

SUBCLINICAL ZONOOSES IN MILK: A HIDDEN PUBLIC HEALTH CHALLENGE AND THE VETERINARIAN'S ROLE

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ABSTRACT

Milk is a widely consumed dietary staple, yet its safety is often compromised in unorganized dairy sectors where regulatory oversight and routine health monitoring are limited. In India, a major share of milk originates from smallholder farms and informal vendors. While this system sustains rural livelihoods, it also presents a significant public health concern due to subclinical zoonotic infections. These infections do not show obvious clinical signs in animals but can result in continuous shedding of pathogens into milk. Zoonoses such as brucellosis, bovine tuberculosis, leptospirosis, and Q fever can be transmitted through raw or inadequately processed milk, leading to underdiagnosed chronic conditions in humans. This review highlights the epidemiology and risks of subclinical zoonoses in unorganized dairy systems and emphasizes the role of veterinarians in surveillance, farmer education, and preventive practices. Strengthening veterinary engagement through a One Health approach is essential to ensure safe milk production and protect public health.

KEYWORDS: Milk, Dairy sector, Zoonoses, Brucellosis, Bovine tuberculosis, Leptospirosis and Q fever

INTRODUTCION

Milk is considered a “complete food” and is an important part of daily nutrition for all age groups. However, its safety depends on the health of dairy animals and proper hygiene during milking, handling, and storage storage processes (Food and Agriculture Organization, 2011). In countries like India, much of the milk comes from small, unorganized dairy systems such as household farms (Food Safety and Standards Authority of India, 2018). These setups often lack regular veterinary supervision, proper biosecurity, and routine disease screening. As a result, subclinical zoonotic diseases where animals show no visible symptoms but still carry infections become a major concern. Such animals may silently shed harmful pathogens into milk, making it a hidden source of disease transmission.

This issue is often overlooked, especially in rural areas where farmers depend on a few animals for their livelihood. Veterinary care mainly focuses on treating sick animals rather than preventing diseases or

ensuring milk safety. This allows infections like Brucellosis and Q fever to go unnoticed, even when animals appear healthy. Contaminated milk can then expose consumers, particularly children and pregnant women, to health risks (Centers for Disease Control and Prevention, 2019). Therefore, improving awareness, strengthening veterinary involvement, and promoting preventive practices are essential to ensure safer milk and protect public health.

SUBCLINICAL ZONOOSES

Subclinical zoonoses are infections in animals that show no visible symptoms yet can transmit pathogens to humans through milk and other secretions, often remaining undetected without laboratory testing (World Health Organization, 2020; Food and Agriculture Organization, 2011)

- No obvious clinical signs in infected animals.
- Intermittent or continuous shedding of pathogens

- Detection requires laboratory diagnostic tests
- Commonly unnoticed in unorganized dairy systems

Due to these characteristics, subclinical zoonoses represent a hidden but significant threat to both animal health and public safety (McDermott & Grace, 2012).

Major Milk-Borne Subclinical Zoonotic Diseases

Several zoonotic diseases can be transmitted through milk without obvious signs in animals. Among them, the following four are especially important in South Asian dairy systems due to their widespread occurrence and low levels of routine screening.

1. Brucellosis

Brucellosis is caused by *Brucella* bacteria, mainly *Brucella abortus* in cattle and *Brucella melitensis* in goats and sheep. Infected animals may abort once but later appear normal while shedding bacteria in milk for long periods, making detection difficult (World Organisation for Animal Health, 2021). In humans, it causes fever, joint pain, weakness, and fatigue, and is often misdiagnosed.

2. Q Fever (Coxiellosis)

Q fever is caused by *Coxiella burnetii*, a highly infectious bacterium. Infected animals usually show no signs but shed large amounts of bacteria through milk, urine, feces, and especially during birth (Centers for Disease Control and Prevention, 2019). Even a small dose can infect humans. In people, it causes flu-like symptoms, but may lead to serious complications like Endocarditis in vulnerable individuals.

3. Leptospirosis

Leptospirosis is caused by bacteria belonging to the genus *Leptospira*. Infected cattle often carry the bacteria in their kidneys and shed it through urine without visible signs. Milk can get contaminated during milking due to poor hygiene. In humans, it ranges from mild fever to severe illness with jaundice, kidney failure, and bleeding, known as Weil's disease (Bharti et al., 2003).

