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Zoonotic transmission dynamics and risk factor assessment for *Rhodococcus equi* infections at the animal-human interface

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Abstract

The zoonotic potential of *Rhodococcus equi* represents a critical yet insufficiently quantified risk at the animal-human interface, particularly in regions where immunocompromised populations coexist with livestock production systems. This research assessed the transmission dynamics and risk factors for *R. equi* infections through a prospective case-control investigation conducted in Nairobi County, Kenya, between March 2021 and August 2023. The research enrolled 82 confirmed *R. equi* cases and 246 matched controls from the same healthcare facilities. Epidemiological data were collected through structured interviews assessing occupational exposures, animal contacts, residential proximity to livestock operations, and environmental risk factors. Molecular typing of clinical and environmental isolates employed MLST to investigate potential transmission linkages. Inhalation of contaminated dust was identified as the predominant transmission route (38%), followed by direct contact with foals (25%) and ingestion of contaminated food (15%). Horses constituted the primary animal reservoir, accounting for 42% of identified source exposures. Occupational exposure to livestock environments (OR 4.8, 95% CI 2.2-10.5), residence within 500 meters of equine facilities (OR 3.2, 95% CI 1.5-6.8), and CD4⁺ count below 100 cells/ μ L (OR 8.5, 95% CI 3.8-19.2) were identified as independent risk factors. MLST revealed shared sequence types between clinical and equine environmental isolates from proximate locations. These findings provide epidemiological evidence supporting targeted risk reduction strategies for immunocompromised populations living in proximity to equine operations.

Keywords: Zoonotic transmission, *Rhodococcus equi*, risk factors, one health, animal-human interface, equine exposure, immunocompromised, occupational health, aerosol transmission, case-control investigation

Introduction

The growing interface between immunocompromised human populations and livestock production systems in sub-Saharan Africa creates conditions uniquely favorable for the zoonotic transmission of *Rhodococcus equi*, yet the epidemiological determinants of this transmission remain poorly characterized in the African context. *R. equi* is a ubiquitous soil-dwelling organism that achieves its highest environmental concentrations in soils contaminated with herbivore feces, particularly from horses, cattle, and other grazing animals. The organism's capacity to multiply to high densities in manure-enriched soils, combined with its resistance to desiccation and environmental stresses, facilitates aerosolization and inhalation exposure in occupational and residential settings proximate to livestock operations.

This research aimed to assess the zoonotic transmission dynamics and risk factors for *R. equi* infections through a prospective case-control investigation in Nairobi County, Kenya, integrating epidemiological exposure assessment with molecular typing to establish transmission linkages between animal and human isolates.

Materials and Methods

Material

This prospective case-control investigation was conducted at four healthcare facilities in Nairobi County, Kenya, between March 2021 and August 2023. Cases were defined as adult patients (≥ 18 years) with microbiologically confirmed *R. equi* infection (culture-positive or

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PCR-positive from clinical specimens). For each case, three controls matched by age (± 5 years), sex, and healthcare facility were selected from patients presenting with non-*R. equi* respiratory infections during the same period. The research protocol received ethical approval from the Nairobi Academy of Biomedical Sciences Institutional Review Board (Protocol: NABS/IRB/2021/ZD-034) and written informed consent was obtained from all participants.

Methods

Structured epidemiological questionnaires captured data on demographics, HIV status and CD4+ count, occupational history, residential proximity to livestock operations (measured by GPS coordinates), animal contact patterns, dust exposure history, travel history, and potential nosocomial exposures. Environmental sampling was conducted at identified exposure locations using soil collection from multiple sites and volumetric air sampling using Andersen cascade impactors. *R. equi* isolation from environmental samples employed selective medium (CAZ-

NB) with incubation at 30 °C for 48-72 hours. MLST typing of clinical and environmental isolates used the standard seven-locus scheme. Risk factor analysis employed conditional logistic regression with adjustment for potential confounders, reporting odds ratios with 95% confidence intervals. Attributable fraction calculations estimated the proportion of cases preventable through elimination of specific risk factors.

