HARNESSING VETERINARY EPIDEMIOLOGY TO COMBAT ZOONOTIC DISEASES IN DAIRY FARMING

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ABSTRACT

Zoonotic diseases pose significant threats to both animal and human health, particularly dairy farming where close contact between livestock and humans is routine. They show high impact on cattle productivity through losses from infertility and abortions, which shows negative impact on dairy related livelihood such as dairy (milk and milk products). In dairy animals, zoonoses mainly affect the herd fertility and reduce the milk production and also significantly decrease livestock production leading to substantial economic losses to dairy farmers. Another major concern is the Zoonotic potential from dairy animals to humans due to their high direct contact with cattle by farm husbandry staff. Even though there is less transmission, the economic and social impact occurred by them sounds more. Intensive livestock production also leads to increases zoonotic risk due to genomic evolution and adaptiveness of micro-organism. To reduce this a proper surveillance, monitoring, studies, surveys are required to predict and prevent the future outbreaks and there comes veterinary epidemiology to do this job. This article explores the scope of zoonoses in dairy animals and associated risks. It also emphasizes how much negative impact they had on dairy animals and related livelihood and scope of veterinary epidemiology, which helps in surveillance, diagnosis, prediction, control and prevention which helps in sustainable dairy production.

KEYWORDS: Dairy zoonotic diseases, Veterinary epidemiology, Intensive farming

INTRODUCTION

Any disease or infection that is naturally transmissible from vertebrate animals to humans or vice versa defines zoonosis. It is a major public health concern and a direct human health hazard that can possibly result in mortality (Rahman *et al* 2020). Till now over 200 zoonoses are identified. In dairy animals (cattle, buffalo, sheep, goat) approximately 30-40 major zoonotic diseases are identified which are transmitted through direct contact, milk, meat, or the animal environment. Zoonotic diseases cause over 1 billion illness and millions of deaths globally, representing more than 60% of emerging infectious diseases. Of the 30 novel human infections identified in the past 30 years, 75% originated from animals. The economic burden of zoonotic outbreaks is significant: the 1994 Plague in India cost USD 600million-2billion, highly pathogenic Avian Influenza (2004-2009) in Asia led to USD 10 billion in losses, and the 1998-1999 Nipah virus outbreak in malaysia caused USD 617 million in damages. This shows significant impact on animal productivity and veterinary costs, causing economic strain on farmers in the dairy industry (Bose, B., & Siva Kumar, S. 2025). Effective disease control, prevention and eradication in animals and humans rely on veterinary epidemiology, which offers tools for outbreak investigation, risk assessment, surveillance, herd health and biosecurity making it vital for managing and eliminating (Robertson, I. D. 2020).

EVALUATING ZOONOTIC RISKS ASSOCIATED WITH DAIRY FARMING

Dairy products are high in protein and bioavailable nutrients. Dairy production benefits local and national economies by creating employment and income, but it also poses health risks, particularly zoonotic illnesses associated

with production and consumption habits. Approximately 30-40 major zoonotic diseases are identified in dairy animals and classified as-

Bacterial zoonoses	Bacillus anthracis, Brucella abortus, Campylobacter jejuni, Chlamydia abortus, Clostridium spp(botulinum, difficile, perfringens, septicum), Escherichia coli, Leptospira hardjo, Listeria monocytogenes, salmonella spp(Dublin, typhimurium), Mycobacterium tuberculosis
Parasitic zoonoses (endoparasites)	Echinococcosus granulosis, Cryptosporidium parvum, Giardia duodenalis, Toxocara vitulorum
Parasitic zoonoses (Ectoparasites)	Cheyletiella, Chorioptes, Psoroptes, Sarcoptes, Demodex bovis,
Fungal infections	Candida subtilis, Aspergillis fumigates, Trichophyton verrucosum
zoonotic viruses	Rift Valley Fever, Cowpox, Vaccinia virus

(Holzhauer, M., & Wennink, G. J. 2023)

Brucellosis is a major public health and economic issue. In East Africa, seroprevalence rates in dairy cattle range between 5% and 22%, depending on the agroecological zone, herd size, and pastoral (breeding) method. Studies suggest a frequency of 7.6%-20.2% in diverse cow populations in West Africa, while reported prevalence rates range from 2.3% to 12.6%, mainly in communal and smallholder dairy farms in Southern Africa (Zimbabwe). High herd density (7.6% in small herds versus 23.8% in medium and large herds) and poor hygiene standards help to spread this disease. It poses a significant occupational risk to farm workers, veterinarians, and laboratory personnel. Transmission of Brucella occurs during calving, abortions (secretions), and it is primarily transmitted through unpasteurized dairy products or handling of infected animals to humans. It affects more than 500,000 people annually worldwide, with sub-Saharan Africa contributing a significant portion of cases (Djibril, A. S. D. *et al*., 2025).

Bovine Tuberculosis, a chronic infection in cattle, reduces productivity and poses a significant public health danger. In 2016, 12,500 to 147,000 new cases of zoonotic tuberculosis were recorded globally. In India, roughly 21.8 million cattle suffer from bovine tuberculosis, which has a 7.3% prevalence rate. In 2020, India had the biggest worldwide burden of tuberculosis, accounting for 26% of TB prevalence and 34% of TB fatalities. Tuberculin tests include SIT, CIT, and γ-IFN assays (Ramanujam, H., & Palaniyandi, K. 2023). Bovine tuberculosis (bTB) can be spread through inhalation or eating of raw dairy products. In Tanzania, up to 16% of human TB cases are associated with bovine Tuberculosis.

