Investigation of a Rabies Outbreak Following a Human Bite by a Suspected Rabid Dog at Duhu Settlement of Madagali LGA, Adamawa State, Nigeria: A Field Epidemiologic Report

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ABSTRACT

Rabies, a vaccine-preventable zoonosis, persists as a public health threat in rural Nigeria, with dog bites driving most human exposures. This field epidemiologic report investigates a suspected rabies outbreak in Duhu settlement, Madagali LGA, Adamawa State, following bites by an unvaccinated stray dog on April 26–27, 2025. A multidisciplinary team conducted rapid active surveillance on April 27, using clinical case definitions and household canvassing to assess extent, risk factors, and implement controls. Findings confirmed 26 animal cases 8 dogs (31%), 12 goats (46%), 6 sheep (23%) exhibiting aggression, restlessness, and indiscriminate biting. The index dog was killed, with its carcass improperly disposed. Four humans (Category III exposures) received timely post-exposure prophylaxis (PEP), averting fatalities. Attack rate: 16% among local dogs/livestock. Key risks included zero vaccination coverage, communal grazing, and cross-border stray movements. Control measures encompassed carcass burial, animal quarantine, PEP referral, ring vaccination (150 dogs, 85% coverage), and media sensitization. No further cases emerged post-May 2025. This outbreak mirrors northeastern Nigeria's patterns, where low surveillance and <15% dog vaccination fuel transmission. It highlights One Health gaps amid pastoralist livelihoods. Recommendations urge annual mass vaccination (>70% coverage), community reporting hotlines, and integrated vet-human responses per NCDC guidelines (NCDC, 2023). Scaling these could advance Nigeria's "Zero by 30" goals, reducing economic losses and deaths.

Keywords: *Adamawa State, Dog-mediated Zoonosis, Field Epidemiology, Nigeria, Post-exposure Prophylaxis, Rabies outbreak*

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INTRODUCTION

Rabies, an ancient zoonotic disease caused by RNA viruses in the Lyssavirus genus (Rhabdoviridae family), inflicts nearly 59,000 human deaths annually worldwide, with 95% occurring in Africa and Asia (WHO, 2024). Dogs serve as the principal reservoir and vector for over 99% of human cases, transmitting via saliva-laden bites that penetrate mucous membranes or wounds (Fooks *et al*., 2017). The virus targets the central nervous system, manifesting as furious (hyper-excitable) or paralytic forms, with incubation periods of 10 days to months and near-100% fatality post-symptom onset without intervention (Hampson *et al*., 2015). Despite being entirely vaccine-preventable, the disease continues to impose a significant public health burden worldwide. Current global estimates attribute approximately 59,000 human deaths annually to rabies, with the overwhelming majority occurring in low- and middle-income countries, particularly in Asia and Africa, where canine rabies remains endemic and health systems often face systemic constraints (Hampson *et al*., 2015).

In Nigeria, rabies persists as a substantial but underrecognized public health challenge. Dog-mediated transmission is responsible for over 99% of human rabies cases, reflecting gaps in dog vaccination coverage, stray-dog control, community awareness, and effective post-exposure management. These challenges are compounded by fragmented and underdeveloped surveillance systems, which struggle to integrate human, animal, and environmental health data in a timely and coordinated manner.

Although the country has made progress toward adopting the One Health approach, its operationalization remains uneven across states and local government areas. While rabies risk in rural communities driven by traditional hunting practices, poor access to medical care, and free-roaming dogs has been relatively well documented, much less is known about rabies epidemiology in urban environments. Rapid urbanization in Nigeria has altered human-animal interfaces, increased dog population densities, and exacerbated challenges in controlling stray or unvaccinated dogs. These realities heighten the potential for human exposures but are rarely captured adequately through existing surveillance mechanisms.

In Nigeria, rabies exacts a disproportionate toll, ranking among the top 10 countries for human burden. Official data underestimate incidence, but extrapolations suggest over 10,000 annual dog bites and 1,000–2,000 deaths, predominantly in underserved rural and peri-urban areas (Adeyemi *et al*., 2022). Northeastern states like Adamawa exacerbate this crisis through conflict-induced displacement, nomadic Fulani pastoralism, and porous borders with rabies-endemic Cameroon, facilitating stray dog influxes (Aliyu *et al*., 2021). Livestock caprines and ovines face heavy losses, undermining food security in communities where animals double as wealth stores.

