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INPLASY

# Rodent Reservoirs and Regional Hotspots of Zoonotic Pathogens in Africa: A Systematic Review and Meta-Analysis

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**ADMINISTRATIVE INFORMATION**

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**Conflicts of interest -** None declared.

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**Amendments -** This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 28 May 2025 and was last updated on 28 May 2025.

## INTRODUCTION

**Review question / Objective** Primary Objective - The objective is to identify high-risk rodent species and geographic hotspots for priority pathogens for targeted One Health interventions.
Secondary Objectives:
1. To identify rodent-borne pathogens associated with zoonotic potential in Africa.
2. To determine the rodent species most frequently associated with zoonotic pathogens in Africa.
3. To identify geographic hotspots within Africa where rodent-borne zoonotic pathogens have been reported, in order to inform targeted One Health interventions.

**Background** Rodents are among the most widely distributed and adaptable mammals globally, living across diverse ecological zones in Africa [1]. They play an important ecological role, but their close association with human settlements and agricultural systems also positions them as significant reservoirs and vectors of numerous zoonotic pathogens [2]. In recent decades, the recognition of rodents as sources of high-priority pathogens has intensified due to recurrent outbreaks and emerging health threats in many parts of Africa [3]. Zoonotic pathogens often cause severe illness or death in humans and pose a considerable public health burden, especially in resource-limited settings.
Despite the growing evidence of rodent-borne zoonoses in Africa, there remains limited synthesis of data regarding which rodent species are most implicated and the specific geographic regions that represent transmission hotspots. Many individual studies report pathogen presence or prevalence in localized settings, but limited research findings hinder a broad understanding of spatial and taxonomic patterns. Such knowledge is essential for designing effective surveillance, early warning systems, and targeted interventions to prevent and control disease emergence.
Africa's dynamic landscapes, rapid urbanization, agricultural expansion, and encroachment into wildlife habitats increase the risk of zoonotic spillover events [4]. In rural areas, rodent exposure

is often intensified by subsistence farming, poor housing infrastructure, and limited access to clean water and sanitation[3]. In urban slums, high rodent densities and poor waste management further increase the risk [3, 5]. Additionally, climate variability and ecological changes are shifting rodent distribution and behavior, influencing pathogen dynamics in ways that are poorly understood [6].

A systematic and quantitative synthesis of existing evidence is urgently needed to address key knowledge gaps regarding rodent species that pose the highest zoonotic risk and the geographic hotspots where pathogen prevalence is most pronounced. By collecting and analyzing data across African countries, this study aims to identify priority rodent species and pathogens, estimate pooled prevalence levels and determine the strength of rodent-pathogen association.

The findings of this review will serve as a critical resource for policymakers, public health practitioners, ecologists, and researchers. Identifying high-risk rodent species and hotspot regions can inform targeted surveillance strategies, guide resource allocation, and strengthen the One Health approach to zoonotic disease management. Furthermore, it will support cross-border collaboration and regional preparedness efforts in anticipation of future outbreaks.

This study also contributes to the global discourse on emerging infectious diseases by emphasizing the importance of Africa's unique ecological and socio-economic contexts. Given the underrepresentation of African data in global zoonotic risk assessments, this review will amplify African evidence and enhance the continent's visibility in the international health research agenda.

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2. Dahmana, H., et al., Rodents as Hosts of Pathogens and Related Zoonotic Disease Risk. Pathogens, 2020. 9(3).
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**Rationale** Rodents are widespread across Africa and are important reservoirs of numerous zoonotic pathogens. However, data on the most high-risk rodent species and their geographic distribution remain patchy and insufficient. As Africa experiences rapid urbanization, environmental change, and increased human-animal contact, the risk of rodent-borne disease emergence grows. Despite localized studies, there has been no continent-wide synthesis to guide public health interventions.

This systematic review and meta-analysis is urgently needed to consolidate existing evidence, identify high-risk rodent species, and map hotspots of zoonotic pathogens. The findings will support targeted surveillance, inform health policies, and strengthen One Health approaches across Africa, aligning with global priorities for zoonotic disease preparedness and response.

