



Bio Vet Innovator Magazine

(Fueling The Future of Science...)

Volume 3 (Issue 1) JANUARY 2026



Review Article

Brucellosis: A Review of Occupational Risks for Veterinary Professionals

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DOI: <https://doi.org/10.5281/zenodo.18275771>

Received: January 13, 2026

Published: January 16, 2026

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Abstract:

Brucellosis continues to be among the most prevalent yet underrecognized zoonotic infections worldwide, with a particularly high burden in developing countries such as India. The disease represents a serious occupational risk for veterinarians and para-veterinary personnel, who are routinely exposed to infected animals, contaminated reproductive tissues, and live attenuated vaccines. This review consolidates existing evidence on occupational exposure to *Brucella* species, highlights veterinary procedures associated with elevated risk, examines diagnostic limitations encountered in clinical settings, and recommends strengthened biosafety measures within the One Health framework.

Keywords: Brucellosis, Zoonotic infection, Occupational risk, Veterinarians, One Health.

Introduction:

Brucellosis is a bacterial zoonotic disease caused by species of the genus *Brucella* and is widely regarded as one of the most common occupational infections globally, particularly among individuals engaged in close contact with animals and animal-derived products. The disease is caused by Gram-negative, facultative intracellular coccobacilli that infect a broad range of domestic animals, especially cattle, sheep, and goats (Qureshi et al., 2023). The capacity of *Brucella* organisms to survive and multiply within macrophages and cells of the reticuloendothelial system enables them to evade host immune defenses, often resulting in persistent and debilitating infections (González et al., 2025).

In humans, infection most commonly occurs through the consumption of unpasteurized milk and dairy products; however, for veterinarians and allied personnel, exposure is largely occupational. Transmission in these groups typically occurs through direct contact with infected tissues, entry via mucous membranes, or inhalation of contaminated aerosols during animal handling and clinical procedures (Almuzaini and Elbehiry, 2025). Although the global burden of human brucellosis has traditionally been estimated at more than 500,000 cases per year, this figure is widely acknowledged to be

a substantial underestimate, and brucellosis remains one of the most prevalent anthroponozoonotic diseases worldwide (Pappas et al., 2006). Recent epidemiological assessments suggest a considerably higher incidence, with approximately 1.6–2.1 million new human cases occurring annually (Laine et al., 2023).

Human infection arises primarily through the consumption of raw milk products, unprotected contact with infected animals or contaminated biological materials, and accidental exposure to live attenuated *Brucella* vaccines used in veterinary practice. These transmission pathways underscore the strong occupational dimension of brucellosis, particularly among veterinary professionals and animal handlers (Ashford et al., 2004).

Occupational Transmission Dynamics:

The effectiveness of *Brucella* as an occupational pathogen is largely attributable to its capacity to persist within host macrophages, thereby evading immune clearance. Veterinary professionals are therefore classified as a “High-Risk Group III” for *Brucella* exposure (Lais et al., 2025). In contrast to the general population, veterinarians encounter the pathogen through distinct occupational routes of transmission:

- **Direct Mucosal Exposure:** Infection commonly occurs during obstetrical interventions, including the management of dystocia or the handling of aborted fetuses and placental tissues, which often contain high concentrations of *Brucella* organisms (Almuzaini and Elbehiry, 2025).
- **Aerosol Transmission:** Clinical and laboratory procedures can generate infectious aerosols, rendering inhalation a major and often underrecognized route of exposure (Qureshi et al., 2023).
- **Accidental Inoculation:** The handling and administration of live attenuated veterinary vaccines, such as *B. abortus* strains RB51 or S19, pose a risk of human infection through accidental self-injection or ocular splashes (Almuzaini and Elbehiry, 2025). Notably, the RB51 strain exhibits resistance to rifampicin, which complicates therapeutic management in infected humans (Hensel et al., 2018).

Occupational "Hotspots" in Clinical Practice:

Research has consistently demonstrated that certain veterinary procedures are associated with a particularly high risk of *Brucella* transmission:

Procedure	Risk Level	Primary Mechanism
Manual Removal of Placenta	Critical	Direct contact with massive bacterial loads in the cotyledons
Dystocia (Assisted Birthing)	High	Prolonged exposure to infected fluids and aerosolization
Post-Mortem Examination	High	Contact with lymphoid tissues and bone marrow where bacteria sequester
Large-Scale Vaccination	Moderate	Needle-stick injuries due to poor animal restraint

Clinical Presentation and "The Great Imitator":

For veterinarians, self-recognition of brucellosis is often challenging due to its non-specific and insidious presentation.

- **Acute phase:** The disease commonly manifests as undulant (intermittent) fever, marked fatigue, and profuse nocturnal sweating, often accompanied by a distinctive “mousy” odour.
- **Chronic or localized phase:** In the absence of timely diagnosis and treatment, *Brucella* infections may become localized, particularly in the musculoskeletal system—most notably causing sacroiliitis—or involve the cardiovascular system, where endocarditis represents the most serious complication and the leading cause of brucellosis-related mortality.
- **Neuropsychological and mental health effects:** Long-standing brucellosis is frequently associated with depression, cognitive impairment described as “brain fog,” and irritability, symptoms that are commonly misattributed to occupational stress or professional burnout.

Diagnostic and Screening Protocols:

Diagnosis of brucellosis is particularly challenging, as its clinical presentation often resembles other common febrile illnesses such as malaria or typhoid (Qureshi et al., 2023). In endemic areas, routine annual screening of veterinary professionals is therefore strongly recommended.

- **Screening Tests:** The Rose Bengal Plate Test (RBPT) is widely used as a rapid screening assay; however, due to the possibility of false-positive results, confirmatory testing with Enzyme-Linked Immunosorbent Assay (ELISA) is often necessary to improve diagnostic accuracy (Mittal et al., 2025).
- **Molecular Approaches:** Advanced molecular techniques, including Polymerase Chain Reaction (PCR) and Whole-Genome Sequencing (WGS), are increasingly being employed for faster and more precise detection of *Brucella*. Nevertheless, bacterial culture remains the diagnostic gold standard, despite limitations such as prolonged incubation periods and the significant biosafety risks it poses to laboratory personnel (Almuzaini and Elbehiry, 2025).

Modern Clinical Management (2025 Guidelines):

As of 2025, the use of dual or triple antibiotic combinations remains the mainstay of brucellosis treatment, primarily to minimize the risk of relapse (Almuzaini and Elbehiry, 2025).

- **Conventional regimen:** The standard therapeutic approach consists of a six-week course of doxycycline in combination with either rifampin or streptomycin, which has long been considered the recommended treatment protocol.
- **Emerging evidence:** Recent studies published in 2025 indicate that shorter, four-week regimens incorporating doxycycline, streptomycin, and hydroxychloroquine may achieve comparable therapeutic efficacy while offering improved safety and tolerability.
- **Risk of relapse:** Treatment with a single antimicrobial agent, such as ciprofloxacin alone, is associated

with a markedly high relapse rate of up to 83% and is therefore strongly discouraged.

Prevention and One Health Strategy:

Effective control of brucellosis demands a One Health approach that links animal disease control measures with stringent human biosafety practices. The mandatory use of personal protective equipment—such as N95 respirators, face shields, and long-sleeved protective gloves—during high-risk veterinary procedures, including manual removal of the placenta, is critical to reducing occupational exposure (Pereira et al., 2020). In addition, all laboratory handling of *Brucella* species should be performed under Biosafety Level 3 (BSL-3) conditions to limit laboratory-acquired infections and prevent nosocomial transmission.

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