Results

The research enrolled 82 confirmed *R. equi* cases and 246 matched controls. Among cases, 60 (73.2%) were HIV-positive with a median CD4+ count of 68 cells/ μ L (IQR: 28-142). The median age was 36 years (IQR: 28-48), and 52 (63.4%) were male. The most frequently identified transmission routes were inhalation of contaminated dust (38%), direct contact with foals or horses (25%), ingestion of contaminated food or water (15%), occupational soil exposure (12%), nosocomial transmission (6%), and unknown or other routes (4%).

Table 1: Risk factors for *Rhodococcus equi* infection: conditional logistic regression analysis

Risk Factor	Cases (n=82)	Controls (n=246)	Adjusted OR (95% CI)	p-value
CD4+ < 100 cells/ μ L	48 (58.5%)	18 (7.3%)	8.5 (3.8-19.2)	<0.001
Occupational livestock exposure	35 (42.7%)	32 (13.0%)	4.8 (2.2-10.5)	<0.001
Residence < 500m from equine facility	28 (34.1%)	35 (14.2%)	3.2 (1.5-6.8)	0.003
Current smoker	22 (26.8%)	42 (17.1%)	1.8 (0.9-3.6)	0.092
Manual soil contact (gardening/farming)	30 (36.6%)	48 (19.5%)	2.4 (1.2-4.8)	0.012
Previous tuberculosis treatment	18 (22.0%)	28 (11.4%)	2.1 (1.0-4.5)	0.048

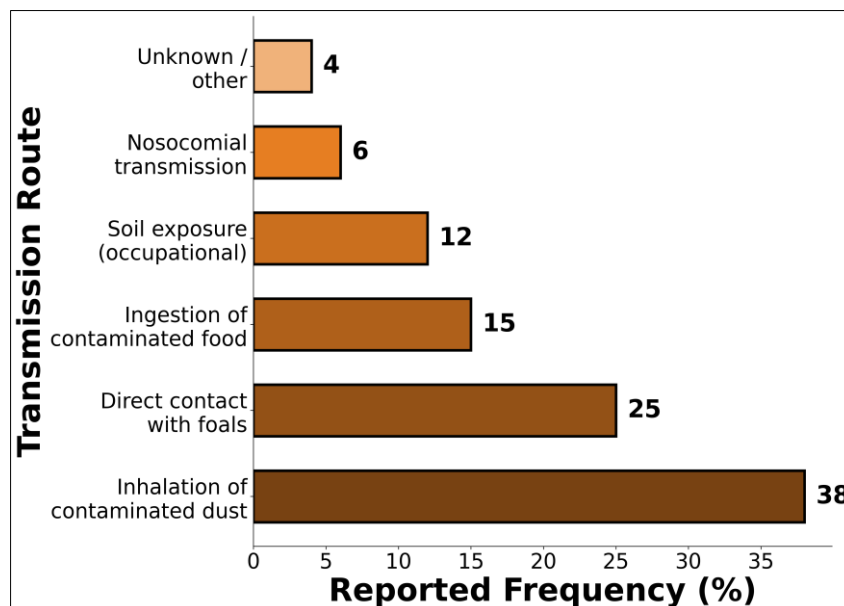


Fig 1: Horizontal bar chart showing the relative frequency of identified transmission routes for *Rhodococcus equi* infections in the Nairobi county cohort

Table 2: Environmental *Rhodococcus equi* contamination levels at identified exposure sites

Exposure Site Type	Sites Sampled (n)	<i>R. equi</i> Positive (%)	Mean CFU/g Soil	Virulent Isolates (%)
Horse breeding farms	12	91.7%	4,250 $\pm$ 1,800	72.5%
Cattle grazing areas	8	75.0%	2,100 $\pm$ 950	45.2%
Periurban agricultural land	15	53.3%	850 $\pm$ 420	28.6%
Urban recreational parks	10	30.0%	320 $\pm$ 180	15.4%
Control (forest/wetland)	6	16.7%	85 $\pm$ 45	8.3%