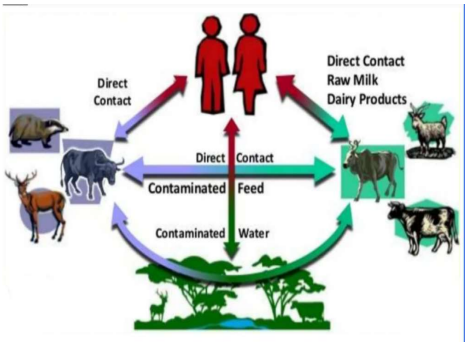

Fig 1. Transmission zoonotic diseases between animals, farmers, consumers (NTEP website)

INTENSIVE LIVESTOCK PRODUCTION

Intensive farming/intensive livestock production also leads to increase in zoonotic risk. A study conducted by (E. Mourkas & co-workers) revealed that the most significant shifts in the natural host niche of campylobacter jejuni has occurred with the rise of intensive livestock farming, which has promoted the emergence of

sublineages adapted to agricultural animal hosts, such as cattle and also reveals dynamic pattern of genome evolution in C.jejuni, aligning with intensified livestock farming and adaptive processes (E. Mourkas *et al*., 2020).

VETERINARY EPIDEMIOLOGY IN ADDRESSING ZOONOTIC DISEASES IN DAIRY FARMING

The study of diseases in the population and the factors that determine their prevalence defines Veterinary epidemiology. It also includes the examination and assessment of health aspects, such as production. The epidemiological objectives include as follows:

1. Identifying the root cause of sickness.
2. Investigation and Control
3. Learn about disease ecology and natural history.
4. Plan, monitor, and evaluate disease management programs.
5. Assessing socio-economic impacts (Thrusfield, M. 2018).

The identification of particular patterns and risk factors that increase the incidence of disease, as well as factors that reduce the likelihood of disease, is crucial for disease control, as it allows interventions to be implemented to minimize disease frequency, severity, and effect. One Health approach that integrates human, animal, and environmental health to mitigating the impact of zoonotic diseases on public health and livestock productivity (Robertson, I. D. 2020). Veterinary epidemiology at Dairy farm/ Herd level helps in identifying, monitoring and controlling these livestock zoonotic diseases through data-driven surveillance, risk assessment and targeted interventions, implementing herd health programs, developing and implementing biosecurity protocols.

CASE STUDIES

Case study 1

From 1970 to 2012, we recorded 318 outbreaks. Outbreaks were most prevalent in Latin America and the Caribbean (36%), followed by Southern Asia (13%), North America (11%). The majority (55%) of outbreaks occurred in tropical and subtropical ecoregions. Guidelines are suggested for building standardized protocols for diagnostic and epidemiological investigations during an outbreak, as well as reporting (Munoz-Zanzi *et al*.,2020).

Case study 2

Overview

Dairy Cattle are essential to Cameroon's rural livelihoods, serving economic, nutritional, and social benefits. However, they serve as reservoirs for a number of important zoonotic bacterial diseases. A comprehensive cross-sectional study was carried out in two major cow-rearing areas: the North West Region (NWR) and Vina Division (VD), sampling both pastoral and dairy animals. A total of 1,558 animals (1,498 pastoral, 60 dairy) were evaluated with ELISA-based diagnostics.

Key Findings

Brucellosis

Seroprevalence was higher in NWR pastoral cattle (4.2%) than VD (1.1%). Dairy herds had similar levels (5.0%), indicating the first documented presence of Brucella spp. in Cameroonian dairy cattle.

Q Fever (C. burnetii)

It had a moderate seroprevalence in both pastoral districts (NWR: 14.6%; VD: 12.4%), but no cases were found in dairy cow.

Leptospirosis (*L. hardjo*)

High seroprevalence was reported in pastoral cattle (30.7%–35.9%) and was notably low in dairy cattle (1.7%).

Transmission Risk Factors

Brucella spp. exposure was significantly associated with co-rearing of sheep and confining cattle at night—practices that facilitate interspecies transmission and close animal contact.

C. burnetii seropositivity was linked to adult age, high tree density, and drier ecological zones. Co-infection with *L. hardjo* further elevated risk.

L. hardjo exposure correlated strongly with age and was significantly lower among cattle engaged in transhumance, suggesting that constant movement reduces prolonged exposure to contaminated water sources (Kelly *et al*., 2021)

The above studies, highlights the importance of region-specific & dairy farm level surveillance and biosecurity measures. Zoonotic disease prevalence in dairy cattle varies by ecology, management, co-rearing practices also, emphasizing the need for targeted interventions.

CONCLUSION AND FUTURE ASPECTS

Dairy cattle can be a source of various types of zoonotic infections which affects productivity such as milk and milk products leads to economic losses. So, Dairy farming surveillance is required which includes regular animal health monitoring, zoonotic pathogen testing, and keeping correct farm records. It allows for early illness detection and control, thereby protecting both animal and public health. Veterinary epidemiology provides an efficient approach to reducing the effect of zoonotic illnesses in dairy farming. Using data-driven surveillance, risk assessment, and intervention tactics, we may detect emerging hazards, track disease transmission, and adopt tailored control efforts. This not only preserves animal health and promotes sustainable dairy production, but it also protects public health by reducing the possibility of zoonotic spillovers. There are some challenges such as data gaps and limited sources that still make controlling the zoonotic diseases difficult. Future research should focus on these challenges to achieve more surveillance that helps in predicting and control of diseases.

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