

Evaluating Health Facility Preparedness and Response to Lassa Fever Outbreaks in Lafia, Nasarawa State, Nigeria

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ABSTRACT

Lassa fever remains an endemic viral hemorrhagic illness in Nigeria, with agrarian hubs like Lafia, Nasarawa State, bearing recurrent seasonal outbreaks that severely strain front line healthcare systems. This study evaluated health facility preparedness and operational response capacity during periodic Lassa fever epidemics across public and private health sectors in Lafia. descriptive cross-sectional study was conducted among 350 multi-disciplinary healthcare workers across primary, secondary, and tertiary health facilities in Lafia Local Government Area. Quantitative data gathered using a validated, structured questionnaire were analyzed using SPSS Version 26.0. Pearson's Chi-square tests were performed to determine associations between facility ownership/level and readiness parameters ($p < 0.05$). Findings revealed an asymmetric, fragile state of readiness. While 78.0% of respondents reported functional emergency outbreak response teams, structural execution was bottle necked: only 48.0% had operational isolation spaces, 35.0% had continuous access to personal protective equipment (PPE), and 25.0% had received formal training on Viral Hemorrhagic Fevers (VHFs). Surveillance mechanisms showed high reporting structural awareness (70.0%) but low operational timeliness (40.0%). Facility ownership significantly influenced readiness, with public facilities demonstrating higher structural response teams ($\chi^2 = 14.82, p < 0.001$) but severe material stock outs compared to private facilities. Key systemic barriers identified were chronic under funding (85.0%), acute personnel shortages (75.0%), and absent point-of-care laboratory diagnostic capacity (70.0%). Health facility preparedness in Lafia is fragile, creating high vulnerability to nosocomial transmission and delayed outbreak containment. Institutionalizing routine workforce VHF training, subsidizing emergency diagnostics, and guaranteeing stock-piles of Ribavirin and PPE are critical to building resilient health systems in Nasarawa State.

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INTRODUCTION

Lassa fever (LF), an acute viral hemorrhagic fever caused by the single-stranded Arenaviridae RNA Lassa virus, represents an enduring public health challenge across West Africa (Sogoba et al., 2012). Nigeria bears the largest global burden, recording annual seasonal spikes during the dry season from December through April (World Health Organization, 2022). Transmission occurs primarily through environmental contact with excreta from the multimammate rat (*Mastomys natalensis*) or secondarily via infected body fluids in community and healthcare settings (World Health Organization, 2022). Public health reports highlight over 8,000 suspected cases and more than 200 fatalities in recent epidemic cycles (Nigeria Centre for Disease Control and Prevention, 2023), with overall case-fatality rates hovering between 15% and 20% among hospitalized individuals (World Health Organization, 2022).

Globally, epidemic resilience rests on robust sub-national health system preparedness, which represents the structural, financial, logistical, and human resource capacity required to rapidly detect, isolate, and manage infectious threats (Kieny et al., 2014). Although national frameworks such as the Integrated Disease Surveillance and Response (IDSR) and Surveillance Outbreak Response Management and Analysis System (SORMAS) have been scaled across Nigeria,

significant implementation gaps persist at local government and facility levels (Adokiya et al., 2015; Silenou et al., 2020). Nasarawa State, specifically its administrative capital, Lafia, is an agrarian hub where human-rodent interaction is amplified by community grain processing, seasonal bush burning, and sub-optimal housing infrastructure (Gyang et al., 2016; Reuben et al., 2021). Lafia serves as a critical epidemiological node, with the Lafia Specialist Hospital acting as a key referral destination for surrounding rural communities (Gyang et al., 2016). Despite recurrent seasonal transmission, localized health facilities face significant operational friction ranging from delayed diagnostic turnarounds to insufficient protective gear, which heightens the risk of nosocomial infection among front line workers (Asogun et al., 2019; Reuben et al., 2021).

