Scientific Knowledge Group

ISSN: 3069-1486

Research Article

Journal of Critical Care and Clinic Nursing

Strengthening Emergency Preparedness and Health System Resilience: Lessons from the 2024 Lassa Fever Response in Kaduna State, Nigeria

Isiaq Hadji Shehu[1*], Zainab Dambazau[2], Jeremiah Daikwo[3], Abdullahi Musa Garba[4], and Amina Birma[5]

[1]*Nigeria Centre for Disease Control and Prevention, Kaduna, Nigeria*

[2]*Nigeria Centre for Disease Control and Prevention, Abuja, Nigeria*

[3]*Ministry of Health, Kaduna State, Nigeria*

[4]*State Primary Health Care Board, Kaduna State, Nigeria*

[5]*Ministry of Agriculture, Kaduna State, Nigeria*

[*]Corresponding author:
Isiaq Hadji Shehu, Nigeria Centre for Disease Control and Prevention, Nigeria.

Received: May 11, 2026;
Accepted: May 18, 2026;
Published: May 25, 2026

ABSTRACT

Background: Lassa fever is an acute viral hemorrhagic disease which remains a recurring public health threat in Nigeria, testing sub-national health systems resilience [1,2,3]. In 2024, Kaduna State recorded a surge of cases, testing its capacity for emergency preparedness and resilience [4]. This study assessed the effectiveness of the state's response, with focus on surveillance, case management, and coordination mechanisms [5].

Methods: A retrospective descriptive study was conducted using Kaduna State Ministry of Health records, Surveillance Outbreak Response Management and Analysis System (SORMAS) platform, and health facility data from January – December (Epi week 1 – 52), 2024 [6]. Suspected cases were defined using the national Lassa fever case definition, and laboratory confirmation was conducted at reference laboratories [7,8]. Data included suspected cases, confirmed cases, and contact tracing line listed were analyzed alongside frequencies, proportions, and case fatality rates (CFR) were generated using Microsoft Excel and Epi Info [6,9].

Results: Kaduna State recorded 111 suspected cases from 15 LGAs, 17 laboratories confirmed from 6 LGAs with 8 deaths (CFR: 47.1%) [7]. A total of 204 contacts were listed with 9 confirmed positive and 21 symptomatic [4]. The outbreak response included activation of the Public Health Emergency Operations Centre (PHEOC), laboratory testing, contact tracing, and community risk communication [10]. Strengths identified were timely case reporting and improved cross-sectoral collaboration [3]. However, major gaps are inadequate infection prevention and control (IPC) in health facilities, delayed patient referral, and insufficient surge workforce capacity [11].

Conclusion: The outbreak highlights both progress and challenges in emergency preparedness, while there were improvements seen with surveillance and coordination mechanisms, structural weaknesses limited overall effectiveness [1,3,5]. Strengthening IPC practices, laboratory networks, workforce surge capacity, and supply chain systems is essential [11]. Lessons from Kaduna State provide actionable insights for improving epidemic preparedness and building resilient sub-national health systems in Nigeria and across Africa [12].

Keywords: Lassa Fever, Outbreak Response, Surveillance Outbreak Response Management and Analysis System (SORMAS), Infection Prevention and Control (IPC), Kaduna State, Nigeria.

Introduction

Lassa fever is an acute viral hemorrhagic fever (VHF) caused by the Lassa virus, endemic in West Africa and primarily transmitted through contact with infected rodents or contaminated materials [1,2,3,8]. Nigeria bears a significant burden of the disease, with recurrent outbreaks posing persistent threats to public health systems [1,3,4]. The disease is associated with high morbidity and mortality,

Citation: Isiaq Hadji Shehu, Zainab Dambazau, Jeremiah Daikwo, Abdullahi Musa Garba, and Amina Birma (2026) Strengthening Emergency Preparedness and Health System Resilience: Lessons from the 2024 Lassa Fever Response in Kaduna State, Nigeria. J Critical Care Clin Nurs 2: 1-9.

particularly in settings with delayed diagnosis and weak infection prevention systems [2,3].