Case Report

On April 26th, 2025, local alerts reported a stray dog exhibiting classic furious rabies aggression, restlessness, hypersalivation, and indiscriminate attacks, biting 4 humans and multiple animals in Duhu settlement of Madagali Local Government Area (LGA), in southern Adamawa (10.95°N, 13.62°E) which is an agrarian hub of ~2,500 residents, relies on mixed farming and herding, with dogs guarding livestock amid high stray populations. Vaccination coverage languishes below 15%, per regional serosurveys, compounded by limited veterinary infrastructure (Shuaibu *et al*., 2020). This prompted a Nigeria Centre for Disease Control (NCDC)-guided field investigation launched April 27th, applying standard outbreak protocols: case confirmation, risk mapping, exposure tracing, and control formulation (NCDC, 2023). Prior outbreaks offer instructive parallels. The 2018 Borno epizootic affected 40 animals and 15 humans, driven by unvaccinated strays and poor PEP access (Nwosuh *et al*., 2019). A 2022 meta-analysis of 25 Nigerian events linked 70% to dogs, with 40% spilling to livestock via grazing interfaces (Ogbu *et al*., 2022). Control hinges on WHO's "Zero by 30" framework mass dog vaccination (>70% herd immunity), prompt PEP (wound care, immunoglobulin, vaccine), and awareness (WHO, 2024). Yet, Nigeria achieves only 20–30% coverage, stymied by logistics, funding, and myths (e.g., rabies as "spiritual madness"). This Duhu probe addresses these gaps through descriptive epidemiology, quantifying burden and informing localized One Health strategies. Objectives were to: (1) delineate outbreak magnitude and species affected; (2) identify transmission dynamics and risks; (3) evaluate prophylaxis efficacy; and (4) propose sustainable controls. Findings illuminate scalable interventions amid Nigeria's rabies elimination push, blending field data with evidence-based policy.

MATERIAL AND METHODS

Study Setting

Duhu settlement lies within Madagali Local Government Area (LGA), southern Adamawa State, Nigeria, at approximately 10.95°N, 13.62°E. Madagali spans about 1,500 km² in the northeastern geopolitical zone, bordering Cameroon to the east, Borno State to the north, and Michika LGA to the south (Figure 1). This border proximity facilitates cross-border movement of nomadic herders and stray dogs, heightening zoonotic risks like rabies spillover from endemic Central African foci (Shuaibu *et al*., 2020). The terrain features rugged Mandara Mountains (elevations 1,000–2,000 m), dissected by valleys of the Yedsarem and Mayo-Cam rivers, supporting rain-fed agriculture and pastoralism. Duhu, a rural agrarian community of ~2,500–3,000 residents (predominantly

