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# **Methodological Framework for Spatial Analysis of Snakebite Incidence and Antivenom Accessibility in Nigeria's Savannah Agro-Ecological Zone**

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## | Abstract

Snakebite envenoming is a significant public health issue in Nigeria, particularly in rural savannah agro-ecological zones where high incidence coincides with substantial barriers to treatment. Planning effective responses is hindered by a lack of integrated, spatially detailed data to guide resource allocation. This article presents a methodological framework to map and analyse the spatial relationship between snakebite incidence and antivenom accessibility in Nigeria's savannah region. Its objective is to provide a replicable tool for identifying geographical disparities and informing the optimal placement of antivenom stocks. The framework employs a multi-step spatial analysis. It integrates retrospective health facility data on snakebite admissions with geographical layers, including land cover, road networks, and health facility locations. Travel time to treatment is calculated using cost-distance modelling. Snakebite risk is modelled using environmental covariates. These layers are synthesised within a geographic information system (GIS) to produce composite vulnerability maps. As a methodology article, this paper presents no empirical results. However, a pilot application demonstrated the framework's utility, revealing a spatial mismatch where areas of high snakebite incidence corresponded with travel times to antivenom exceeding two hours. The framework offers a systematic, evidence-based approach for visualising and analysing the spatial dynamics of snakebite

envenoming and treatment access. It translates disparate data sources into actionable intelligence for public health planning. We recommend that Nigerian state health ministries and partners adopt and adapt this framework for situational analysis and strategic planning. Future work should prioritise validating the model with community-level incidence data and incorporating real-time antivenom stock availability at health facilities. snakebite, spatial analysis, geographic information systems (GIS), health access, antivenom, Nigeria, savannah, health systems This work provides a structured methodological framework for spatial analysis of snakebite burden and antivenom access, aiming to strengthen evidence-based decision-making for snakebite envenoming management in Nigeria and similar settings.

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