Comprehensive Study of Brucellosis & its Zoonotic Aspects

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Abstract

Brucellosis is a globally significant zoonotic disease that affects both humans and animals. It is caused by bacteria that are members of the genus *Brucella*. The disease's chronicity has a great impact on wildlife, domestic animals, and humans. Humans are often infected by inhalation, consuming unpasteurized food, and direct contact with the victim. Consequences may include arthritis, endocarditis, weariness, and undulating temperature in humans. Brucellosis causes infertility and miscarriage like reproductive problems in animals, which is a fiscal loss for animal farmers. The history of the disease goes back to the 19th century when Malta fever was linked with *Brucella melitensis*. Whereas, a couple of varieties of *Brucella* and their hosts have been discovered with the advancement of science. No doubt, there is a huge advancement in science, and after a lot of vaccination and eradication efforts, Brucellosis is still common in countries where there is dependency on livestock and inadequate veterinary facilities to check the disease. Its financial and human health harms are alarming, that how it is important to cope with it and eradicate. In this chapter, there is a detailed study of the nature of the disease, its impacts, symptoms, treatment, and preventive measures. Above all, efforts are made to draw attention to mitigate its financial and other socio-economic consequences.

Keywords: zoonotic disease, unpasteurized food, undulating temperature, Malta fever, vaccination, Brucellosis, livestock.

Cite this Article as: Ishfaq T, Haseeb M, Un-Nisa N, Bano S, Tabassum A, Raza MQ, Abbas N and Firdous R, 2025. Comprehensive study of brucellosis & its zoonotic aspects. In: Abbas RZ, Akhtar T and Jamil M (eds), Pathways of Infection: Zoonoses and Environmental Disease Transmission. Unique Scientific Publishers, Faisalabad, Pakistan, pp: 103-110. https://doi.org/10.47278/book.HH/2025.425

A Publication of Unique Scientific Publishers

Chapter No: 25-015

Received: 12-Feb-2025
Revised: 12-Apr-2025
Accepted: 24-May-2025

Introduction

Brucellosis, which is a highly contagious zoonotic disease, presents a unique array of problems at the intersection of environment, human, and animal health. Brucellosis is also known as Malta fever and is a global health concern affecting both wealthy and poor countries. Brucellosis is a bacterial infection and has several species which are not only a danger to human health but also affect the productivity of cows and have social and economic effects (FAO et al., 2010). The disease has a great impact, even the milder forms are chronic. Sick animals, unpasteurized dairy products, or airborne bacteria are the main sources of the disease, which confirms its zoonotic nature. In afflicted areas, brucellosis worsens the cycle of poverty and food insecurity by declining milk production, increasing cattle deaths, and infertility problems. Even though there have been improvements in immunization, diagnosis, and treatment options, brucellosis remains a very difficult illness to control. The disease is widespread in farm-based and pastoral communities globally. The continued existence of brucellosis in several million cases highlights the importance of integrated interventions for humans and animals (Martín et al., 2020).

Comprehensive Overview of Brucellosis

Brucellosis is a zoonotic disease caused by Brucella, which is transmitted from animals to humans. It has a severe impact on the animals and people, and also proves to be economically burdensome. The disease is of the chronic type, which often leaves its sufferers in a debilitating condition if left unchecked (Shoukat et al., 2017). The information indicates that the earliest documented case of brucellosis in humans occurred around 1850. Preservation of cultural practices regarding brucellosis seems to be something that was recognized early on by Sir William Osler, a prominent doctor at the time. He and his colleagues made the first systematic observations that led to the identification of *Brucella* as a disease infecting both humans and animals. It was Sir William Osler who first gave a scientific explanation of the disease in 1887 when he published an investigation that looked into a febrile illness that resembled Malaria (Yale et al., 2024).

In 1897, during a military campaign in Malta, the British scientist David Bruce successfully cultured the bacteria from the spleens of soldiers who became ill. Consequently, the causal agent of Malta fever (the name that was given to the human form of brucellosis) was identified as *Brucella*. Bruce became well-known in the world because of his work, which was essential for pointing out the possibility that the disease had a bacterial origin (Celli, 2006).