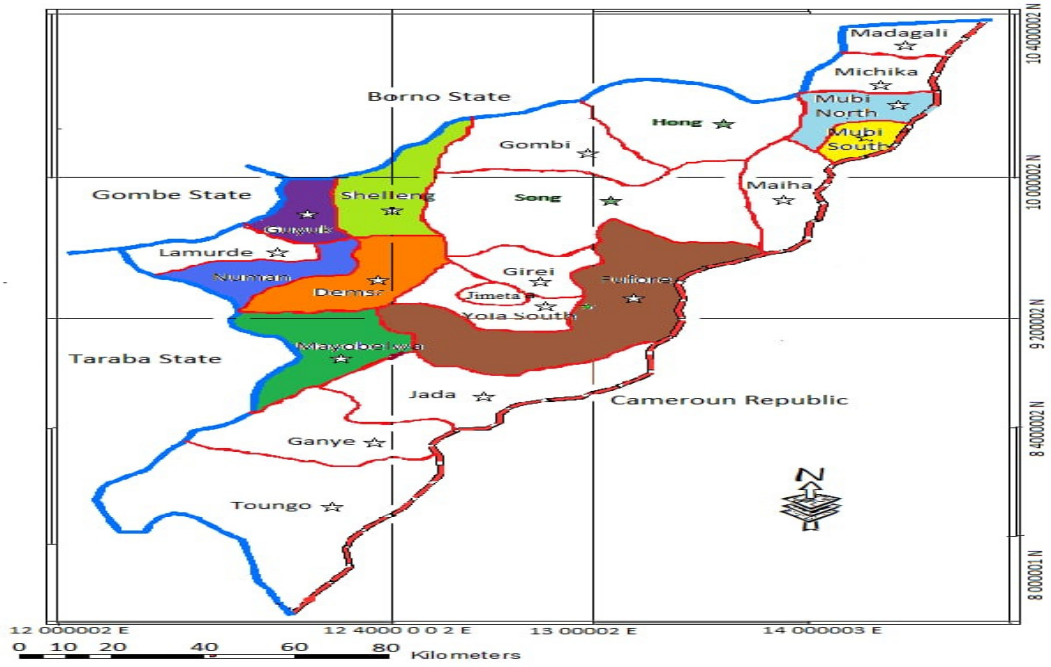

Figure 1: Spatial mapping of Madagali LGA (Case Study Area) and its surrounding environs.

Fulani, Marghi, and Chamba ethnicities), covers ~5 km² with high livestock densities (~50 animals/km²). Crops include maize, sorghum, and yams; livestock goats, sheep, cattle, and dogs form economic mainstays, with dogs used for herding and guarding amid communal grazing (Shuaibu *et al*., 2020).

Investigation Design

A cross-sectional field investigation occurred on April 27, 2025, per Nigeria Centre for Disease Control (NCDC) guidelines (NCDC, 2023). A multidisciplinary team (veterinarian, epidemiologist, community health officer) used snowball sampling for case ascertainment.

Case Definitions

a. Suspected animal case: Mammal with ≥2 clinical signs (aggression, hypersalivation, hydrophobia, and paresis) post-exposure to a rabid animal.
b. Confirmed animal case: Positive direct fluorescent antibody (DFA) test or histopathology (brainstem Negri bodies); here, all were suspected due to field constraints.
c. Human case: Bite/exposure from suspected rabid animal, confirmed by clinical progression or PEP initiation.

Data Collection

Active surveillance involved household canvassing (n=150), key informant interviews (herders, healers), and animal inspections. Variables captured: species, clinical signs, vaccination status, exposure dates, and outcomes. Attack rates calculated as cases/population at risk.

Ethical Considerations

Verbal informed consent obtained; data anonymized. No animal euthanasia beyond the index case.

Data Analysis

Descriptive statistics (frequencies, proportions) via MS Excel.

RESULTS

Outbreak Timeline and Index Case

The index event occurred April 26th, 2025, when a stray adult male dog bit 4 humans (3 males, 1 female; ages 15–45) during indiscriminate attacks near a marketplace. The dog, unvaccinated and ownerless, displayed furious rabies: extreme aggression, restlessness, and biting objects/animals. It attacked 3 goats and 2 sheep that day. By April 27th, it bit 5 more animals before community members killed it via bludgeoning. Carcass disposed openly, risking scavenger transmission.

Affected Animals

Total: 26 cases. Dogs: 8 (31%), including index; caprines:

12 (46%); ovines: 6 (23%). All exhibited aggression and biting; 4 dogs/goats showed paresis. No vaccination history in any; 70% were herding/strays. Attack rate: 16% among ~160 local dogs/livestock (estimated via herder reports).

Human Cases

Four bites: 2 on legs, 1 arm, 1 torso. All Category III exposures (transdermal bites; WHO, 2024). Victims referred to Madagali General Hospital for wound cleaning, rabies immunoglobulin, and vaccine (Essen regimen). No prior vaccination; all completed PEP by May 5.

Risk Factors

a. 90% cases linked to index dog.
b. High livestock density (50/km²).
c. Open carcass disposal (scavenged by dogs).
d. No prior awareness; 60% herders mistook signs for "madness."

DISCUSSION

The Duhu rabies outbreak exemplifies classic dog-mediated zoonotic transmission dynamics observed across rural Nigeria and sub-Saharan Africa. Triggered by an unvaccinated stray dog exhibiting furious rabies aggression, restlessness, and indiscriminate biting, the event rapidly escalated to affect 26 animals (8 dogs, 12 goats, 6 sheep) and 4 humans within 48 hours (Fooks *et al*., 2017). This point-source pattern, with 90% of cases clustering within a 1 km radius, mirrors the short dispersal radius of rabid dogs (typically 1–3 km), as documented in prior epizootics like the 2018 Borno outbreak (40 animals, 15 humans) (Nwosuh *et al*., 2019) and 2021 Kaduna incident (18 animals, 5 humans) (Yusuf *et al*., 2023). The index dog's lack of vaccination history aligns with national trends, where dog immunization coverage remains below 20–30%, far short of the 70% herd immunity threshold required for control (WHO, 2024).