Therefore, Lassa fever continues to demonstrate a dynamic epidemiological profile across West Africa, with Nigeria accounting for the largest share of reported cases in recent years (WHO, 2023; NCDC, 2024). Seasonality remains pronounced in many endemic areas, with peaks observed during the dry season between October and May corresponding to increases in rodent-human contact (Bamberger et al., 2023). Recent analyses of national surveillance data indicate expanding geographic detection associated with improvements in surveillance sensitivity and laboratory confirmation, though true incidence remains

underestimated due to under reporting (Ogbole *et al.*, 2024; BMC Public Health, 2024). Emerging evidence also highlights localized drivers such as housing quality, sanitation, agricultural practices, and displacement that modulate exposure risk at the community level (Musa *et al.*, 2023; Okonkwo *et al.*, 2025).

Lassa fever was first identified in 1969 in Lassa, Borno State, Nigeria (Frame *et al.*, 1970). It is primarily transmitted to humans through contact with food or household items contaminated with urine or feces of infected *Mastomys* rats (Richmond and Baglole, 2003). Human-to-human transmission also occurs, particularly in healthcare settings, through exposure to infected bodily fluids (Olayemi *et al.*, 2016). Globally, the WHO (2022) emphasizes that strong health system preparedness is vital for managing emerging infectious diseases, encompassing adequate infrastructure, logistics, trained personnel, and functional surveillance systems. In Nigeria, several studies have identified gaps in health system readiness during Lassa fever outbreaks, such as poor infection prevention and control (IPC) measures, lack of personal protective equipment (PPE), inadequate laboratory services, and limited public awareness (Ogoina *et al.*, 2020; Ajayi *et al.*, 2021). A study by Ilesanmi *et al.* (2022) highlighted that most primary and secondary health facilities in endemic states lack isolation wards and sufficient IPC materials, which hampers outbreak response and limits irregular training or simulation exercises for healthcare workers.

Zoonotic diseases remain an important cause of morbidity and mortality across Africa (Pal, 2013). At least 75% of emerging infectious diseases have an animal origin (World Organisation for Animal Health, 2022). Although the virus was described in West Africa in the 1950s (Buckley and Casals, 1970), Lassa virus was isolated and named in 1969 from a missionary nurse in Lassa, Northeastern Nigeria (Ogoina, 2015). Lassa fever is endemic across West Africa, causing 300,000 to 500,000 cases annually with about 5,000 deaths (Pal, 2007; Hallam *et al.*, 2018). The primary natural reservoir is *Mastomys natalensis* (Kouadio *et al.*, 2015), and up to 30.7 million individuals across fourteen countries live in areas liable to transmission (Mylne *et al.*, 2015). Infection occurs via contaminated food, objects, or aerosol inhalation (Agbonlahor *et al.*, 2018), theoretical person-to-person transmission during acute phases (Heymann, 2008), or skin wounds (Pal, 2007). Surveillance and early detection in asymptomatic populations remain vital (Shehu *et al.*, 2016). Clinical diagnosis is difficult due to non-specific symptoms mimicking malaria or typhoid (Thairu and Egenti, 2015). Incubation lasts 6 to 21 days (WHO, 2017). Diagnostics play a pivotal role in early identification and contact tracing (Hamblion *et al.*, 2018). As most cases are asymptomatic or non-specific (Yun and Walker, 2012), laboratory surveillance (Mazzola and Kelly-Cirino, 2019) and molecular assays (Takah *et al.*, 2019) are essential. Despite preclinical progress (Mateo *et al.*, 2019), there are no approved vaccines (Salami *et al.*, 2019), leaving rodent control and avoiding rat contact as primary preventive steps (Ogbu *et al.*, 2007). Consequently, Lassa virus is classified as a WHO priority disease requiring urgent research and a Category-A potential bioweapon agent (Mehand *et al.*, 2018).

