Bovine tuberculosis

Wetlands supporting groups of susceptible animals

Wildlife ✓
Livestock ✓
Human ✓

Synonyms: bovine TB

KEY FACTS

What is bovine TB?

Bovine tuberculosis (TB) is a significant zoonotic disease which affects cattle and other domestic and wild mammals and is transmissible to humans. Eradication programmes in most developed countries have reduced or eliminated bovine TB in cattle and subsequently human disease is rare, however, complete eradication is difficult as wildlife may act as reservoirs for the disease. In many less developed countries bovine TB is common and creates public health concerns, economic losses resulting from livestock deaths, persistent disease and trade restrictions. This disease is typically spread to humans by inhalation of aerosols, or ingestion of contaminated unpasteurised milk (relatively rare).

Causal agent

Mycobacterium bovis (*M. bovis*), a Gram positive, acid-fast bacterium in the *Mycobacterium tuberculosis* complex of the family Mycobacteriaceae.

Species affected

The primary hosts for *M. bovis* are cattle but a broad range of domesticated and wild mammals may also be infected. High profile and well studied apparent wildlife reservoirs of infection include badgers *Meles meles* in the UK and Ireland and brushtail possums *Trichosurus vulpecula* in New Zealand. The disease has a broad host range and numerous wildlife species have been affected to varying degrees including kudu and African buffalo *Syncerus caffer* in southern Africa and bison and elk *Cervus canadensis* in Canada. The disease has also been described in wild felids, deer, elephants, rhinoceroses, hares, raccoons, bears, warthogs, primates, opossums, foxes, coyotes, mink, otters, seals, sea lions, deer, elk and some rodent species. In general the wetland manager should consider all wild mammals to be potentially susceptible to infection.

Domestic species known to be susceptible include dogs, cats, pigs, ferrets, camelids, sheep, goats and horses.

Although generally thought to be resistant there is little known about the susceptibility of birds to *M. bovis*.

Geographic distribution

Once found worldwide but now 'kept at bay' in domesticated animals in many countries due to control programmes. Bovine TB remains widespread in Africa, parts of Asia and some Middle Eastern countries. Eradication programmes are underway in some countries of Central and South America, the United States, Mexico, New Zealand, Japan and Europe. It is important to periodically consult the OIE and wider literature as whilst a country may be currently classified as bovine TB free or under eradication, this may sporadically change if some herds become infected. Complications in eradication efforts occur particularly where wildlife are involved in the epidemiology of the disease such as infection in wild white-tailed deer in parts of the USA, badgers in the UK and Ireland, and brushtail possums in New Zealand.

Environment

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Survival of *M. bovis* in the environment is primarily affected by exposure to sunlight. In cold, dark and moist conditions it can survive for several months and at 12-24°C (54-75°F), depending on the exposure to sunlight, survival time varies from 18 to 332 days. Studies showed *M. bovis* remained viable for four to eight weeks in dry or moist soil samples in 80% shade [34°C (93°F)] and another showed it was destroyed within four days in either summer or winter on New Zealand pastures.

TRANSMISSION AND SPREAD

Vector(s)

As discussed above, maintenance and spillover hosts may both act as disease vectors. The bacterial agent may be carried on the clothing or shoes of personnel in contact with infected animals.

How is the disease transmitted to animals?

The main source of transmission is an infected animal. *M. bovis* may be transmitted by aerosol inhalation (organisms excreted in exhaled air), secretions and excretions, by ingestion (contaminated food/water) or by cutaneous infection (through wounds or abrasions). Genital and congenital infections occur but are rare. The chief mode of transmission is exchange of respiratory secretions between infected and uninfected animals and ingestion of infected milk for calves. Population densities and social structure can be key in *M. bovis* transmission which usually occurs when animals are in close contact.

Humans have been known to transmit *M. bovis* to cattle, which is linked to genitourinary TB, and most reported cases are associated with urination in cowsheds.

How does the disease spread between groups of animals?

Infection has been observed to spread in both directions between livestock and wildlife, when both share the same environment and food. Examples of such spread include infection in badgers in the UK and possums in New Zealand. Potential routes of transmission include by aerosol, when in close proximity, and by ingestion when feeding in contaminated environments. In pigs, ferrets and most likely deer, ingestion seems to be the primary route of transmission. Cats may be infected *via* ingestion or percutaneous transmission in bites and scratches or by the respiratory route. Non-human primates are typically infected by inhalation. Predatory and scavenging animals are infected from consumption of infected prey. In the case of badgers, aerosol transmission would appear to be the main route with biting being an additional possibility. *M. bovis* may be shed in the urine and the faeces of infected badgers with advanced disease.

How is the disease transmitted to humans?