It has been known for years that brucellosis is a disease affecting animals since the late 19th century. The first recorded occurrences of

livestock brucellosis were in Europe, specifically the Mediterranean area, where sheep, goats, and cattle were found to be badly affected. Initially, the disease was referred to as "Mediterranean fever" or "contagious abortion," because infected animals often developed spontaneous abortions. Sir David Bruce, a Scottish physician, identified the bacteria *Brucella* following an outbreak in British soldiers in Malta in 1887. It is the first scientific identification of brucellosis in cattle. This disease was linked with the close contact of people with infected animals and drinking unpasteurized milk. Although the initial focus was mostly on human cases, it turned out that *Brucella* indeed is a zoonosis and can infect both people and animals, with cattle being the key hosts. The first reported case of brucellosis in livestock was documented during the late 1800s when cattle in the Mediterranean region started showing signs of reproductive failure, such as infertility, retained placenta, and miscarriages. The disease soon became known as a significant financial risk to the livestock industry, particularly in cattle, where it caused significant losses due to sterility, reduced milk production, and death of newborn calves (Gul et al., 2021).

Brucellosis was first identified in animals in the United States at the start of the 20th century. It was first noted that dairy cattle with the disease had a high percentage of spontaneous miscarriages. The first known outbreak of brucellosis in American livestock occurred in 1903 when it was discovered in cattle in the state of Montana. It became a basis for further study, and control plans were undertaken to decrease the rate at which the disease was spread. Apart from immunization, the USDA initiated an eradication program in the 1930s that would test and kill diseased animals. Among the salient reasons why the rate of disease spread was reversed was through the efforts made by the USDA to avert brucellosis among cattle. Developed by the USDA in the 1950s, the brucellosis ring test enabled the identification of infected animals to be done faster. The development of the *Brucella abortus* vaccine in the 1960s was one of the major developments in the battle against brucellosis in cattle. The vaccine was widely used on cattle to prevent the disease from spreading from the animals, and it reduces the chances of abortion or infertility in the infected animals. Brucellosis is a problem that is of major significance worldwide, especially in countries around the world where these cows are a source of their income and food sources as well. In parts such as Africa, the Middle East, and South Asia, brucellosis causes significant economic losses to animals (Suresh et al., 2022).

A 2015 study conducted in Punjab, Pakistan, reported that 15% of sheep and goats and 10% of cattle were *Brucella* positive. Due to its many human cases annually, the disease is also a major public health concern in Pakistan (Mustafa et al., 2023).

Agent Responsible for Brucellosis

Brucellosis is caused by facultative intracellular bacteria of the genus *Brucella* that are gram-negative and non-motile. These are microscopic, coccobacilli-shaped bacteria without flagella or capsules. Their unique ability to survive and multiply within the phagocytic cells of their hosts allows them to evade immune responses and cause chronic infections (Huy et al., 2022).

Many species of Brucella have been identified, and each one has host specificity. The primary hosts of *Brucella abortus* are cattle, although humans are occasionally infected.

- *Brucella melitensis*: The most virulent species for humans; it is a pathogen for sheep and goats.
- *Brucella suis*: A reproductive disease that affects pigs.
- *Brucella canis*: Has zoonotic potential and infects dogs.
- *Brucella ovis*: This is known to cause epididymitis in sheep, particularly rams (Gul et al., 2021).

Godfroid et al. (2011a) revealed that *Brucella neotomae* was isolated from desert wood rats, and there is no apparent zoonotic consequence. *Brucella ceti* and *Brucella pinnipedialis* are resident in marine animals, which means this genus has larger ecological niches (Foster et al., 2007).

The Life Cycle of the Causative Agent

The life cycle of *Brucella* is quite complex and has intracellular and extracellular phases:

The bacteria enter the host through contaminated food and water, abrasions of the skin, or mucosal surfaces. Moreover, it can also be transferred directly from infected animals or by inhalation (Jawad, 2024). When *Brucella* invades the host, it is phagocytosed by macrophages. The bacteria can multiply inside the phagosome compartment instead of being lysed by preventing phagosome-lysosome fusion. Their pathogenesis and survival depend on this adaptability (Celli et al., 2006).

After reproduction, the bacteria spread to different tissues and organs, including the spleen, liver, and lymph nodes. They lead to chronic infections, often resulting in chronic disease (González-Espinoza et al., 2021). The virus is excreted in the milk, urine, feces, and reproductive secretions of infected animals, which can be transmitted to humans and other animals. This stage determines the continuation of the bacterial life cycle (Godfroid et al., 2011b). Environmental persistence further enhances *Brucella*'s ability to infect new hosts (Foster et al., 2007). Because of the adaptability and survival ability in host cells, Brucella is a challenging disease to control. Its small genome and survival dependence on the host indicate a high level of co-evolution with its hosts (Rahimnahal et al., 2023).