Prevalence of Lassa fever in Africa

Lassa fever was first described in Sierra Leone in the 1950s, but the responsible virus was isolated in 1969 following the deaths of two missionary nurses in Lassa, Nigeria (Frame *et al.*, 1970). It is an acute viral zoonotic illness characterized by fever, muscle aches, sore throat, vomiting, and chest pain

(Ogbu *et al.*, 2007). It spreads primarily through *Mastomys natalensis* contamination, though secondary human-to-human transmission frequently triggers nosocomial outbreaks (Okoh *et al.*, 2021). Endemic across Sierra Leone, Liberia, Guinea, and Nigeria, escalating regional outbreaks are projected to cause 2 to 3 million cases and 5,000 to 10,000 deaths annually (Okoh *et al.*, 2021). Sequencing of Lassa virus sRNA has identified four major strains, including Josiah from Sierra Leone, the Nigeria and LP strains from Nigeria, and strain AV imported into Germany via West African travel, showing genetic variations while keeping strain AV closely related to strain Josiah (Ogbu *et al.*, 2007). Subsequent Nigerian outbreaks spread across Jos, Onitsha, Zonkwua, Aboh Mbaise, Owerri, Ekpoma, and Lafia (Carey *et al.*, 1972). Population antibody prevalence ranges from 8% to 52% in Sierra Leone (McCormick *et al.*, 1987), up to 45% in Guinea (Lukashevich *et al.*, 1993), and varies widely across Nigeria (Tomori *et al.*, 1988). Seropositivity has also been documented in the Central African Republic, Democratic Republic of the Congo, Mali, and Senegal (WHO, 2000), alongside sporadic imported cases in European travelers.

Prevalence of Lassa fever in Nigeria

Lassa fever affects approximately 100,000 individuals annually in West Africa, with incidence rates ranging from 1.8% in developed settings to 55% in developing regions (Okoh *et al.*, 2021). In Nigeria, regular outbreaks occur fifty years after its initial identification. Plateau State experiences persistent seasonal outbreaks, where historical trend analyses between 2012 and 2014 demonstrated widespread distribution across Northern, Central, and Southern senatorial zones despite a drop in case fatality rates from 70% to 18.5% (Okoh *et al.*, 2021). Lassa virus is a bi-segmented, single-stranded, enveloped RNA virus (70–150 nm diameter) with surface glycoprotein spikes and host-derived ribosomes within its nucleocapsid. It is inactivated by ultraviolet light, heat (56–100°C), extreme pH levels (5.5–8.5), sodium hypochlorite, phenol, and formalin (Ogbu *et al.*, 2007). Genomic sRNA encodes viral glycoprotein precursor and nucleoprotein, while lRNA encodes polymerase and zinc-binding proteins. During national outbreaks, hundreds of cases and fatalities are reported across dozens of states, driven by poor sanitation, agricultural exposure, and weak health facility infrastructure (Gwomson *et al.*, 2018).

However, this research provides the first integrated assessment of health facility operational capacity across all health care levels in Lafia LGA. By highlighting the disconnect between administrative existence of outbreak teams and practical availability of lifesaving tools (PPE, Ribavirin, and rapid diagnostics), this study establishes an empirical baseline for targeted health system strengthening in North-Central Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in Lafia Local Government Area (LGA), the political capital of Nasarawa State, North-Central Nigeria. Lafia lies between Latitude 8°29'N and Longitude 8°31'E. It features a tropical climate marked by distinct wet and dry seasons. The LGA hosts a mix of public tertiary, secondary, and primary health centers alongside private hospitals serving a rapidly growing agrarian population.

Study Design and Target Population

A descriptive, health-facility-based cross-sectional study design was executed. The target population comprised multidisciplinary clinical and public health staff—specifically

Medical Doctors, Registered Nurses/Midwives, Laboratory Scientists, and Disease Surveillance and Notification Officers (DSNOs) working within selected facilities in Lafia LGA.