The World Health Organization identifies Lassa fever as a priority disease due to its epidemic potential and health systems impact [1]. Nigeria has experienced annual outbreaks, with increasing geographic spread and case numbers in recent years [3,4]. According to the Nigeria Centre for Disease Control and Prevention, Lassa fever outbreaks continue to challenge response capacity at both national and sub-national levels [4,7].

Haven mentioned earlier, Lassa fever is a significant zoonotic viral hemorrhagic disease that continues to pose a major public health threat in West Africa, particularly in Nigeria where it is endemic, it was first identified/reported around 1969 in Borno State, Nigeria and the disease has since evolved into a recurrent epidemic-prone illness affecting thousands annually [13,14]. The causative agent, Lassa virus, belongs to the Arenaviridae family and it is primarily transmitted to humans through exposure to infected rodents or contaminated materials [15]. Over the decades, the epidemiological profile of Lassa fever has shifted from isolated outbreaks to widespread endemicity with seasonal surges [16].

Lassa fever presents a wide spectrum of clinical manifestations, ranging from mild febrile illness to severe hemorrhagic disease [20]. Approximately 80% of infections are mild or asymptomatic, while severe cases may lead to death [21]. The case fatality rate among hospitalized patients remains high, especially with delayed treatment [22]. The public health importance of Lassa fever extends beyond morbidity and mortality to include economic and health system impacts [23].

Nigeria carries the highest burden of Lassa fever globally, accounting for the majority of reported cases in West Africa [17]. The disease has been reported in almost all states, with increasing frequency and geographic spread in recent years [18]. This rise reflects improved surveillance and diagnostics, as well as persistent environmental and socio-economic risk factors [19].

Kaduna State, located in northwestern Nigeria, has historically reported Lassa fever cases but experienced a notable surge in 2024 [4]. This surge tested the robustness of surveillance systems, laboratory capacity, case management protocols, and coordination mechanisms [5]. Understanding how the system responded provides critical insights into health system resilience and emergency preparedness [5,12].

Health system resilience refers to the ability of health systems to prepare for, respond to, and recover from shocks while maintaining essential functions [12]. In the context of infectious disease outbreaks, resilience depends on effective surveillance, rapid diagnosis, efficient case management, and coordinated response systems [5,6,11].

This study assesses the 2024 Lassa fever outbreak response in Kaduna State, focusing on surveillance effectiveness, case management outcomes, coordination mechanisms, and system strengths and gaps [5,11]. Kaduna State, located in northwestern Nigeria, provides a relevant case study due to its population diversity and healthcare challenges [25].

Background

Historical Perspective

Lassa fever was first recognized in 1969 following the deaths of missionary nurses in northeastern Nigeria [14]. Subsequent investigations led to the identification of Lassa virus as the causative agent [15]. The disease has since been reported in several West African countries including Sierra Leone, Liberia, and Guinea [26].

In Nigeria, Lassa fever has transitioned from sporadic outbreaks to annual epidemics [27]. Improved surveillance systems such as those coordinated by national public health agencies have enhanced detection [28]. However, the disease persists due to ecological and behavioral factors [29].

Etiology and Virology

Lassa fever is caused by an enveloped single-stranded RNA virus of the Arenaviridae family [15]. The virus exhibits genetic diversity across West Africa, influencing disease patterns [30]. The primary reservoir is the multimammate rat (Mastomys natalensis) [31]. These rodents are widely distributed and commonly inhabit human dwellings [32]. They shed the virus through urine and feces, contaminating the environment [32]. Human-to-human transmission occurs through direct contact with bodily fluids of infected individuals [34]. Nosocomial transmission is a major concern in poorly equipped healthcare settings [24].

Transmission Dynamics

Rodent-to-human transmission is the primary route of infection [15]. This is facilitated by poor sanitation, overcrowding, and unsafe food storage [35]. Consumption of contaminated food or inhalation of contaminated particles increases infection risk [36]. Human-to-human transmission can occur in households and healthcare facilities [34]. Improper use of medical equipment and lack of PPE contribute to spread [24]. Lassa fever shows seasonal variation, peaking during the dry season in Nigeria [37]. However, transmission occurs year-round in endemic areas [38].