M. bovis can be transmitted to humans in a number of ways, primarily through ingestion of unpasteurised milk and other dairy products, and inhalation of aerosols. Although rare, agricultural workers in contact with infected livestock are at risk of developing pulmonary bovine TB by inhaling aerosolised bacteria. Infection may also be caused by ingestion of raw or undercooked meat and through breaks in the skin.

Person-to-person transmission is possible, particularly in immunocompromised humans, alcoholics or HIV-infected individuals but evidence for extensive human-to human transmission is limited.

IDENTIFICATION AND RESPONSE

Field signs

In cattle, early infections are often asymptomatic, but in the late stages common symptoms include a low–grade fluctuating fever, weakness and inappetence, progressive emaciation and animals with pulmonary association typically have a moist cough. Animals may become acutely emaciated and develop severe respiratory distress in the terminal stages.

In cervids, infections may be subacute or cause chronic disease with variable rates of progression. Some animals may only show abscesses of unknown origin with additional symptoms developing years later and other cases may exhibit rapid dissemination with relatively quick onset of symptoms.

In general, any field signs seen depend on the host species. Often there may be no obvious clinical signs. The most likely presentation in wildlife such as wild ungulates and carnivores (*e.g.* lions) with advanced disease, is progressive wasting, emaciation and weakness, possibly with coughing in the former.

Recommended action if suspected

Contact and seek assistance from appropriate animal health professionals. Bovine TB is a notifiable disease and suspected cases must be reported immediately to local and national authorities and the OIE.

Diagnosis

Based on clinical signs alone, bovine TB can be very difficult to diagnose and there are numerous other conditions which display similar signs (including a broad range of bacterial and parasitic infections). In developed countries most infections in domestic livestock are diagnosed by routine testing or found at the slaughterhouse.

Bovine TB may be diagnosed in live cattle in the field with the tuberculin skin test. A strong skin-based immune response to bovine tuberculin is consistent with infection. In many instances this is performed in a comparative manner, using avian tuberculin in addition to bovine. The magnitude of the avian response is taken into consideration when determining positive or negative status. All skin tests are two step procedures involving tuberculin injection on day one, and a reading of the skin response 72 hours later. Presumptive testing may be carried out using histopathology and/or the microscopic demonstration of acid-fast bacilli, where direct smears from clinical samples or tissues (usually collected *post mortem*) may be stained with the Ziehl Neelsen stain, a fluorescent acid-fast stain or immunoperoxidase techniques. Confirmatory testing involves isolation of *M. bovis* on selective culture media, which are incubated for eight weeks. The organism can be confirmed with biochemical tests or polymerase chain reaction (PCR) assays (including spoligotyping which can both confirm and type bacteria).

Blood-based tests for immune responses to *M. bovis* include the lymphocyte proliferation and gamma-interferon assays and serological tests. For the diagnosis of infection in animals that are difficult to capture or handle (wildlife or zoo animals), blood based tests may be more useful than the skin tests as only one capture event is required.

In cervids, bovine TB should be considered as a differential diagnosis when abscesses of unknown cause are found.

PREVENTION AND CONTROL IN WETLANDS

Environment

In a wetland setting, disinfection is unlikely to be considered a viable control measure. In domestic animal housing, however, **disinfection and sanitisation**

may help minimise spread of *M. bovis* within a herd. It is important to use an effective disinfectant, such as 5% phenol, iodine solutions with a high concentration of available iodine, or glutaraldehyde, as *M. bovis* is moderately resistant and long contact times are necessary for inactivation. On infected farms rodent control may be advisable given these species may become infected and may be able to transmit infection more widely.

Livestock

The insidious, chronic nature of this disease makes prevention or early detection and control imperative. The most effective method to eradicate bovine TB from domesticated animals is the **test-and-slaughter** technique. However, eradication efforts can be complicated by the occurrence of *M. bovis* in wildlife reservoir hosts.

Summary of some methods to decrease the risk of bovine TB in cattle:

- Where possible maintain a closed herd (a herd with animals all bred from within the same herd).
- Limit opportunities for contact with neighbouring herds.
- Isolate and test purchased stock.
- Isolate and test cattle re-entering the herd.
- Enforce biosecurity on premises to prevent contact with cattle of unknown bovine TB status.
- Develop and implement a herd health programme (record individual records).
- Keep stocking densities low.
- In collaboration with the authorities conduct routine diagnostic tests and report suspected cases and dead animals.
- If suspected cases confirmed then quarantine the animals and bovine TB test the rest of the herd and re-tested periodically.
- Develop a bovine TB testing policy for employees.
- Control of wildlife reservoirs or means by which to isolate livestock from the reservoir.

Carcases with confirmed bovine TB should not be used for human consumption and the herd of origin of the infected carcase should be bovine TB tested.

A badger entering a cattle shed, and a badger-proofed shed, which is a relatively straightforward means by which contact between livestock and wildlife can be reduced (*Fera*).