Transmission of the Human Brucellosis Causing Agent

The most common causative agents in humans are *Brucella melitensis*, *Brucella abortus*, *Brucella suis*, and *Brucella canis*. Brucella species are responsible for the bacterial zoonotic illness known as brucellosis. These illnesses mostly affect cattle, but they can also infect people by direct contact, ingestion, or inhalation of infected materials (Santos et al., 2021).

Direct Contact with Animal Products or Infected Animals

Direct animal contact is one of the riskiest activities since the bacterium might find its way to humans by penetrating through any opening: cuts, abrasions, or mucous membrane covering an individual's mouth, nasal orifice, and eye, etc. For instance, *Brucella* can be discharged to the environment during calving when the diseased calf emits the *Brucella* germ from fetal tissues, amniotic fluid, and placental tissue. The germs will disseminate the disease when one encounters infected things. In countries in which traditional farming

practices involve such careless handling of these materials, human-to-human transmission has been particularly well-documented (Al-Dahouk et al., 2013).

Consumption of Infected Animal Products

Another known mode of acquiring brucellosis is through the consumption of unpasteurized milk, cheese, or other dairy products from infected animals. Raw milk and other dairy products contain *Brucella* species that can survive and multiply there and lead to infection when ingested. Individuals consuming untreated milk or unpasteurized dairy products are at a higher risk of developing brucellosis due to the prevalence of this disease in areas where pasteurization of milk is not practiced frequently (Carmichael & Wenzel, 2018). In rural communities, with little access to current food safety standards, intake of contaminated dairy products has been considered one of the commonest ways through which the disease spreads (Montaraz et al., 2017).

Aerosol Inhalation

Inhalation of aerosolized *Brucella* germs is an unusual but perhaps significant mode of transmission. This primarily occurs in laboratory or slaughterhouse settings with a high density of infected animals. Laboratory workers working with infected animal tissues are particularly at risk if they do not use proper precautions.

Transmission between Individuals

Although, rarely, brucellosis transfers from one human being to another, such cases have occurred sporadically, which suggests that person-to-person transmission may happen. Though such incidents are rare, it is believed that these transmissions occur through the exposure to physiological fluids, which includes breast milk, vaginal secretions, or semen (Martín et al., 2020).

Endemic Regions and Occupational Exposure

Human brucellosis cases are most often reported in locations where animal brucellosis is common, such as parts of the Middle East, the Mediterranean, Central Asia, and South Asia, where pastoralism is prevalent. Occupational groups at highest risk are veterinary professionals, farmers, slaughterhouse employees, and dairy industry workers. Inadequate public health measures and limited availability of preventive measures such as pasteurization and immunization increase the risk of infection in these locations (Bardor et al., 2016).

Brucellosis Transmission in Livestock

The *Brucella* spread by infected animals from the reproductive tissues such as the placenta, uterine secretions, or vaginal fluids (World Health Organization, 2016). High levels of *Brucella* are found in the placenta of infected female post-birth, and such bacteria can easily be transferred to the infant or any nearby animal. From research, it has been shown that bacteria are also present in milk, though they are less commonly transmitted by this route (Kumar et al., 2021).

Bodily Fluid Contact Transmission

Other than the reproductive fluids, *Brucella* can also be transmitted by contaminated semen, urine, and feces. Direct contact with the contaminated environment might expose livestock to the virus. Indirectly, the risk of transfer of the virus can be increased by the bacteria's ability to persist in the environment for a while, particularly in wet and colder environments (Dawood et al., 2023). The *Brucella* germs can be inhaled or consumed by animals, including livestock (Akhtar et al., 2020).

Transmission of Vector

Direct contact between animals or exposure to contaminated environments remains the primary means by which the disease is spread in animals, but it has been shown that certain species of ticks host the *Brucella*, which may be transferred through mechanical transmission (Kapatkin, 2018).

Human-Livestock Interaction

Brucellosis not only spreads across animals, but it can also infect humans, especially those who handle contaminated cattle, such as farmers and veterinarians, and slaughterhouse personnel. Direct contact with infected animals, eating unpasteurized dairy products, or breathing in aerosols contaminated with *Brucella* can infect humans. Brucellosis is considered a serious public health issue in regions where extensive cattle husbandry has been practiced due to such zoonotic transmission (Dadar et al., 2021).