Epidemiology

Lassa fever is endemic in West Africa, with Nigeria reporting the highest number of cases [17]. It is estimated that hundreds of thousands of infections occur annually, many of which go unreported [39]. The disease is now widespread across Nigeria, affecting multiple states including Kaduna [18]. Recent increases in reported cases reflect both improved detection and rising incidence [19]. Adults are more commonly affected, with occupational exposure playing a role [40]. The case fatality rate among hospitalized patients ranges between 15–20% [22].

Clinical Presentation and Disease Progression

The incubation period of Lassa fever ranges from 6 to 21 days [41]. Early symptoms include fever, weakness, and headache [42]. These nonspecific symptoms often resemble malaria or typhoid fever [43]. As the disease progresses, symptoms may include vomiting, diarrhea, and chest pain [44]. Severe cases may involve hemorrhage, neurological complications, and organ failure [45]. Hearing loss is a common complication and may be permanent [46]. Delayed diagnosis contributes significantly to increased mortality [22].

Public Health Importance

Lassa fever places a heavy burden on healthcare systems in endemic countries [23]. Frequent outbreaks disrupt routine health services and increase healthcare costs [47]. The disease also affects socio-economic stability due to reduced productivity

[48]. Fear and stigma can hinder effective outbreak response [49]. Globally, Lassa fever is classified as a priority disease for research and development [50]. There is currently no widely available licensed vaccine [51].

Kaduna State Context

Kaduna State is one of Nigeria's most populous states with diverse ecological zones [25]. Its population includes both urban and rural communities with varying healthcare access [52]. Agricultural practices increase exposure to rodent reservoirs [35]. Poor housing and sanitation contribute to persistent rodent infestations [32]. Kaduna has recorded multiple Lassa fever outbreaks aligned with national trends [18]. Healthcare infrastructure disparities affect disease detection and management [53].

Rationale for Kaduna as a Case Study

Kaduna State provides a representative setting for studying Lassa fever in Nigeria [25]. Its mix of urban and rural environments reflects varying transmission dynamics [52]. The state's recurrent outbreaks highlight ongoing challenges in disease control [18]. Understanding Kaduna's context provides insights into national response strategies [28].

Methods

Study Design and Population

A retrospective descriptive study was conducted analyzing outbreak data from January to December 2024 (Epidemiological Weeks 1–52) affecting fifteen LGAs which are; Chikun, Igabi, Ikara, Jema'a, Kaduna North, Kaduna South, Kagarko, Kajuru, Kaura, Kauru, Kubau, Lere, Makarfi, Sabon Gari, Zaria LGAs [6,9]. The Infectious Disease Hospital (IDH), Ahmadu Bello Teaching Hospital (ABUTH), Barau Dikko Teaching Hospital (BDTH) and 44 Nigeria Army Reference Hospital have been designated and activated as isolation and treatment centers in the state for the management of Lassa Fever cases. The Kaduna State Public Health Emergency Operation Centre (SPHEOC) constituted a Rapid Response Team (RRT) using the one health and a multi-sectoral approach in responding to the outbreak. The state has a mix of urban and rural populations, with varying access to healthcare services [5]. Health services are delivered through a tiered system of primary, secondary, and tertiary facilities [5].

A retrospective descriptive study design was used to analyse surveillance and outbreak response data for all reported suspected and confirmed Lassa fever cases during the outbreak period in Kaduna State.

However, the study population included:

1. **Suspected cases**: Individuals presenting with possible clinical signs and symptoms of Lassa fever and fits into the criteria for the disease as described in the national case definition guidelines for Lassa fever during the outbreak period.
2. **Confirmed cases**: Individuals whose specimens were diagnosed via laboratory procedures and tested positive to the virus and also meets the national case definition for Lassa fever during the outbreak period.
3. **Probable cases**: Cases whose specimen/samples were not taken before their death occurred but presented with classical clinical signs and symptoms of Lassa fever and meets the national case definition for Lassa fever during the outbreak period.
4. **Contacts of cases:** Individuals identified through contact tracing activities who had direct or indirect exposure to confirmed or suspected or probable Lassa fever cases.