## METHODS

**Strategy of data synthesis** A comprehensive search strategy was developed to identify studies reporting zoonotic pathogens in rodents across Africa. The following electronic databases were searched:

• PubMed

Search string:

(((Rodents) AND (zoonotic)) AND (pathogens)) AND (Africa)

• Web of Science

Search string:

Rodent zoonotic pathogens Africa

• MEDLINE

1. Rodents.mp. or Rodentia/
2. Zoonoses/ or zoonotic.mp.
3. africa.mp. or Africa/
4. 1 and 2 and 3
5. Limit 4 to yr="2020 - Current"

• CAB Abstracts

1. rodents.mp. [mp = abstract, title, original title, broad terms, heading words, cabicodes]
2. zoonoses.mp. [as above]
3. africa.mp. [as above]
4. 1 and 2 and 3
5. Limit 4 to yr="2020 - Current"
6. Limit 5 to English language

The search was limited to articles published between 2020 and the present, in English, and focused on African settings. The search terms were adapted for each database using controlled

vocabulary (MeSH or CAB thesaurus) and free-text terms to ensure sensitivity. Search results were exported to a reference manager for de-duplication and screening.

All eligible studies will be imported into Covidence, a systematic review platform.
Two independent reviewers will screen and extract data from each eligible study using a standardized, piloted data extraction form. Discrepancies between reviewers will be resolved through discussion, with mediation by a third reviewer if needed. The extraction form will capture key variables, including study citation, country, trapping methods, rodent species, detected zoonotic pathogens, sample sizes, geographic locations, and study design. This structured approach ensures consistency and transparency and minimizes the risk of bias.

Meta-analysis
Where sufficient data are available, meta-analyses will be performed to estimate:
• Rodent species-pathogen associations, summarizing the frequency and strength of association between specific rodents and particular pathogens.
• Pooled prevalence of specific zoonotic pathogens across rodent species using a random-effects model.

Subgroup analyses will be conducted where possible, based on:
a) Rodent species
b) Pathogen type (viral, bacterial, parasitic)
c) Geographical region
d) Year or period of study

Heterogeneity and publication bias
Heterogeneity will be assessed using the $I^2$ statistic and Cochran's Q test. Publication bias will be evaluated using funnel plots and Egger's test where applicable. When necessary, multiple meta-regression models will be used to determine the cause of heterogeneity.

Sensitivity Analysis
Sensitivity analyses will be performed by excluding studies with a high risk of bias or unclear methodological quality to assess the robustness of pooled estimates.
All analyses will be carried out in R statistical software.

## Eligibility criteria

Types of Participants
Studies must involve field-trapped wild rodents in Africa. Only studies that clearly identify the species of trapped rodents will be included. Laboratory-based or experimental studies using captive or genetically modified rodents will be excluded.

Concept
The review focuses on the detection of zoonotic pathogens in wild rodents. Included studies must identify at least one zoonotic pathogen in sampled rodents and provide sufficient methodological detail on trapping and pathogen detection.

Context
Only studies conducted in a single African country will be eligible. Multi-country studies will be excluded unless data can be clearly disaggregated by country. Included studies must describe the trapping location, method, or duration, and be published in English in peer-reviewed journals or credible organizational reports with accessible metadata.

Studies will be excluded if they are reviews, commentaries, editorials, or conference abstracts; do not provide sufficient data for extraction; focus solely on ectoparasites; or are unpublished preprints without credible authorship.

## Source of evidence screening and selection

The source selection process will be conducted in three stages: title and abstract screening, full-text review, and final inclusion. At each stage, two reviewers will independently assess all records for eligibility based on predefined inclusion and exclusion criteria.

Stage 1: Title and Abstract Screening
All retrieved citations will be imported into Covidence tool for screening. Two reviewers will independently screen titles and abstracts to identify potentially relevant studies. Any discrepancies will be discussed to reach consensus. Records deemed irrelevant by both reviewers will be excluded.

