

Spatio-Temporal Association Between Human Brucellosis Incidence and Livestock Seroprevalence In Navoiy Region, Uzbekistan: A One Health Study Protocol

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Abstract: Background: Brucellosis remains one of the most important neglected zoonoses in Central Asia, with the highest reported human incidence globally recorded in the Middle East and Central Asia region [1]. Neighbouring Central Asian countries report substantial and, in places, rising human and livestock brucellosis burdens despite decades of control efforts, and One Health-informed evaluations in Kazakhstan and Kyrgyzstan have highlighted persistent gaps in inter-sectoral (human-veterinary) data sharing and coordination [1,2]. A district-level, spatially explicit comparison of human and livestock brucellosis burden has not previously been published for Navoiy region. **Objective:** To examine the spatial and temporal association between officially registered human brucellosis incidence and livestock seroprevalence across the districts of Navoiy region, to identify high-risk districts and occupational groups, and to characterise the current mechanisms of data exchange between the region's sanitary-epidemiological and veterinary services. **Methods:** An ecological, spatio-temporal descriptive study will combine officially registered human brucellosis case data (2018–2026) from the Navoiy Regional Department of Sanitary-Epidemiological Welfare and Public Health with district-level livestock serological surveillance data from the Regional Veterinary Administration. District-level incidence/seroprevalence “heat maps” will be constructed in GIS software (QGIS), and correlation between human and animal indicators will be assessed with Spearman/Pearson correlation. A supplementary knowledge-attitudes-practices (KAP) survey among livestock keepers will characterise risk behaviours in higher-incidence districts. **Expected results:** A district-level risk map and a set of recommendations for strengthening cross-sectoral (human-veterinary) collaboration under a One Health framework in Navoiy region. **Ethics and dissemination:** The study will be submitted to [name of ethics committee] for approval; the KAP survey component will use written informed consent. Findings will be shared with regional health and veterinary authorities and submitted for peer-reviewed publication.

Keywords: Brucellosis; One Health; zoonosis; spatial epidemiology; GIS; livestock; Uzbekistan; Central Asia.

Introduction: Brucellosis is a globally re-emerging, neglected bacterial zoonosis transmitted from livestock (principally sheep, goats and cattle) to humans, most often through contact with infected animals or reproductive tissues, or through consumption of unpasteurised dairy products. The World Health

Organization estimates more than 500,000 new human cases annually worldwide, with the highest incidence currently recorded in the Middle East and Central Asia [1].

Regional experience illustrates both the scale of the problem and the difficulty of controlling it. In

Kyrgyzstan, human brucellosis incidence has been among the highest reported worldwide, and a comprehensive review of the country's human and animal surveillance systems over 2010–2020 concluded that mass livestock vaccination contributed to declines in both animal and human infection, while also identifying continuing gaps in cross-sectoral data integration and the need for further spatial and molecular-epidemiological studies [1]. In Kazakhstan, brucellosis has been endemic in livestock since 1930 and has caused substantial annual economic losses; a One Health evaluation of the country's control programme found that, despite repeated calls from international bodies (including a 2019 FAO/OIE workshop establishing a Central Asian Animal Health Network with Kazakhstan, Kyrgyzstan, Uzbekistan, Turkmenistan and Tajikistan, in which brucellosis was identified as the priority disease), the public health and veterinary services still lacked a joint operational policy for the disease, despite existing informal collaboration during outbreak investigations [2]. An earlier field study in Samarqand Oblast, Uzbekistan a region neighbouring Navoiy similarly identified specific occupational and behavioural risk factors for human brucellosis, underscoring that locally relevant risk factors, rather than assumptions imported from elsewhere, are needed to guide control efforts [3]. A recent global incidence review reaffirms that brucellosis remains substantially under-reported relative to its true burden in endemic regions, which limits the accuracy of risk maps based on human notification data alone [4].

Navoiy region, with its substantial livestock-farming and pastoral sector alongside its industrial and mining economy, is well placed to benefit from a structured, spatially explicit comparison of human and animal brucellosis data. Systematically overlaying officially registered human case data with existing livestock serological surveillance data would allow identification of the districts and occupational groups at highest risk, and would provide an evidence base for strengthening operational collaboration between the region's sanitary-epidemiological and veterinary services, consistent with the One Health approaches recommended regionally [1,2].

OBJECTIVES

General objective: To characterise the spatio-temporal relationship between human brucellosis incidence and

livestock seroprevalence across the districts of Navoiy region and to identify priority areas and groups for a coordinated One Health response.