Case Definitions

Cases were classified using national guidelines. A suspected case was defined as any individual presenting with fever and clinical symptoms consistent with Lassa fever. A confirmed case required laboratory confirmation via PCR. A contact was defined as any person exposed to a confirmed case [7].

The national standard case definitions were applied as follows:

- **Suspected case**: Any person presenting with fever ≥38°C and at least one symptom consistent with Lassa fever (e.g., bleeding, vomiting, abdominal pain, or malaise).
- **Confirmed case**: A suspected case with laboratory confirmation of Lassa virus infection by reverse transcriptase polymerase chain reaction (RT-PCR).
- **Contact:** Any individual with direct or indirect exposure to a suspected or probable or confirmed Lassa fever case during the infectious period.

Study Setting

Kaduna State is one of Nigeria's most populous states with 23 Local Government Areas (LGAs). This study was conducted in Kaduna State located in northern Nigeria (northwest to be precise). It operates disease surveillance systems under the national Integrated Disease Surveillance and Response (IDSR) framework, supported by the Nigeria Centre for Disease Control and Prevention (NCDC) and the World Health Organization (WHO) [4].

Data Sources

Data were obtained from National and Kaduna State Ministry of Health situation reports/records, SORMAS platform, health facility surveillance registers, and laboratory confirmation records. The Surveillance Outbreak Response Management and Analysis System is a real-time digital tool used in Nigeria for outbreak detection and response [6].

Data obtained from the above multiple verified sources to ensure accuracy and completeness of the data and reports:

- **SORMAS (Surveillance Outbreak Response Management and Analysis System):** This tool has provided real-time data on case notifications, laboratory confirmations, and contact tracing activities.
- **National and State Situation Reports (Sitreps):** This report summarized information on outbreak progression, case counts, and interventions implemented by the rapid response teams (RRT) [6].
- **Health Facility Surveillance Registers:** This register included both in-patients and out-patients information, clinical information, patient outcomes, and reports of healthcare worker exposure incidents.
- **Laboratory Confirmation Records:** This report contains documented results of Lassa virus confirmation using the RT-PCR.

The Lassa fever outbreak data in Kaduna State were obtained from official state Lassa fever situation reports (from Epidemiological Weeks 1–52, 2024), in addition to SORMAS, laboratory, and facility records.

Data extracted are epidemiological overview which includes suspected and laboratory confirmed cases, demographic characteristics, contact tracing, and response activities such as emergency coordination, surveillance, laboratory response, case management and risk communication.

Data Quality and Management

Data were cleaned and validated using Microsoft Excel. Duplicate entries were removed, and inconsistencies were resolved through cross-validation with other data sources such as laboratory records, situation reports, and health facility registers where available.

Missing or incomplete data were assessed during data cleaning. Where possible, missing values were verified using alternative data sources. Cases with incomplete key variables were excluded from specific comparative analyses but retained in descriptive summaries.

Accuracy and completeness data on age and sex aggregation were more detailed with the use of SORMAS tool and microsoft excel for suspected cases; therefore, demographic analysis was conducted using suspected case data.

Data Analysis

Data were analyzed using SORMAS, Microsoft Excel and Epi Info. Descriptive statistics included frequencies, proportions, and case fatality rate (CFR). CFR was calculated as the number of deaths divided by confirmed cases multiplied by 100 [9].

Results

Epidemiological Overview

During the 2024 outbreak period, Kaduna State reported a total of 111 suspected Lassa fever cases, from which seventeen (17) were laboratory confirmed. Among the confirmed cases, eight (8) deaths were recorded, yielding a case fatality rate (CFR) of 47.1% (Figure 1).