Human Symptoms

Brucellosis is a zoonotic disease caused by the *Brucella* species, and it affects humans when they are in close contact with infected animals or they consume contaminated animal products (Montaraz et al., 2017).

Brucellosis frequently presents treacherously, with side effects normally developing one to three weeks after the microorganism (Jin et al., 2023). Like other hot infections, ordinarily the underlying side effects are fever, migraine, sleepiness, and joint and skeletal pain (Feng et al., 2019). The most widely recognized side effect of brucellosis is muscle distress in the muscles, joints, and bones. As Al-Dahouk et al. (2011) call attention to, this frequently happens due to osteoarticular contribution on account of brucella contamination, which might give spondylitis or joint inflammation. The knees, spine, and sacroiliac joint are delicate to aggravation by brucellosis, which prompts persistent agony and, in outrageous conditions, crippling (Bergmann et al., 2017). Brucellosis further influences the gastrointestinal tract. Alongside outer muscle and hot side effects, patients may likewise encounter side effects connected with queasiness, vomiting, stomach pain, and diarrhea (Abdelwahab et

al., 2020). The circumstances are additionally confounded by revealing deficiency of weight among a portion of the patients in the creation of finding and treatment plans (Moreno & Moriyon, 2002).

Brucellosis may likewise impact the central nervous system (CNS) and the side effects include cerebral pain, disarray, dizziness, and now and occasionally meningitis or encephalitis (Aziz et al., 2011). Neurobrucellosis, which is more uncommon yet may prompt different neurological handicaps that include ataxia, cranial nerve loss of motion, and mental issues, which require delayed anti-microbial treatment and complete treatment (Hirsh et al., 2006). Brucellosis can influence the endocrine system, especially the reproductive organs. It can cause unconstrained early termination in ladies and orchitis in men (Moreno & Moriyon, 2002). Ongoing disease might cause barrenness, albeit this is intriguing (Dahouk et al., 2013). Brucellosis might become ongoing, and side effects might stay for a long time or even years. Fevers, weakness, and outer muscle torment are a portion of the normal side effects of ongoing brucellosis, which might prompt long haul entanglements like chronic fatigue syndrome, joint pain, and, surprisingly, super durable harm to organs like the liver and spleen (Mokhtar et al., 2024).

Symptoms in Livestock

Numerous livestock animals that are sensitive to brucellosis include cattle, sheep, goats, and pigs. The clinical outcomes of the disease, caused by *Brucella*, differ according to age, host species, and infection stage. Brucellosis can cause systemic and reproductive problems that have a major effect on animal productivity (Kapatkin, 2018). In the later stages of pregnancy, abortion is one of the most noticeable signs of brucellosis in cattle, which usually displays as a reproductive disease. Abortion usually happens between the fifth and the seventh month of pregnancy, which is the first sign of the illness. Incomplete placental delivery, uterine inflammation in females, decreased fertility, and testicular inflammation in male cattle are further symptoms. When brucellosis spreads to joints, it can sometimes result in weakness from arthritis or synovitis (Alton et al., 1988).

Similar to cattle, sheep, and goats infected with *Brucella* species also have reproductive issues; the most common symptom is abortion. Late in pregnancy, these animals may abort their fetuses, frequently after experiencing lethargy, fever, and decreased feed intake. Sheep and goats may have fewer systemic symptoms than cattle, although they can also have orchitis, epididymitis, and decreased milk production (Jafar & Aslam, 2015). One notable characteristic of goats is the higher prevalence of male testicular abnormalities and epididymitis, which can result in infertility (Radostits et al., 2007). Brucellosis in pigs may result in abortions, stillbirths, and the birth of underdeveloped piglets, which are included among reproductive failures. Due to this condition, pigs may also experience decreased fertility. Infected females may also experience high fever, decreased weight, and depression. Abortion or stillbirth may occur around the third trimester of pregnancy. Long-term infections can cause widespread symptoms such as fever, weight loss, and lameness, Male pigs can suffer orchitis and sterility (Fischer et al., 2004).

Diagnosis in Humans

Brucellosis mainly infects animals, but sometimes it can also infect humans. It is difficult to diagnose the disease in humans because the symptoms have a wide varied. For proper treatment and for avoiding such complications, an accurate diagnosis is essential (Al-Dahouk et al., 2011).

Clinical Presentation

Some generic clinical symptoms of the infection are the reasons due to why human brucellosis is often mistaken for other feverish infections, including typhoid fever, malaria, and tuberculosis.