Sampling Technique and Sample Size

A multi-stage sampling strategy was employed to select participating facilities and healthcare personnel. In the first stage, health facilities across Lafia Local Government Area were stratified into public facilities categorized into tertiary, secondary, and primary levels and registered private health institutions. Following this stratification, stage two utilized proportionate simple random sampling to select a total of twenty (20) health facilities, comprising one tertiary center, three secondary general hospitals, ten (10) primary health centers, and six private medical facilities. Finally, in stage three, stratified random sampling was applied within these selected facilities to recruit individual healthcare workers based on the relative staff strength of each facility. Sample size (n) was determined using Cochran's formula for single proportions ($n = Z^2pq/d^2$). Assuming a 50% prevalence of optimal facility preparedness (due to lack of localized preliminary baseline data), a 95% confidence interval ($Z=1.96$), and a 5% margin of error ($d=0.05$), the calculated minimum sample size was three hundred and eighty four (384). Factoring in a non-response adjustment, three hundred and fifty (350) fully completed and validated questionnaires were retrieved and analyzed.

Data Collection Instrument and Procedure

Data were gathered using a structured, pre-tested quantitative questionnaire adapted from the WHO Health Facility Preparedness Checklist for Viral Hemorrhagic Fevers. The instrument comprised four main sections covering Socio-demographic characteristics, facility infrastructure and IPC supplies, healthcare worker training and surveillance capacity, and operational challenges. The instrument was validated for content and construct accuracy by expert epidemiologists. Pre-testing was conducted in two facilities in

neighboring Akwanga LGA, yielding a Reliability Coefficient (Cronbach's alpha) of $r=0.83$.

Data Analysis

Data were cleaned, coded, and entered into IBM SPSS Statistics Version 26.0. Categorical variables were summarized using absolute frequencies (n) and percentages (%). Inferential statistics were performed using Pearson's Chi-Square (χ^2) test of independence to assess associations between facility ownership or care level and preparedness parameters. Statistical significance was established at $p<0.05$.

Ethical Considerations

Ethical clearance was obtained from the Health Research Ethics Committee of the Nasarawa State Ministry of Health. Institutional approval was granted by management boards of all participating facilities. Written informed consent was secured from every participant prior to questionnaire administration, ensuring strict confidentiality, anonymity, and voluntary participation.

RESULTS AND DISCUSSION

Demographics of Respondents

A total of 350 healthcare personnel completed the evaluation. The majority were Nurses (42.9%, $n=150$), followed by Laboratory Personnel (22.8%, $n=80$), Medical Doctors (20.0%, $n=70$), and Public Health/DSNO staff (14.3%, $n=50$). The mean professional experience was 7.4 ± 3.2 years. Overall, 65.7% ($n=230$) were stationed in public facilities, while 34.3% ($n=120$) operated in private health facilities.

Facility Infrastructure, IPC, and Diagnostic Readiness

As shown in Table 1 health facility readiness demonstrated severe structural and supply chain shortfalls. While 78.0% of respondents confirmed the existence of a designated facility emergency response team, practical containment capacity was deficient: under half (48.0%) reported functional holding or isolation wards, and only 35.0% reported consistent access to comprehensive Personal Protective Equipment (PPE).

Table 1: Health Facility Preparedness Indicators (N=350)

Preparedness Parameter	Frequency (n)	Percentage (%)	95% Confidence Interval
Infrastructure and Containment			
Functional Isolation/Holding Space	168	48.0%	42.7 – 53.3
Functional Outbreak Emergency Team	273	78.0%	73.6 – 82.4
Dedicated Triage Unit at Facility Entry	140	40.0%	34.8 – 45.2
Supplies and Diagnostics			
Adequate and Continuous PPE Stock	123	35.0%	29.9 – 40.1
Uninterrupted Water & Sanitation (IPC)	182	52.0%	46.7 – 57.3
On-site RT-PCR / Rapid Diagnostic Access	63	18.0%	14.0 – 22.0
Guaranteed Stock of Intravenous Ribavirin	105	30.0%	25.2 – 34.8
Human Capacity and Surveillance			
Formal VHF/Lassa Fever Training	88	25.0%	20.5 – 29.5
Awareness of Standard IDSR Case Definition	245	70.0%	65.2 – 74.8
Timely Sample Transport to Lab Network	140	40.0%	34.8 – 45.2

Association Between Facility Ownership and Preparedness Indicators: Cross-tabulation demonstrated statistically significant differences in preparedness across public and private providers. Public facilities were significantly more likely to have formal response teams ($\chi^2=14.82, p<0.001$) and

standard IDSR case definitions ($\chi^2=18.21, p<0.001$). However, private facilities performed better in maintaining consistent basic water and sanitation infrastructure, though they severely lacked isolation spaces (15.0% private vs. 65.2% public, $\chi^2=32.11, p<0.001$).