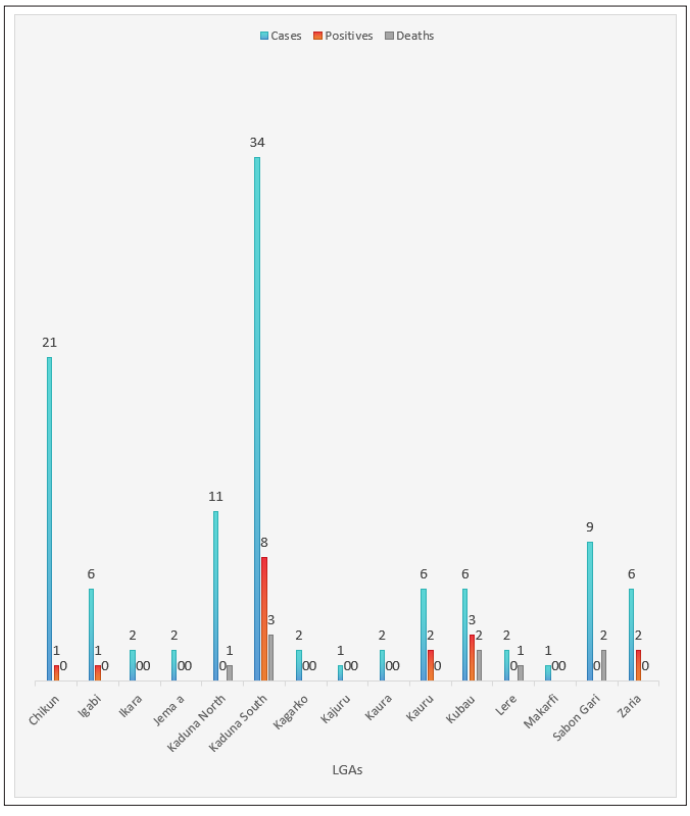

Figure 1: LGA Distribution of suspected, confirmed Lassa fever cases, and deaths in Kaduna State, Nigeria, 2024.

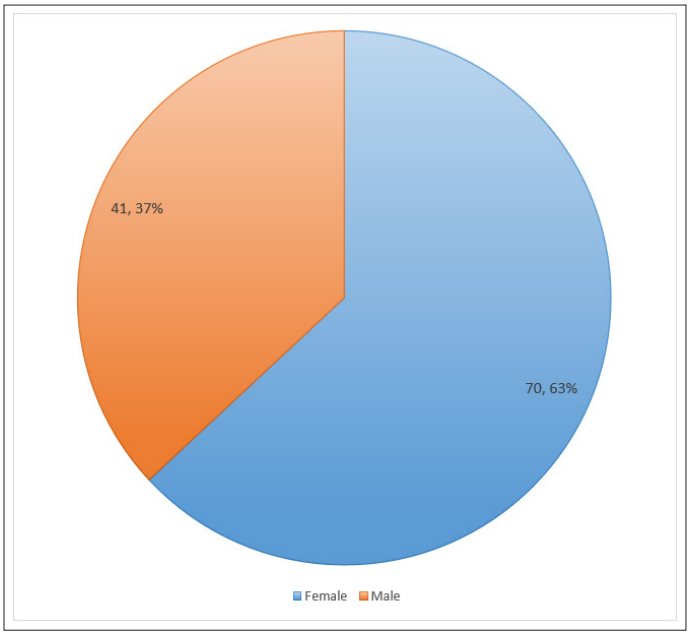

Figure 2: Gender Distribution of suspected cases in Kaduna State, Nigeria, 2024.

