

Tuberculosis—Human and Cattle

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There is renewed interest in the interactions of humans, cattle and TB with the continuing occurrences of Tuberculosis in deer and cattle in Michigan and in dairy cattle in Texas along with the recent finding of TB in a California dairy herd. TB is caused by the bacteria, Mycobacterium. The Mycobacterium that is the main cause of human TB is *M. tuberculosis*. The agent responsible for most cattle TB is *M. bovis*. Birds are affected by *M. avium*. *M. tuberculosis* and *M. bovis* are more closely related to each other than to *M. avium*. Of the three, *M. tuberculosis* is the most host specific preferring to infect humans.

Human TB of human origin. The primary reservoir for humans is other currently infected humans. Usually long term exposure is necessary for transmission from one person to another. This often happens between family members in the same households or other locations where close contact occurs such as shelters, schools or prisons. In families with one infected member, there is about a 30% chance that another member will become infected. However there is only a 5% chance of this infection developing into clinical disease within a year of exposure. Simultaneous infections with immunosuppressive diseases may increase the risk of infection.

People with the human origin form of TB (*M. tuberculosis*) have been known to temporarily infect cattle. Under these conditions, cattle may be sensitized to TB testing. However, permanent infections do not usually persist as cattle seem to be very resistant to infections by *M. tuberculosis*. This sensitization may last for 6 to 8 months after the *M. tuberculosis* is cleared from the cattle. Humans are much more likely to infect monkeys or dogs with progressive tuberculosis than cattle.

Human TB of animal origin. The prevalence of human tuberculosis originating from animals (*M. bovis*) has diminished in most countries where pasteurization of milk is required. In countries where pasteurization of milk is not required and the prevalence in cattle remains high, both pulmonary and extra-pulmonary forms of TB continue to be a problem. Even under these circumstances, less than 5% of humans exposed to TB bacteria will ever develop the clinical disease; however, they will very often react positively to TB testing.

The human form of *M. bovis* infection has similar clinical forms as that caused by *M. tuberculosis*. Historically, the extra-pulmonary form has been the most prevalent and children are most often affected. The extra-pulmonary form is often seen as lymph gland infections of the neck region, urinary or reproductive tract lesions, bones or joint infections and infections of the brain. The bacteria are primarily transmitted to the children by the consumption of raw milk and raw milk products. The pulmonary form of

TB occurs less frequently and is usually occupationally related. It is seen most often in groups that work closely with cattle or their carcasses. The workers are thought to be infected by inhaling small aerosol droplets containing the TB bacteria. Man is usually an accidental host for *M. bovis* and is not an efficient transmitter of *M. bovis* to other humans due to the low numbers of bacteria shed in the sputum.

In some countries where pasteurization or boiling of milk prior to drinking or eating is not practiced the prevalence of human TB from cattle can be higher. This is more common in rural areas where raw milk is consumed. People in these areas often also consume cream, butter and soft cheese made from raw milk. Children continue to be the main victims of these cultural habits.

People suffering from *M. bovis* TB can re-transmit the infection to cattle; however, this is not common. This may be particularly evident in areas where TB has been eradicated from cattle. It is more likely to occur in areas where raw milk products are consumed. In areas where cattle TB is prevalent, humans are not significant sources of infection for cattle.

Humans can also be sensitized to TB testing by exposure to cattle TB. In some countries up to a third of the people reacting to TB testing were sensitized by exposure to bovine TB. Incidentally, these sensitized people are at a much lower risk of developing pulmonary TB, perhaps because they were sensitized by ingestion of the TB bacteria rather than by inhalation.

Cattle TB from cattle origin. The main cause of TB in cattle is *M. bovis*. The route of infection is usually by inhalation; however, calves can be infected by ingestions of milk. As inhalation is the principle route of infection, the pulmonary form of the disease is the most common form. The bacteria enter the lungs, multiply and spread to the nearby lymph nodes. When the immune resistance of the cow is high to the infection, the infection may remain dormant in the lungs for a long time. Otherwise, with lowered immune resistance, the infection can spread to many other organs. With a completely functioning immune system, cattle may become sensitive to tuberculin testing within several weeks after becoming infected. In most cases, a chronic, long-term disease course is followed with infection limited to the lungs. While these animals remain a threat to infect other animals in the herd, they may lead very productive lives even though infected. Reactivation of the disease is possible at anytime. Rarely will animals develop a cough, weight loss and reduced milk production. This is particularly true in countries with highly developed dairy industries as culling practices remove most cows before a long-term disease like TB can produce clinical symptoms. In the most advanced cases, 5% may develop uterine infections and 1-2% mammary gland infections.

Cattle are resistant to *M. avium* and rarely suffer from clinical TB due to this agent. However, *M. avium* complicates cattle TB eradication programs as it sensitized the cattle to TB testing. This particularly evident when using the tail or caudal fold TB testing method.

Surveillance for bovine TB. Carcasses of all cattle proceeding through state and federally inspected slaughterhouses are examined by trained inspectors. These inspectors view each carcass for lesions of TB. Carcasses with lesions suspicious for TB are held for further examination. Suspected lesions are collected from the cattle for microscopic and culture examinations. Suspect carcasses are held until a negative test is confirmed. Carcasses that are positive for TB are condemned for human consumption. In areas of California, Cryptococcus, a fungal disease, may produce gross lesions in the pulmonary lymph nodes that can only be differentiated from those of TB by microscopic examination and culture.

Diagnostic testing. The final definitive diagnosis of TB is made by isolation of the TB bacteria and specifically typing the isolate as *M. tuberculosis*, *M. bovis* or *M. avium*. For routine field testing, the caudal fold tuberculin test is used. In this test, 0.1 ml of PPD (purified protein derivative) is injected into the skin. In 72 hours, the injection site is examined for swelling. If a positive test is found, it is often confirmed using the comparative cervical test. In this test, both mammalian and avian tuberculin are injected into the skin on the side of the neck and the sites are compared to determine the causative agent.

Summary. Historically, cattle have been a source of TB for humans, particularly in developing countries where raw milk and milk products are consumed. Humans are not a significant source of TB infection for cattle; however, they are the primary source for other humans. Cross-exposure may increase the risk of a positive TB test reaction. For public health reasons beyond TB, raw milk should not be consumed in any form. The public is protected from cattle TB by current milk pasteurization methods and slaughter cattle are visually inspected to remove infected cattle from the human food chain.