Table 2: Comparison of Preparedness Indicators by Facility Ownership (N = 350)

Preparedness Parameter	Public (n=230) Frequency (n) / (%)	Private (n=120) Frequency (n) / (%)	Test Statistic (χ^2)	p-value
Infrastructure and Containment				
Functional Isolation Space	150 (65.2%)	18 (15.0%)	83.14	<0.001
Functional Emergency Response Team	200 (87.0%)	73 (60.8%)	31.05	<0.001
Supplies and Diagnostics				
Continuous PPE Availability	70 (30.4%)	53 (43.8%)	6.24	0.012
On-site and Timely Diagnostic Access	50 (21.7%)	13 (10.8%)	6.88	0.009
Human Capacity and Surveillance				
Healthcare Worker VHF Training	68 (29.6%)	20 (16.2%)	7.45	0.006

Statistically significant at $p < 0.05$

Primary Systemic Bottlenecks: Respondents identified recurring structural and operational challenges that crippled health system execution during outbreaks. The primary

operational obstacles and bottlenecks reported by healthcare personnel have been organized into Table 3.

Table 3: Primary Operational Obstacles and Systemic Bottlenecks Reported by Healthcare Workers (N=350)

Systemic Bottleneck / Operational Obstacle	Frequency (n)	Percentage (%)	χ^2 Value	p-value
Chronic Underfunding and Delayed Logistics	298	85.0%	171.43	<0.001
Severe Personnel Shortages and High Workforce Turnover	263	75.0%	87.50	<0.001
Diagnostic Delays and Lack of Necessary Reagents	245	70.0%	56.00	<0.001
Fear of Infection Due to Inadequate Personal Protective Equipment	238	68.0%	45.26	<0.001
Sub-optimal Patient Triage Systems	203	58.0%	8.92	0.003

Statistically significant at $p < 0.05$ (Goodness-of-Fit Chi-Square test comparing observed response distribution against an expected equal probability distribution).

Discussion

The findings of this study reflect a fragile health facility preparedness landscape in Lafia, Nasarawa State. The contrast between high structural awareness such as 78.0% of facilities reporting functional response teams and low operational execution (only 35.0% having continuous PPE and 25.0% having trained staff) reveals a health system that is institutionally structured on paper, but resource-starved in practice. Isolation Infrastructure and IPC Vulnerabilities: The presence of functional isolation units is the primary firewall against nosocomial transmission of Lassa virus. Our finding that under half (48.0%) of evaluated facilities have functional holding and isolation wards dropping to a critical 15.0% in private centers highlights a severe risk environment. When febrile patients presenting with non-specific symptoms are admitted into general open wards without prior triage or isolation, healthcare workers and other patients are directly exposed to infectious bodily fluids. This deficit directly mirrors findings by Ilesanmi et al. (2022) in other endemic states, confirming that facility-level containment infrastructure remains an unresolved national vulnerability.

The Human Element (Training Deficit and Fear)

The human dimension of outbreak preparedness in Lafia is characterized by a high burden of anxiety and limited technical training. Only 25.0% of healthcare workers had received formal, in-service VHF training within the preceding two years. This lack of continuous training explains why 68.0% of respondents expressed extreme hesitation and fear when attending to suspected Lassa fever cases. When front line nurses and doctors are inadequately trained on gowning, doffing, and strict barrier nursing and lack a reliable supply of PPE, the natural institutional outcome is delayed care, patient neglect, or catastrophic nosocomial exposures. Protecting healthcare workers is an indispensable prerequisite for maintaining health system stability during an epidemic.