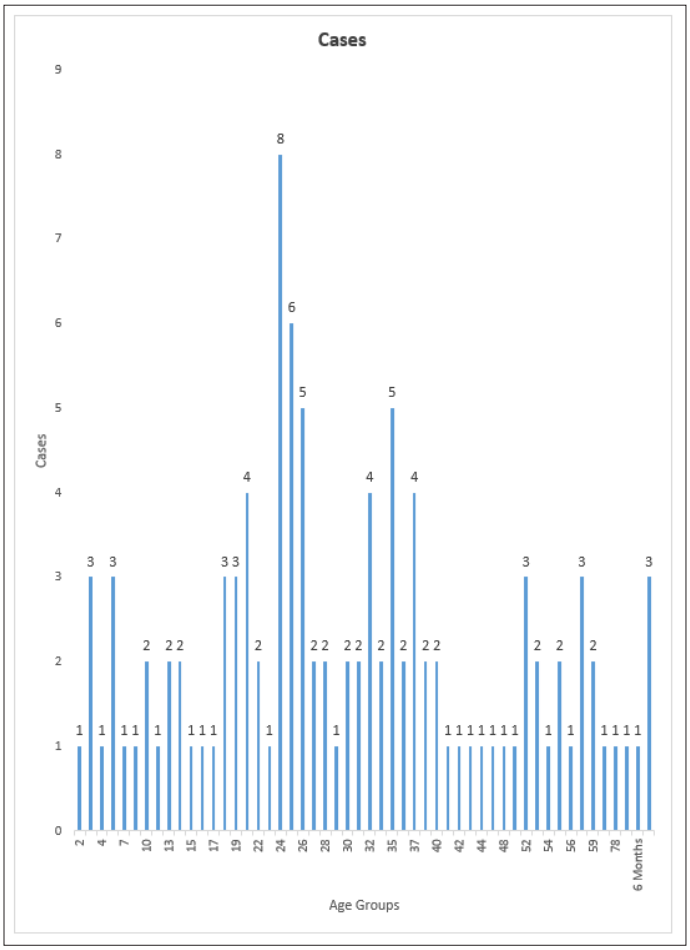

Figure 3: Age Distribution of suspected cases in Kaduna State, Nigeria, 2024.

Geographical Distribution

In Kaduna, confirmed cases were reported across fifteen LGAs

(Chikun, Igabi, Ikara, Jema'a, Kaduna North, Kaduna South, Kagarko, Kajuru, Kaura, Kauru, Kubau, Lere, Makarfi, Sabon Gari, Zaria), with Kaduna South recording the highest number of suspected and confirmed cases. The LGA has also reported more numbers in death cases. The distribution of suspected and confirmed cases as well as death is presented in Figure 1.

Gender and Age Distribution

The 2024 outbreak descriptive analysis showed that females have been reported with higher number of the Lassa fever infection as compared to males. It appeared that females had 63% infection rate while males had 37% infection rate as shown in Figure 2.

For the age distribution, it appeared that age groups between 19 to 40 had increased number of infection of the Lassa virus as shown in Figure 3.

Contact Tracing

During the outbreak period, a total number of 204 contacts were identified following the contact tracing activities conducted at the affected communities and health facilities among which nine (9) contacts were confirmed as secondary cases. From the total number of contacts, twenty-one (21) contacts developed symptoms and were identified during the conduct of the contact tracing and follow-up activities within the affected communities and health facilities. These findings suggested ongoing transmission and highlight gaps in early containment [11].

Response Activities

Emergency Coordination

During the peak of the outbreak, the State Public Health Emergency Operations Centre (SPHEOC) was activated for effective coordination and management of the outbreak response. The activation of the SPHEOC enabled well organized and structured incident management system (IMS) to mobilize, coordinate and manage resources and improve multi-sectoral collaboration.

Surveillance

Before and during the Lassa fever outbreak response, the SORMAS platform was used to rapidly report cases from the communities and health facilities. The data flow from various health facilities improved during the outbreak response period. This has contributed to improving outbreak investigation, detection and monitoring. Surveillance activities such as active case finding and contact tracing were intensified at the affected communities and health facilities. Contacts identified were been followed up for 21days as described in the national guideline.

Laboratory Response

Laboratory specimens/samples were collected from the affected communities and health facilities and were transported to the designated testing laboratories for diagnostic confirmation via RT-PCR testing machine. However, turnaround time were observed in some instances due to delays of sample transportation from the various affected communities and health facilities.

Case Management

All patients or confirmed cases were moved to designated isolation/treatment centres spread around the state for easier cluster access. Appropriate antibiotics for the treatment of Lassa fever which is Ribavirin was administered to all the confirmed cases as required in the national guideline. Late presentation of patients/cases contributed to the high mortality observed [3,11].

Risk Communication and Community Engagement

Some preventive measures and strategies carried out during the Lassa fever outbreak response are;

- Community awareness campaigns: conducted community mass campaign awareness during the outbreak within the various affected communities at selected places like markets, religious places, small and large gathering, etc.
- Radio and TV jingles: Jingles were developed for radio and televisions on preventive measures and health seeking behaviors of individual.
- Townhall meetings: Meetings held with key stakeholders from various response levels.
- Community participation: Involvement of all community structures to pass on the right messages on preventive measures within their local environments and communities at large.
- Social media creation: Social media handles were created for public health messaging focusing on hygiene practices and prevention strategies.

