCR, especially on whole blood or infected heart valve tissue, may aid in diagnosing chronic cases. Due to symptoms being non-specific, Q fever is often not considered early in an illness so the window for testing PCR is often missed. Concurrent serologic tests are recommended with PCR in the early stages of illness for a definitive diagnosis.

Serologic methods, such as immunofluorescence assays (IFA), assess IgG antibody titers to Q fever's two antigenic phases: phase I and phase II, corresponding to chronic and acute infection, respectively. IgG can persist for months after disease has resolved, so single specimens are difficult to interpret. When testing for acute disease, the first specimen should be collected as early as possible during illness and the second 3-6 weeks later. IgM antibodies to *C. burnetii* rise along with IgG but are less specific; IgM testing on its own is therefore of limited diagnostic value. Of note, the national seroprevalence of Q fever in the United States is approximately 3%, presumably due to historical infections.

Isolating *C. burnetii* by culture is not routinely recommended for diagnosis because it is difficult to grow and can pose a risk to laboratory technicians. *C. burnetii* should only be handled in a biosafety level 3 laboratory.

Studies of genotypic diversity of *C. burnetii* in the United States reveal a lack of diversity and segregation of genotypes between host species. Genotype ST20 is strongly associated with dairy cows, and has been detected in environmental samples, human specimens, and cow's milk. Likewise, genotype ST8 is strongly associated with goats; ST20 is rarely detected from goats. Genotyping from a PCR positive extraction or the clinical material from which the PCR positive arose can lend important information to assist in determining possible exposure sources when they are unknown.

Routine Surveillance and Response

The recent upswing in Q fever cases raises concern for its increasing role as a zoonosis. Continued awareness Q fever for communities and providers is critical for prevention and control. Those who visit or work with goats, sheep, or cattle should know the risk and appropriate infection-control precautions. Risk groups includes visitors to spring fairs, petting zoos, livestock sales, and other venues allowing close animal contact. Livestock owners should quarantine new animals, maintain detailed records of animal sales, health, and adverse pregnancy events, and report abortions among livestock to their veterinarians. Enhanced precautions should be taken during livestock birthing seasons and for human healthcare providers doing aerosol-generating and other obstetrical procedures for an infected woman. In addition, since *C. burnetii* can be easily disseminated on air currents over long distances, vigilance should be maintained for its use in bioterrorism events.

Q fever is a nationally notifiable condition and prompt reporting supports rapid public health response and a more accurate understanding of disease distribution. Washington State Department of Health is available for consultation on testing or diagnosing Q fever cases, and for facilitating either PCR testing at PHL or specimen transfer to CDC.

Resources

- Q fever overview: https://www.doh.wa.gov/YouandYourFamily/IllnessandDisease/QFever
- Reporting Q fever in Washington: https://www.doh.wa.gov/ForPublicHealthandHealthcareProviders/NotifiableConditions/Qfever
- Q fever outbreak in Washington and Montana, 2011: https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6040a5.htm
- Diagnosis and management of Q fever (CDC): https://www.cdc.gov/mmwr/pdf/rr/rr6203.pdf
- CDC: https://www.cdc.gov/qfever/index.html
- Center for Food Security & Public Health: http://www.cfsph.iastate.edu/DiseaseInfo/disease.php?name=q-fever&lang=en