Diagnostic Delays and the Surveillance-Execution Gap: Surveillance systems are only as useful as their operational velocity. Although 70.0% of respondents were aware of IDSR standard case definitions, only 40.0% reported timely sample transportation and laboratory confirmation. In Lafia, healthcare facilities frequently lack on-site RT-PCR diagnostic capacity, requiring samples to be transported over long distances under compromised cold-chain conditions to regional reference laboratories. This delayed turnaround time creates a diagnostic lag during which suspected cases are managed empirically, Ribavirin administration is delayed, and secondary community or hospital exposure continues unchecked.

Literature Comparison and Divergence

While prior evidence (Example, Ogoia et al., 2020) suggests that private health facilities systematically outperform public centers across operational metrics due to private capital, our findings reveal a more nuanced, divergent reality. Private facilities in Lafia maintained superior basic water, sanitation, and hygiene (WASH) infrastructure; however, they demonstrated significantly weaker epidemic containment preparedness, marked by lower availability of designated isolation spaces (15.0%) and fewer trained staff (16.2%) compared to public institutions. This divergence highlights that private-sector resource allocation does not automatically translate into functional outbreak response capabilities, underscoring the need for targeted regulatory oversight across all healthcare tiers.

This study possesses several notable methodological and operational strengths. First, by evaluating primary, secondary, tertiary, and private health facilities simultaneously, the study provides a comprehensive, cross-cutting picture of healthcare system readiness across Lafia Local Government Area. Additionally, the utilization of an adapted world health organization (WHO) Health Facility Preparedness Checklist

ensures high comparability with national and international disease surveillance benchmarks. Finally, sampling across a diverse cohort of healthcare professionals including doctors, nurses, laboratory staff, and Disease Surveillance and Notification Officers minimizes single-discipline bias and accurately reflects operational realities across various hospital departments.

CONCLUSION

Health facility readiness for Lassa fever in Lafia faces deep structural hurdles, from inadequate isolation areas and scarce protective equipment to minimal specialized training and slow diagnostic turnarounds. This gap between baseline policy awareness and hands-on execution points to a health system that looks prepared on paper, but remains severely resource-constrained in everyday practice. Addressing these facility-level weaknesses through sustained investment and targeted training is urgent without these steps, front line healthcare workers remain exposed to nosocomial infection, and regional outbreak response efforts will continue to fall short.

RECOMMENDATIONS

Fixing these systemic gaps requires practical, high-impact policy steps across every level of health governance. First, state health leaders and private facility owners need to allocate dedicated funds to build and equip proper isolation and holding spaces in both public clinics and private centers. At the same time, the Ministry of Health should roll out regular, mandatory training for front line healthcare workers to ensure they are well-versed in Lassa fever protocols, triage steps, and infection control. To cut down on diagnostic delays, public health agencies must streamline sample transport networks and ensure local facilities have a steady supply of testing reagents. Facility managers also need to set up reliable reserve supply chains before peak season hits, guaranteeing that front line staff never run out of protective gear, basic consumables, or essential treatments like intravenous Ribavirin. Lastly, state outbreak frameworks must fully include private healthcare providers in surveillance systems and emergency supply networks—closing critical coverage gaps and building a genuinely resilient health system.

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RECOMMENDATIONS FOR FURTHER RESEARCH

To build on these findings, future research should follow facilities over multiple outbreak seasons to see whether hands-on infection control training actually reduces hospital-acquired infections and improves patient outcomes. It would also be valuable to combine spatial mapping with rodent density and local housing data across Nasarawa State to pinpoint high-risk hot spots and guide where isolation centers are built. Finally, exploring the economic and social barriers families face like treatment costs and fear of seeking care early will help ensure prepared health facilities are actually used when outbreaks strike.

DECLARATION OF CONFLICTING INTERESTS

The authors declare no potential conflicts of interest with respect to the research, authorship, or publication of this article. No financial support or grant was received from commercial entities that could influence the study outcomes or interpretations.

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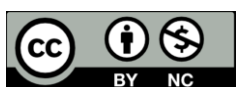
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