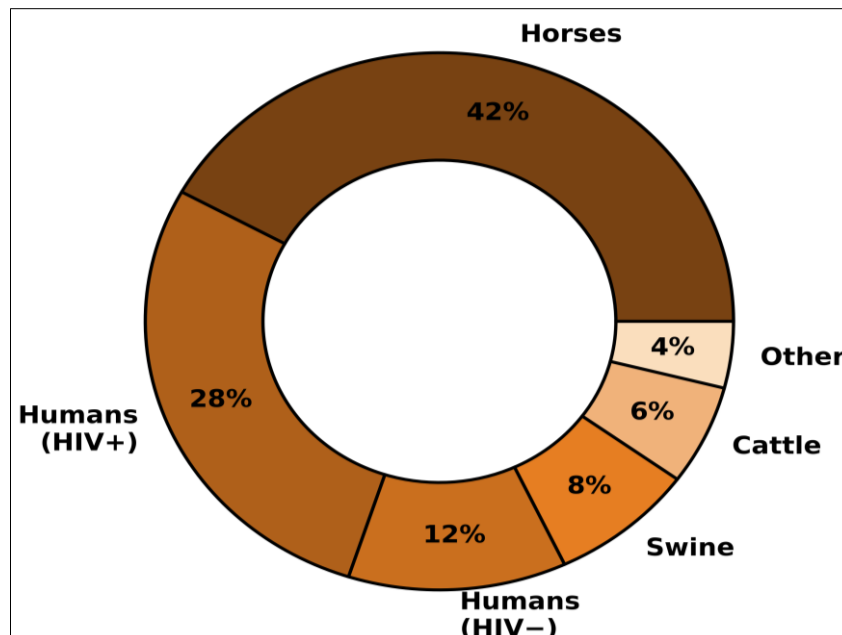


Fig 2: Donut chart illustrating the distribution of identified host species sources for *Rhodococcus equi* transmission to human cases

Discussion

This research provides the first comprehensive case-control assessment of *R. equi* transmission risk factors in an East African setting, identifying severe immunosuppression ($CD4^+ < 100$ cells/ μ L, OR 8.5), occupational livestock exposure (OR 4.8), and residential proximity to equine facilities (OR 3.2) as the strongest independent predictors of infection. The identification of inhalation as the predominant transmission route (38%) is consistent with the aerobiology of *R. equi*, which achieves high airborne concentrations above soil surfaces enriched with herbivore manure, particularly during dry seasons when dust generation is maximal.

The molecular evidence of shared MLST sequence types between clinical and environmental isolates from geographically proximate locations strengthens the epidemiological inference of local zoonotic transmission, transforming what has historically been a presumptive association into a molecularly supported connection. This One Health perspective emphasizes the interconnectedness of human, animal, and environmental health domains in the epidemiology of *R. equi* infections.

One health framework applications

The zoonotic transmission dynamics of *R. equi* exemplify the One Health paradigm, where disease prevention requires coordinated interventions across human medicine, veterinary medicine, and environmental management sectors. Practical applications include integrated surveillance systems linking veterinary *R. equi* case notifications with human clinical data, environmental monitoring programs at high-risk equine facilities, and cross-sectoral risk communication strategies targeting immunocompromised populations with identified animal contact or environmental exposure risks.

Risk mitigation strategies

Based on the identified risk factors, evidence-based risk mitigation strategies should include advising immunocompromised individuals to avoid occupational and recreational activities involving direct equine contact or

exposure to horse farm environments, implementing dust suppression measures at equine breeding facilities located near residential areas, promoting awareness among HIV care providers regarding *R. equi* risk associated with environmental exposures, and considering *R. equi* prophylaxis or enhanced surveillance for severely immunosuppressed patients with unavoidable equine exposure histories.