Stage 2: Full-Text Review
Full texts of potentially eligible studies will be retrieved and independently reviewed by the same two reviewers. The full text will be assessed against the inclusion criteria, focusing on field rodent trapping, zoonotic pathogen identification, trapping location, and study setting in Africa. Studies that do not meet the criteria will be excluded, and reasons for exclusion will be documented.

Stage 3: Final Inclusion
Studies meeting all inclusion criteria will be included in the final review. A list of included and

excluded studies, along with reasons for exclusion at the full-text stage, will be maintained for transparency and reported in the final review. The entire selection process will be documented in a PRISMA flow diagram, detailing the number of records identified, screened, included, and excluded at each stage, along with reasons for exclusion at the full-text review phase.

Discrepancy Resolution
At all stages, any disagreements between the two reviewers will first be resolved through discussion. If consensus cannot be achieved, a third reviewer will be consulted to resolve the disagreement.

**Data management** All references retrieved from database searches will be imported into Covidence a reference management software for de-duplication and screening where titles, abstracts, and full texts will be assessed independently by two reviewers.
Data from included studies will be extracted using a pre-designed standardized form in Microsoft Excel Sheets.
Each entry will include study metadata, rodent species, trapping methods, location, zoonotic pathogens detected, and other relevant variables. Version control will be maintained throughout, with restricted access to ensure data integrity and confidentiality. All decisions made during screening, extraction, and synthesis will be documented and archived to ensure transparency and reproducibility of the review process.
The methodological quality and risk of bias of included studies will be assessed using a modified version of the Newcastle–Ottawa Scale. This tool evaluates key domains such as sampling methods, measurement of outcomes, and statistical analysis. Two reviewers will independently appraise each study, with disagreements resolved through discussion or consultation with a third reviewer. The quality assessment will inform the interpretation of findings and guide sensitivity analyses in the meta-analysis. However, no study will be excluded solely based on quality scores.

**Reporting results / Analysis of the evidence** The results will be reported following the PRISMA 2020 guidelines. A flow diagram will outline the study selection process, including the number of records identified, screened, included, and excluded, with reasons for exclusion at the full-text stage.
A descriptive synthesis will summarize the characteristics of included studies, such as geographic location, rodent species, zoonotic pathogens identified and study design. Findings will be presented in tables and visual maps if necessary to highlight geographic distribution and pathogen-host associations.
In case data will be sufficiently available, a meta-analysis will be conducted, and an estimate of pooled prevalence rates of specific zoonotic pathogens across rodent species and regions will be reported. Heterogeneity will be assessed using the $I^2$ statistic, and subgroup analyses will explore differences in groups studied. Sensitivity analyses and publication bias assessment (e.g., funnel plots) will also be conducted and reported where appropriate.

**Presentation of the results** Results will be presented using a combination of descriptive tables, figures, and thematic maps if possible to effectively communicate the key findings.

A summary table will present the characteristics of included studies, including author(s), publication year, country, study design, rodent species identified, zoonotic pathogens detected, and diagnostic techniques used. This table will provide a comprehensive overview of the scope and diversity of the studies included in the review.

A matrix table will be used to display the distribution of zoonotic pathogens by rodent species and country, helping to identify high-risk rodent–pathogen pairings and geographic concentrations.

A geographic map of Africa will be generated using GIS tools to illustrate spatial hotspots of rodent-borne zoonotic pathogens, based on the reported trapping locations.

If sufficient prevalence data are available, forest plots will be generated to summarize pooled estimates of pathogen prevalence across rodent species and/or countries. These plots will include confidence intervals and heterogeneity measures from the meta-analysis.

The final report will follow the PRISMA 2020 guidelines, including a flow diagram showing the study selection process, and appendices with search strategies, data extraction forms, and quality assessment results.

**Language restriction** English.

**Country(ies) involved** Uganda.

**Keywords** Rodents; Zoonotic pathogens; Africa; One Health; Geographic hotspots; Systematic review.

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