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REVIEWER'S REPORT

Manuscript No.: IJAR-57142

Title: The Impact of Vaccination on the Dynamics of Paratuberculosis Transmission in Guinea

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Recommendation:
Accept after minor revision

Rating	Excel.	Good	Fair	Poor
Originality		✔,		
Techn. Quality		✔,		
Clarity	✔,			
Significance	✔,			

Reviewer Name: Abdul Haseeb Mir

Detailed Reviewer's Report

The article titled "The Impact of Vaccination on the Dynamics of Paratuberculosis Transmission in Guinea" presents a robust mathematical inquiry into a significant veterinary and economic challenge. By formulating a compartmental model tailored to the transmission dynamics of Johne's disease within ruminant herds, the researcher provides a theoretical framework for evaluating the efficacy of public health interventions in the livestock sector. The study's focus on the Guinea context is particularly valuable, as paratuberculosis remains a major hurdle for sustainable agriculture in developing regions. The central contribution of the paper is the derivation and comparison of the basic reproduction number ($\mathcal{R}_{0}$) and the effective reproduction number ($\mathcal{R}_{0}^{V}$), which quantifies the potential for vaccination to transition a herd from an endemic state to disease eradication.

The primary strength of the manuscript lies in its rigorous application of epidemiological modeling to a specific localized problem. The author successfully identifies the "critical vaccination threshold," a vital metric for veterinary policymakers. By demonstrating that the disease's transmission potential significantly decreases as a function of vaccination coverage and vaccine efficacy, the paper moves beyond qualitative observations to provide a precise mathematical target for herd immunity. The inclusion of parameters reflecting "husbandry conditions" and "local epidemiological parameters" suggests that the model is intended to be functionally relevant to the unique challenges of the Guinean livestock environment.

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The theoretical analysis of the reproduction numbers is well-executed, providing a clear demonstration of how vaccination can theoretically "starve" the pathogen of susceptible hosts. The researcher's conclusion that the strategy's success depends heavily on the level of coverage and vaccine efficacy is a sobering but necessary reminder of the practical barriers to disease control. This focus on "vaccine efficacy" is especially pertinent given that paratuberculosis vaccines often provide protection against clinical disease rather than complete sterile immunity, a nuance that the author's compartmental model (Susceptible-Infected-Vaccinated) is well-equipped to handle.

However, from a peer-review perspective, the manuscript could be strengthened by a more detailed discussion of the "I" (Infected) compartment. Paratuberculosis is notorious for its long subclinical phase, where animals are infected and shedding the bacteria but do not yet show clinical signs. The paper would benefit from a more narrative explanation of how the model accounts for this "silent shedding." If the model assumes a single infected compartment, the author should discuss the potential impact of including a "latent" or "subclinical" stage (e.g., an SEIV model) on the sensitivity of the $\mathcal{R}_{0}^{V}$ calculations. This would demonstrate a deeper engagement with the specific biological complexities of *Mycobacterium avium* subspecies *paratuberculosis*.

Furthermore, the discussion on the "economic challenge" mentioned in the abstract could be bolstered by linking the mathematical results to tangible livestock productivity outcomes. While the reduction in $\mathcal{R}_{0}$ is an important epidemiological victory, the paper would have a higher impact if it briefly explored how a decrease in transmission correlates with reduced mortality or increased milk and meat yields in the Guinean context. This would bridge the gap between abstract mathematical modeling and the practical economic goals of livestock systems in developing countries.

Methodologically, the use of reproduction numbers and sub-threshold endemic equilibria is a standard and respected approach in mathematical biosciences. However, the author should ensure that the "local epidemiological parameters" used to populate the model are clearly defined. Providing a table of the specific values assigned to transmission rates, recovery (or culling) rates, and vaccine efficacy—along with the sources for these values—is essential for reproducibility. If these values are estimated based on Guinean data, explaining the data collection process or the specific reports used (e.g., from the Direction Nationale des Services Vétérinaires) would significantly increase the study's empirical authority.

The language of the manuscript is precise and technical, appropriate for a journal specializing in veterinary science or mathematical modeling. To improve the overall flow, the author should ensure that

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the transition from the mathematical derivation to the practical implications in Guinea is seamless. The conclusion could be refined to offer a more specific "policy recommendation" based on the critical threshold found. For example, if the model suggests that 70% coverage is required for eradication, the author should discuss the feasibility of reaching this target in various husbandry systems in Guinea.

In conclusion, "The Impact of Vaccination on the Dynamics of Paratuberculosis Transmission in Guinea" is a significant achievement that utilizes sophisticated modeling to address a pressing regional issue. It successfully highlights the transformative potential of vaccination while grounding the analysis in the cold reality of coverage thresholds. With minor revisions to include more biological nuance regarding subclinical infection and a more detailed disclosure of model parameters, this article will serve as a vital tool for both researchers and veterinary authorities in the field of Johne's disease control.

Recommendations:

- Provide a detailed table of the parameters used in the model, including the values for transmission, mortality, and vaccine efficacy, and cite the specific Guinean or regional sources for these estimates.
- Incorporate a discussion on the "subclinical" nature of paratuberculosis, explaining how the model accounts for animals that are infected and shedding but remain asymptomatic.
- Explicitly link the mathematical reduction in $\mathcal{R}_{0}$ to specific economic benefits for Guinean livestock systems, such as improved herd longevity or reduced economic loss from clinical Johne's disease.
- Compare the findings with existing paratuberculosis vaccination trials in other developing regions to provide a comparative global context for the Guinean results.
- Update the bibliography to include more recent (2020–2026) research on "vaccine-induced immunity" specifically regarding *Mycobacterium avium* subspecies *paratuberculosis*.
- Clarify the "husbandry conditions" mentioned in the results; a brief qualitative description of how different rearing systems (e.g., intensive vs. extensive) might alter the transmission rate parameter in the model would be highly beneficial.
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Recommendation: Recommend for publication with minor revision.