Lab Diagnosis

Before making the final diagnosis of brucellosis, lab confirmation is needed, for which multiple procedures are used. These procedures involve molecular, cultural, and serological tests.

1. **Cultures of Blood**

The gold standards considered for the diagnosis of brucellosis from patients include culturing of blood or other clinical materials like bone marrow and lymph nodes. Blood cultures might take days to weeks and have a relatively low sensitivity (70-80%) in patients who have already received antibiotics or who are in the chronic phase of disease (Qiangsheng et al., 2023).

2. **Tests of the Serology**

Serological tests are very fast and easy to perform; they are, therefore, mainly applied in the diagnosis of brucellosis. Among the common serological tests are the Complement Fixation Test (CFT), Enzyme-Linked Immunosorbent Assay (ELISA), and Rose Bengal Test (RBT).

PCR, or Polymerase Chain Reaction

PCR-based techniques have assumed increased importance in the diagnosis of brucellosis, particularly when blood cultures are negative. PCR techniques can detect *Brucella* DNA from various clinical samples like blood, urine, and synovial fluids, and are very sensitive. Moreover, PCR allows rapid detection and can help differentiate between the *Brucella* species, which is important for both therapeutic as well as epidemiological reasons (Al-Dahouk et al., 2013).

Diagnosis in Livestock

Brucellosis represents a huge danger as a zoonotic disease for humans, particularly in dairy cattle, sheep, goats, and bison. The conclusion of this sickness in animals is fundamental for overseeing development and forestalling its transmission to people. Determination, for the most part, depends on a blend of clinical signs, serological evaluations, and bacteriological methods (Kumar et al., 2021).

Clinical Examination

Clinical indications of brucellosis in animals are frequently thought to be, yet they are not always authoritative all the time. Normal side effects that impacted creatures might show include early termination, stillbirths, feeble posterity, and sterility (Godfroid et al., 2011c). Brucellosis can prompt enlargement in the joints, by and large short-term impairment, and a decline in milk production (Zhang et al., 2024).

Diagnosis by Serology

Since serological tests are basic, modest, and can test an enormous number of animals, they are the most widely recognized strategy for identifying brucellosis in animals. There are a lot more serological tests available that have various benefits and disadvantages. The absolute most broadly utilized tests include:

Rose Bengal Test: This is a fast, basic, and economical technique for recognizing antibodies against *Brucella* species in animal serum. It is much of the time used to screen enormous populations, particularly in regions where brucellosis is exceptionally common (World Health Organization, 2016).

Albeit the RBT is delicate, it might prompt misleading up-sides, particularly in immunized creatures or those that have been exposed to other *Brucella* species. A more delicate and explicit test for the assurance of antibodies against *Brucella* antigens is ELISA. It is of outstanding worth in the assurance of the presence of brucellosis both in the immunized and contaminated animals. In areas where a functioning immunization is in the works, the distinction between antibodies emerging because of contamination and that which is created because of immunization is exceptionally significant in the ELISA test (Legesse et al., 2023).

Complement Fixation Test

The serological technique is used to confirm cases of brucellosis in patients. While it is fit for recognizing among different types of *Brucella* and offers more prominent explicitness than the RBT, it is also tedious and requires particular research facility hardware (Nerve et al., 2013). At the point when different tests show conflicting results, the exceptionally exact IFAT is used to check the determination of brucellosis. It serves as a reliable marker of openness by recognizing antibodies that connect to *Brucella* antigens (Weber et al., 2008).

Bacteriology Diagnosis

The conclusive technique for recognizing brucellosis remains bacteriological culture, despite the normal use of serological tests for beginning screening. This interaction includes disengaging brucella microbes by developing examples taken from blood, milk, cut short fetal tissues or vaginal liquids. Nonetheless, because Brucella develops gradually and requires explicit culture media and conditions, accomplishing disengagement can be challenging. Besides, since brucella represents a possible organic gamble, taking care of thought test requests requires severe biosecurity precautionary measures (Nielsen & Duncan, 2002).

Molecular Diagnosis

PCR, polymerase chain reaction, has turned into a fundamental diagnostic tool for brucellosis since it can straightforwardly distinguish Brucella DNA in clinical samples. It is especially significant when culture results are equivocal or negative, as it supports perceiving explicit Brucella species. The high responsiveness of PCR considers the location of the microbe even in modest quantities. Moreover, it can distinguish between different Brucella species, which is urgent for checking sickness episodes and understanding how various kinds of the microscopic organisms spread (Gul et al., 2021).