4. Bovine Tuberculosis

Bovine tuberculosis is caused by *Mycobacterium bovis*. Infected animals may show mild weight loss, but many appear normal, especially in early stages. The infection can spread to humans through raw or unpasteurized milk (World Organisation for Animal Health, 2021). In people, it can cause Extrapulmonary tuberculosis, affecting organs beyond the lungs, particularly in children. These diseases show that seemingly healthy animals can still transmit infections, making awareness, testing, and preventive measures essential for milk safety.

Unorganized Dairy Farms: A High-Risk Environment

Unorganized dairy systems contribute significantly to milk production in developing countries such as India but often lack adequate infrastructure, regulation, and veterinary oversight (Food Safety and Standards Authority of India, 2018). Unlike organized farms, these systems rely heavily on traditional practices, increasing the risk of undetected subclinical infections (Grace et al., 2012).

Key risk factors include:

- Irregular veterinary services focused mainly on treatment rather than prevention
- Poor hygiene during milking and storage
- Lack of routine disease surveillance
- Absence of animal identification and health records
- Sale of raw or unpasteurized milk
- Limited testing focused on adulteration rather than pathogens
- Ineffective traditional boiling practices
- Low awareness among farmers

These gaps facilitate silent contamination of milk and increase the risk of zoonotic transmission (McDermott & Grace, 2012).

Public Health Implications

Consumption of contaminated or improperly processed milk can have serious consequences, particularly when derived from unregulated systems (Centers for Disease Control and Prevention, 2019). Milk from subclinically infected animals may harbor

pathogens without visible warning, leading to unnoticed exposure.

Such exposure can result in:

- Chronic infections
- Misdiagnosis due to nonspecific symptoms
- Increased healthcare burden in rural areas
- Occupational risks for dairy workers

Studies in India have reported the presence of zoonotic pathogens in raw milk from informal sectors.

Vulnerable populations—including children, pregnant women, elderly individuals, and immunocompromised persons—are at higher risk of severe complications (World Health Organization, 2020). These findings highlight the need for improved surveillance, awareness, and milk safety practices

The Veterinarian's Role in Food Safety

Veterinarians play a crucial role in ensuring the safety of milk, particularly within unorganized dairy sectors where formal monitoring systems are limited. While traditional veterinary practice often focuses on diagnosing and treating clinically ill animals, addressing subclinical zoonotic infections requires a broader approach that emphasizes prevention, early detection, and community awareness (Food and Agriculture Organization, 2011; McDermott & Grace, 2012). By adopting this expanded role, veterinarians can act as key links between animal health and public health.

1. Disease Surveillance and Screening

Veterinarians are essential in identifying infections that are not visible at the farm level. This includes:

- Promoting regular and targeted screening of dairy animals, especially in high-risk herds
- Using cost-effective diagnostic tools such as the Rose Bengal Plate Test (RBPT) for brucellosis and ELISA-based tests for other zoonotic pathogens
- Monitoring herd health trends to detect patterns such as abortions or repeat breeding that may indicate underlying infections

Importantly, farmers must be made aware that apparently healthy animals may still carry infections.

2. Farmer Education and Awareness

Creating awareness among farmers is one of the most effective ways to reduce zoonotic risks. Veterinarians should:

- Educate farmers about common milk-borne zoonotic diseases and their transmission routes
- Promote hygienic milking practices, including clean utensils, proper hand hygiene, and safe storage
- Encourage the use of basic protective measures when handling animals, especially during calving or illness

Clear and simple messages can significantly improve on-farm practices and reduce contamination risks.

3. Promotion of Safe Milk Handling Practices

Veterinarians should actively advocate for safe milk consumption by:

- Advising proper boiling of milk, ensuring it reaches a full rolling boil rather than just being warmed
- Discouraging practices such as mixing raw milk with already boiled milk
- Raising awareness about the risks of consuming raw milk, particularly for children and vulnerable individuals (Centers for Disease Control and Prevention, 2019).

These small but practical interventions can greatly reduce the risk of disease transmission.

4. Implementation of Biosecurity Measures

Preventing the spread of infection within and between farms is another key responsibility. This involves:

- Recommending isolation of animals suspected or confirmed to be infected
- Guiding farmers on controlling animal movement and introducing new animals safely
- Promoting regular cleaning and disinfection of animal housing and milking areas

Such measures help limit the spread of pathogens at the source.