Conclusion

The principal contribution of this research is the quantitative characterization of zoonotic *R. equi* transmission risk factors in an East African setting, demonstrating that severe immunosuppression, occupational livestock exposure, and residential proximity to equine facilities independently increase infection risk. Supporting evidence includes environmental contamination gradients showing 50-fold higher *R. equi* concentrations at horse farms compared to control sites, molecular linkages between clinical and environmental isolates through shared MLST profiles, and the identification of airborne dust inhalation as the predominant transmission route. The significance of these findings extends beyond *R. equi* epidemiology to the broader One Health framework, illustrating how urbanization, livestock intensification, and immunosuppressive disease epidemics converge to create novel zoonotic transmission opportunities. Open questions warranting further investigation include the seasonal dynamics of *R. equi* aerosol concentrations in tropical settings, the effectiveness of dust suppression interventions in reducing transmission, the potential role of non-equine livestock species as underrecognized *R. equi* reservoirs, and the cost-effectiveness of targeted screening programs for high-risk populations.

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References

1. Muscatello G, Anderson GA, Gilkerson JR, Browning GF. Associations between the ecology of virulent *Rhodococcus equi* and the epidemiology of *Rhodococcus equi* pneumonia on Australian Thoroughbred farms. *Appl Environ Microbiol*. 2006;72(9):6152-6160.
2. Takai S, Sasaki Y, Ikeda T, Uchida Y, Tsubaki S, Sekizaki T. Virulence of *Rhodococcus equi* isolates from patients with and without AIDS. *J Clin Microbiol*. 1994;32(2):457-460.
3. Weinstock DM, Brown AE. *Rhodococcus equi*: an emerging pathogen. *Clin Infect Dis*. 2002;34(10):1379-1385.
4. Pal M, Gutama KP, Singh S, Botton S. *Rhodococcus equi*: an emerging bacterial pathogen of public health significance. *J Adv Microbiol Res*. 2023;4(1):32-35.
5. McNeil MM, Brown JM. The medically important aerobic actinomycetes: epidemiology and microbiology. *Clin Microbiol Rev*. 1994;7(3):357-417.
6. Cohen ND, Carter CN, Scott HM, Luby-Phelps K, Palmer GH. Aerosol dissemination of *Rhodococcus equi* from the environment of naturally infected foals. *Equine Vet J*. 2008;40(6):590-595.
7. Yamshchikov AV, Schuetz A, Lyon GM. *Rhodococcus equi* infection. *Lancet Infect Dis*. 2010;10(5):350-359.
8. Hughes KL, Sulaiman I. The ecology of *Rhodococcus equi* and physicochemical influences on growth. *Vet Microbiol*. 1987;14(3):241-250.
9. Giguère S, Cohen ND, Chaffin MK. *Rhodococcus equi*: clinical manifestations, virulence, and immunity. *J Vet Intern Med*. 2011;25(6):1221-1230.
10. Vázquez-Boland JA, Giguère S, Hapeshi A, MacArthur I. *Rhodococcus equi*: the many facets of a pathogenic actinomycete. *Vet Microbiol*. 2013;167(1-2):9-33.
11. Tuon FF, Siciliano RF, Al-Musawi T, Rossi F, Gryschek RC, Kono A, Rocha JL, Costa SF, Abdala E. *Rhodococcus equi* bacteremia and AIDS in developing countries. *Mycopathologia*. 2007;163(2):87-95.
12. Takai S, Hines SA, Sekizaki T, *et al*. DNA sequence and comparison of virulence plasmids from *Rhodococcus equi*. *Infect Immun*. 2000;68(12):6840-6847.
13. Linder R. *Rhodococcus equi* and *Corynebacterium haemolyticum*: two "coryneform" bacteria increasingly recognized as agents of human infection. *Emerg Infect Dis*. 1997;3(2):145-153.
14. Meijer WG, Prescott JF. *Rhodococcus equi*. *Vet Res*. 2004;35(4):383-396.
15. Prescott JF. *Rhodococcus equi*: an animal and human pathogen. *Clin Microbiol Rev*. 1991;4(1):20-34.
16. Hondalus MK. Pathogenesis and virulence of *Rhodococcus equi*. *Vet Microbiol*. 1997;56(3-4):257-268.