Wildlife

However desirable, there are many difficulties in controlling the disease in wildlife. Control can be achieved to some extent by using a combination of surveillance and management to monitor and control the spread and occurrence of the disease. Within *well managed* strategies, **culling** of infected wildlife may be considered but *ad hoc* or even well planned culling may not

bring benefits and may even exacerbate the problem. Also, this measure is unlikely to constitute an 'ecosystem approach' to health.

Restricting access of wildlife to infected domestic herds helps to reduce risk. This might be achieved in various ways including use of physical barriers to restrict wildlife access to domestic animal housing.

In some wildlife populations **reducing population density** and/or **changing social behaviour** can help to reduce risk. This may be achieved in a number of ways including *not* providing supplementary food which can maintain animals above a carrying capacity for an area and not using feeding stations (for *e.g.* hunter or tourist interests) to reduce risk of transmission at these localised feeding sites.

Vaccination is a possibility for control of the disease in wildlife (primarily to reduce risk to livestock). However, the only TB vaccine currently licensed for use in wildlife is an injectable BCG vaccine for badgers in use in the UK.

Humans

Humans should protect themselves by wearing **protective clothing** (including gloves, masks) when dealing with infected animals as infections in humans are difficult to treat. **Cooking meat thoroughly** or **pasteurisation** of milk and other dairy products reduces risk of infection.

IMPORTANCE

Effect on wildlife

In some situations *M. bovis* may be a serious threat to wildlife in particular where disease becomes endemic and present in a wide range of hosts (*e.g.* some southern African protected areas). It can affect common and threatened species alike and in some species (*e.g.* lions) has been found to negatively affect social structures and ultimately populations. In Spain, *M. bovis* infection is a cause of serious concern for the conservation of the highly endangered Iberian lynx *Lynx pardinus*.

Effect on livestock

Bovine TB is of significant importance to the cattle industry in terms of loss of production, control measures and trade restrictions. Presence of the disease may also lead to loss of consumer confidence in milk and beef products. Potential human health risks in the developing world, in particular, and the additional potential for infection in a wide range of hosts including free-roaming wildlife increases the need for control in domestic situations.

Effect on humans

Public health concerns arise from the possibility of human infection with *M. bovis* through the consumption of unpasteurised dairy products or meat from infected animals. Although rare in countries with bovine TB eradication programmes and pasteurised milk, it is still a significant concern in countries where the disease is poorly controlled. Incidence appears higher in personnel that work closely with cattle such as farmers and abattoir staff. It has also been documented that humans can be infected by exposure to other species, including goats, farmed elk and even rhinoceros. In countries where bushmeat is eaten wildlife species may be a particular source of infection. In some communities the close contact of humans and animals may facilitate disease transmission, for example, in some African countries cattle are an integral part of life and are present at ceremonies representing wealth and animals working in agriculture. People infected with HIV are also at increased risk from opportunistic bovine TB infections.

Economic importance

Annual economic losses to countries with bovine TB can reach many millions of US dollars. Bovine TB is also important due to potential impacts on the meat and live animal export trade, and expansion of the dairy industry may be severely limited at regional and national levels. Cost of control measures both in livestock and wildlife can be significant.

FURTHER INFORMATION

Useful publications and websites

- Cousins, D. V & Florisson, N. (2005). **A review of tests available for use in the diagnosis of tuberculosis in non-bovine species**. *Revue Scientifique et Technique de l'Office International des Épizooties*, 24 (3): 1039-1059 www.oie.int/doc/ged/D3021.PDF. [Accessed May 2011].
- World Organisation for Animal Health. **Bovine TB factsheet**. www.oie.int/fileadmin/Home/eng/Media_Center/docs/pdf/Disease_cards/BOVINE-TB-EN.pdf. [Accessed May 2011].
- World Organisation for Animal Health (OIE). **Chapter 2.04.07: Bovine tuberculosis.** Manual of diagnostic tests and vaccines for terrestrial animals. http://www.oie.int/fileadmin/Home/eng/Health_standards/tahm/2.04.07_BOVINE_TB.pdf [Accessed May 2011].
- World Organisation for Animal Health (OIE). **Terrestrial animal health code**. www.oie.int/international-standard-setting/terrestrial-code/access-online/. [Accessed May 2011].
- Merck & Co. Inc. **The Merck veterinary manual: tuberculosis**. http://www.merckvetmanual.com/mvm/index.jsp?cfile=htm/bc/204400.htm&word=tuberculosis. [Accessed May 2011].
- Michigan Bovine Tuberculosis Eradication Project. www.michigan.gov/emergingdiseases/0,1607,7-186-25804-74719--,00.html
- Public Health Agency of Canada. **Pathogen safety data sheets**. www.phac-aspc.gc.ca/msds-ftss/index.html