5. Risk-Based Monitoring and Early Warning Systems

Instead of uniform testing, veterinarians can adopt a risk-based approach by:

- Prioritizing farms with a history of abortions, infertility, or unexplained illnesses in animals or humans
- Encouraging farmers to report unusual health events promptly
- Identifying possible links between human illness in farming households and animal health issues

This approach improves efficiency while focusing resources where they are most needed.

6. Strengthening One Health Collaboration

Veterinarians serve as an important bridge between animal health and human health systems. Their role includes:

- Communicating findings of zoonotic diseases to local health authorities when necessary
- Collaborating with public health professionals to manage outbreaks
- Supporting government initiatives and extension programs aimed at improving food safety

By integrating animal and human health perspectives, veterinarians can function as early warning sentinels for zoonotic diseases.

Overall, veterinarians are not only clinicians but also public health guardians responsible for preventing disease transmission and ensuring food safety.

Strategies for Improving Milk Safety

Improving milk safety in unorganized systems requires practical and community-based interventions (Grace et al., 2012), following strategies can help reduce the risk of contamination and strengthen overall food safety:

- **Development of community-level milk testing facilities:**

Set up local milk testing centers for regular screening of contamination and zoonotic pathogens.

- **Expansion of veterinary outreach services:**

To ensure regular monitoring, early detection, and safe dairy practices.

- **Adoption of cost-effective diagnostic methods:**

Use low-cost, easy tests to detect hidden infections early, even in low-resource settings.

- **Promotion of cooperative dairy systems:**

Encourage farmers to join cooperatives for better cooling, milk testing, and organized marketing facilities.

- **Implementation of grassroots awareness programs:**

Conducting education campaigns at the village level can increase awareness about zoonotic diseases, hygienic milk handling, and the importance of consuming properly processed milk.

Together, these measures can significantly enhance milk safety, protect public health, and support sustainable dairy production.

Challenges in Control and the Way Forward

Control of subclinical zoonotic diseases in unorganized dairy systems is hindered by economic, infrastructural, and social constraints. Farmers may hesitate to adopt control measures due to financial concerns, while access to veterinary services and diagnostic facilities remains limited in rural areas (Food Safety and Standards Authority of India, 2018). Cultural practices such as consumption of raw milk and weak enforcement of food safety regulations further complicate control efforts (Grace et al., 2012)

Key challenges include:

- Limited financial and technical resources in rural settings
- Reluctance among farmers to adopt control measures that may affect income
- Inadequate access to diagnostic facilities and laboratory support

- Cultural practices that encourage consumption of raw or minimally processed milk

Despite these barriers, several practical and achievable solutions can help improve the situation:

Subsidized diagnostic support: Provide low-cost or government-supported test kits to help farmers check animals regularly.

Incentive-based programs: Reward dairy groups that follow disease screening and safe milk practices to encourage more participation.

Strengthening One Health collaboration: Work together locally with veterinarians, doctors, and community leaders to detect and control zoonotic diseases early.

Use of digital tools: Mobile-based reporting systems can help track disease occurrence, improve communication, and enable quicker intervention in case of outbreaks.

While these challenges cannot be addressed by veterinarians alone, they are in a strong position to lead awareness, guide implementation, and advocate for better policies. Their role is vital not only in treating animal diseases but also in protecting public health and ensuring the safety of the food supply.

Future Perspectives

Controlling subclinical zoonotic diseases in dairy systems needs an integrated One Health approach linking animal, human, and environmental health. Strong collaboration enables early detection and coordinated action. Advances in rapid, affordable diagnostics, along with mobile veterinary services and digital platforms, improve surveillance and access. Combined with community awareness and supportive policies, these measures enhance milk safety and safeguard public health.

Conclusion

Milk is an essential source of nutrition for millions, but it can also carry hidden pathogens when subclinical zoonotic infections go unnoticed. In unorganized dairy systems, animals often appear healthy and routine screening is limited, making early detection difficult. As a result, infections may silently spread through milk, creating risks to food safety and public health without obvious warning signs. At the same time, these dairy systems support rural livelihoods, so solutions must balance health and economic needs. Veterinarians play a key role by not only treating animals but also supporting disease surveillance, farmer awareness, and hygienic practices. Using the One Health approach, along with stronger field-level awareness and preventive care, can help ensure milk remains both nutritious and safe.

“A healthy animal is not always a safe animal. Recognizing this distinction allows veterinarians to protect both animal and human lives”

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