Specific objectives:

1. To describe the district-level distribution and trend of officially registered human brucellosis cases in Navoiy region, 2018–2026.
2. To describe the district-level distribution and trend of livestock (cattle, sheep, goats) brucellosis seroprevalence over the same period, using existing veterinary surveillance data.
3. To assess the correlation between human incidence and livestock seroprevalence at the district level using spatial and statistical methods.
4. To characterise knowledge, attitudes and risk practices related to brucellosis transmission among livestock keepers and dairy/meat-processing workers in the districts identified as higher risk.
5. To document the current mechanisms (if any) of data exchange and joint investigation between the region's sanitary-epidemiological and veterinary services, and to identify opportunities for strengthening this collaboration.

METHODS

An ecological, spatio-temporal descriptive study, combining routinely collected surveillance data from the human and animal health sectors, supplemented by a cross-sectional knowledge-attitudes-practices (KAP) survey among livestock keepers in selected districts an approach comparable to published One Health brucellosis evaluations in Kazakhstan and Kyrgyzstan [1,2].

Setting and data sources

The study will cover all administrative districts (tumans) of Navoiy region. Human case data (2018–2026) will be obtained from the official brucellosis notification registers of the Navoiy Regional Department of Sanitary-Epidemiological Welfare and Public Health. Livestock serological surveillance data (Rose Bengal test and/or ELISA results, by district and species) will be obtained from the Navoiy Regional Veterinary Administration for the same period. Where available, agricultural census data (livestock population by district, farm type subsistence versus industrial) will be used as denominators.

Study population, inclusion and exclusion criteria (KAP survey component)

Inclusion criteria: adult livestock keepers (household or commercial), and dairy/meat-processing workers, resident or employed in the districts identified as higher-incidence based on the ecological analysis, who provide informed consent. Exclusion criteria: individuals under 18 years of age; those unable to provide informed consent.

Sample size (KAP survey component)

For the KAP survey, sample size will be estimated using the standard cross-sectional proportion formula $n = Z^2 \cdot p(1-p)/d^2$, with p informed by knowledge/practice prevalence estimates reported in comparable regional livestock-keeper surveys, and d set to the desired absolute precision (e.g., 5%); a design effect will be applied to account for cluster sampling by village/farm. Final parameters will be confirmed once district selection is finalised following the ecological analysis (Objective 3).

Variables

Human data: district, year/month of notification, age, sex, occupation (where recorded). Animal data: district, year, species, number tested, number seropositive, test method. KAP survey: knowledge of transmission routes, attitudes toward vaccination and safe handling, self-reported practices (e.g., use of personal protective equipment when assisting births, raw milk/dairy consumption), demographic and occupational characteristics.

Spatial and statistical analysis plan

District-level human incidence rates and livestock seroprevalence will be mapped using QGIS (a free, open-source geographic information system) to produce choropleth “heat maps” for each year and for the study period as a whole. The correlation between human incidence and livestock seroprevalence at the district level will be assessed using Spearman's or Pearson's correlation coefficient, as appropriate to data distribution; where sufficient years of data are available, a time-lagged correlation (animal seroprevalence preceding human incidence by one or more years) will also be explored, consistent with the biological plausibility of zoonotic spillover. KAP survey data will be summarised descriptively (proportions, scores) and, where appropriate, compared across

districts using chi-square tests; multivariable regression will be used to identify independent predictors of risk practices.

Ethical considerations

The study will be submitted for approval to [name of relevant institutional/regional ethics committee]. Analysis of aggregated, de-identified surveillance data will be conducted under a data-sharing agreement between the sanitary-epidemiological and veterinary authorities, with no individual-level human or animal identifiers used. The KAP survey component will use written informed consent, voluntary participation, and confidential handling of individual responses.

Expected outcomes and significance

This study is expected to generate the first district-level map of human-livestock brucellosis risk for Navoiy region, together with an evidence-based characterisation of risk practices among livestock keepers and a documented assessment of current inter-sectoral collaboration. These findings are intended to directly support the Navoiy Regional Department of Sanitary-Epidemiological Welfare and Public Health, together with the regional veterinary service, in prioritising districts for joint vaccination, surveillance and public-education interventions, in line with the One Health approaches recommended for brucellosis control across Central Asia [1,2].

Strengths and limitations

- Combines existing human and animal surveillance data, minimising additional data-collection burden for the ecological component.
- GIS-based spatial analysis allows visual and statistical identification of priority districts for intervention.
- As an ecological study, associations observed at the district level cannot be assumed to hold at the individual level (ecological fallacy); the KAP survey component is included specifically to address this limitation by generating individual-level risk-factor data.
- Under-reporting of human brucellosis (a recognised limitation in most endemic settings, including regionally [4]) may lead to underestimation of true incidence; this will be discussed as a limitation when interpreting

correlation results.

Dissemination plan

Results will be prepared for submission to international peer-reviewed journals with a focus on zoonotic and One Health epidemiology, such as Zoonoses and Public Health (Wiley), One Health (Elsevier), PLOS Neglected Tropical Diseases, Frontiers in Veterinary Science / Frontiers in Public Health, and BMC Public Health, and will be shared directly with regional health and veterinary authorities to support operational collaboration.

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