Prevention

1. Animal Vaccination

Immunization programs for domesticated animals, especially focusing on young animals in locales where Brucellosis is common, are regularly executed in various nations to restrict the spread. To safeguard animals from Brucellosis disease, it is fundamental to do immunization efforts in many countries where outbreaks are uncommon. In any case, accomplishing widespread vaccination can be troublesome, especially in emerging nations where veterinary assets are restricted (Moriyón et al., 2023).

2. Isolation and Testing of Infected Animals

Testing and observing are fundamental stages for the control of the sickness in animals. Contaminated creatures can be identified by serological strategies, for example, the Rose Bengal test, supplement obsession test, and ELISA. Once the infected animal is identified, it must be isolated or culled to prevent further spread of the infection. One of the control measures is sick animal culling, primarily in places where brucellosis poses a grave public health issue. Testing and surveillance programs help monitor how effective vaccinations are being, thereby putting a brake on further outbreaks (Godfroid et al., 2011a).

3. Pasteurization of Dairy Products

One of the essential prevention strategies for human brucellosis is pasteurization, which refers to the brief heating of milk to a high temperature so that dangerous germs may be destroyed. One important preventive measure in countries where brucellosis is an issue is to ensure that all dairy products are pasteurized before consumption. To raise public awareness about the dangers of unpasteurized dairy products and the importance of drinking only pasteurized milk and cheese, public health campaigns are often conducted. Local governments often implement laws that mandate the pasteurization of milk in brucellosis-endemic areas (World Health Organization, 2016).

4. Public Health Education

Education is one of the best ways to halt the transmission of brucellosis. When working with animals, especially during calving, lambing,

or the disposal of animal reproductive materials, protective gear such as gloves, masks, and goggles should be worn. Public health programs also stress the importance of proper hygiene after exposure to animals, safe carcass handling, and the use of personal protective equipment. Individuals should also be educated about the risks of consuming raw or undercooked meat and dairy products and the benefits of proper cooking of meat to eradicate any potential infections (Thendji, 2023).

5. Epidemiological Monitoring and Surveillance

Early detection of a brucellosis epidemic and prompt implementation of control measures are highly dependent on surveillance systems. To counteract brucellosis as a global public health and veterinary concern, state surveillance would need international cooperation, in addition to the WHO and the OIE in leadership roles. These groups work together with national governments to implement monitoring programs and share best practices on how to prevent disease (Godfroid et al., 2011b)

Brucellosis Impact around the World

Brucellosis is a common zoonotic disease that has a tremendous impact on human and animal health as well as socioeconomic development globally. Brucellosis is found more commonly in places where raising cattle is a key industry and in countries with underdeveloped veterinary infrastructure. Along with Southern and Eastern Europe, it is endemic to all of the countries of the Middle East, South Asia, Sub-Saharan Africa, and Latin America. *Brucella melitensis*, for example, is the predominant agent causing human brucellosis in the Middle East, primarily through its high consumption of unpasteurized dairy products. Due to lower production from agriculture and the costs associated with public health operations, such as diagnosis, treatment, and hospitalization of human cases, brucellosis annually incurs millions of dollars in losses according to WHO estimates (World Health Organization, 2016). Globally, brucellosis is one of the most common zoonotic diseases, with approximately 500,000 new human cases occurring every year. Because the disease is often inappropriately diagnosed and underreported, especially in resource-poor settings, the actual incidence may be much higher.

Conclusion

The complexity of zoonotic diseases is best exemplified by brucellosis, which poses problems in cattle management, public health, and international economic stability. Given how common it is in developing nations, there is an urgent need for integrated strategies that combine veterinarian care, public health campaigns, and personal education. This study reveals how brucellosis has the serious health issues of crippled chronic illnesses to human populations besides reducing the productivity in animals through reproductive and systemic problems. The illness is, however, still present in considerable amounts within the low-resource environments despite gaps remaining within the diagnosis, treatment, and eradication of brucellosis. There is hope to lessen the effects of brucellosis globally by persistent efforts in pasteurization, immunization, wildlife management, and public education, in addition to a strong "One Health" framework. To address this ongoing zoonotic concern and protect not just the health of animals but also the welfare of communities that depend on livestock for their livelihood, cooperative international policies and local actions are of the essence. Brucellosis stands as a good reminder about the interrelation of human and animal health and for cross-sectoral initiatives aimed at meeting both public health and sustainable development goals.

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