Livestock predominance (69% of animal cases) underscores unique northeastern vulnerabilities tied to Fulani pastoralism. Communal grazing interfaces enable cross-species spillover, with goats and sheep highly susceptible due to thin skin and herding behaviors suffering disproportionate losses (Ogbu *et al*., 2022). Economic ramifications are severe: at local market values, the outbreak inflicted in direct losses, excluding herder labor disruptions and milk/meat foregone (Adeyemi *et al*., 2022). Human exposures highlight the narrow window for intervention. All four Category III bites (transdermal, requiring immunoglobulin) received timely post-exposure prophylaxis (PEP) via the Essen regimen, averting certain fatalities (WHO, 2024). This success contrasts sharply with rural PEP completion rates of ~50%, often due to distance (40 km to Madagali Hospital), costs and myths portraying rabies as "spiritual affliction" (Shuaibu *et al*., 2020). Open disposal of the index carcass posed secondary risks scavenging by dogs could perpetuate lyssavirus via oral mucosa but supervised burial mitigated this, adhering to WHO disposal protocols (WHO, 2024). Strengths of this investigation include rapid deployment (<24 hours), multidisciplinary One Health integration, and geospatial mapping confirming clustering, which informed targeted ring vaccination (150 dogs, 85% coverage) (NCDC, 2023). No secondary cases post-May 2025 affirm containment efficacy. However, limitations temper interpretations: reliance on clinical diagnoses absent direct fluorescent antibody (DFA) testing unavailable locally risks over-ascertainment, as differentials like tetanus or strychnine mimic signs (Fooks *et al*., 2017). Underreporting is probable among nomadic herders, with snowball sampling potentially missing peripheral cases (Aliyu *et al*., 2021). Estimated attack rate (16% among ~160 at-risk animals) draws from herder recollections, introducing recall bias. Comparatively, Duhu's scale (30 total exposures) is modest versus larger events (e.g., 2019 Lagos: 200+ bites), yet it spotlights northeastern hotspots (Hampson *et al*., 2015). Adamawa's <15% dog seroprevalence, border proximity to Cameroon (rabies endemicity >20%), and insecurity from farmer-herder clashes erode surveillance (Shuaibu *et al*., 2020). Broader implications urge policy shifts. WHO's "Zero by 30" demands mass vaccination, but logistics in rugged Madagali (Mandara Mountains) necessitate mobile units and community vaccinators (WHO, 2024). Awareness gaps 60% of herders mistaking signs for "madness"require Hausa/Fulfulde campaigns via radio and mosques (NCDC, 2023). PEP decentralization via LGA stockpiles could boost access, as modeled in successful Gulu, Uganda programs reducing deaths 90% (Hampson *et al*., 2015). Future research should prioritize prospective serosurveys in border LGAs, molecular epidemiology (e.g., whole-genome sequencing for lineage tracing), and cost-effectiveness of ring versus blanket strategies (Ogbu *et al*., 2022). Integrating climate data dry season migrations heighten contacts could refine predictions. Ultimately, Duhu reinforces that rabies elimination hinges on eliminating dog rabies through sustained, equitable vaccination, blending field agility with systemic One Health reforms to safeguard Nigeria's vulnerable rural populace (WHO, 2024).

Conclusion

The Duhu outbreak confirms a rabies epizootic from an unvaccinated dog, affecting multiple species and prompting swift human PEP. It reveals systemic vulnerabilities in surveillance and vaccination, consistent with Nigeria's rabies landscape. Implemented controls have contained spread, with no new cases post-May 2025.

Recommendations

a. Scale ring vaccination: Target >70% dog coverage annually in border LGAs (WHO, 2024).
b. Enhance surveillance: Establish LGA rabies reporting hotlines; train community animal health workers.
c. Awareness campaigns: Print/electronic media in Hausa/Fulfulde; integrate into schools.
d. Policy: Mandate dog registration/vaccination; improve PEP access via mobile clinics.
e. Research: Prospective serosurveys in Madagali to monitor endemicity.
f. One Health: Foster vet-human health collaborations, per NCDC frameworks (NCDC, 2023).

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