Discussion

The Lassa fever outbreak of 2024 in Kaduna State has revealed the important differences in outbreak dynamics and health system response. These findings highlight the critical role of early detection, infection prevention and control (IPC), and clinical response capacity in determining outbreak outcomes.

The higher case fatality rate observed in Kaduna State suggests delayed case detection and late presentation of patients, which are known to worsen outcomes in Lassa fever. Delayed recognition of suspected cases reduces opportunities for early supportive treatment and timely referral to designated treatment centers. Similar findings have been reported in previous studies in Nigeria [3,10].

The occurrence of healthcare worker infections in Kaduna further underscores gaps in IPC practices, particularly during the early phase of the outbreak. Healthcare-associated transmission has been linked to weak triage systems, delayed isolation, and inconsistent use of personal protective equipment [3,5].

The outbreak response demonstrated strong performance in contact tracing, achieving complete follow-up with no loss to follow-up. This likely contributed to limiting secondary transmission. Effective contact tracing has been consistently associated with reduced transmission in Lassa fever outbreaks [11].

The geographical distribution of confirmed cases highlights the spread of transmission across affected LGAs in Kaduna state according to Table 1. This pattern reflects the widespread rodent–human interface in both rural and peri-urban settings, emphasizing the importance of localized surveillance and targeted interventions.

Table 1: Summary of suspected, confirmed Lassa fever cases, and deaths in Kaduna State, Nigeria, 2024.

LGAs	Cases	Positives	Deaths
Chikun	21	1	0

Igabi	6	1	0
Ikara	2	0	0
Jema a	2	0	0
Kaduna North	11	0	1
Kaduna South	34	8	3
Kagarko	2	0	0
Kajuru	1	0	0
Kaura	2	0	0
Kauru	6	2	0
Kubau	6	3	2
Lere	2	0	1
Makarfi	1	0	0
Sabon Gari	9	0	2
Zaria	6	2	0
Total	111	17	9

Table 2. Age distribution of suspected Lassa fever cases in Kaduna State, Nigeria, 2024.

Age	Cases
2	1
3	3
4	1
5	3
7	1
9	1
10	2
11	1
13	2
14	2
15	1
16	1
17	1
18	3
19	3
20	4
22	2
23	1
24	8
25	6
26	5
27	2
28	2
29	1
30	2
31	2
32	4
33	2
35	5
36	2
37	4
39	2
40	2
41	1
42	1
43	1
44	1
45	1
48	1
49	1
52	3
53	2
54	1
55	2
56	1
58	3
59	2
73	1
78	1
85	1
6 Months	1
Unknown	3

Community engagement also played an important role in outbreak response. Evidence from previous outbreaks indicates that culturally appropriate risk communication improves care-seeking behaviour, enhances early reporting, and reduces exposure to rodent reservoirs [5,7]. Strengthening community-based surveillance and awareness is therefore essential for improving early detection and reducing mortality.

Importantly, these findings reinforce the relevance of a One Health approach in Lassa fever prevention and control. The disease is closely linked to environmental and zoonotic factors, particularly the presence of Mastomys rodents in human settlements. Poor housing conditions, inadequate food storage, and weak environmental sanitation increase the risk of human exposure. Addressing these drivers through rodent control, improved sanitation, and environmental hygiene is essential to reducing transmission.

Integrating human, animal, and environmental health systems can enhance early detection and response. Strengthening these One Health interventions is critical for preventing recurrent outbreaks and reducing disease burden, particularly in endemic settings.

Key Findings

The outbreak demonstrated both improvements and persistent weaknesses in Kaduna State's health system [5,11]. Real time data capturing via the SORMAS platform improved outbreak

detection, monitoring and response. The state public health emergency operation center (SPHEOC) Coordination enhanced response efficiency through multi-sectoral collaboration using the one health approach and strengthened contact tracing capacity during the outbreak response.

However, late detection of cases and delay in the treatment of cases resulted to the high case fatality rate (CFR). Lack of practicing the best IPC protocols and procedures in the health facilities contributed to transmission risks among healthcare workers and healthcare workers to patients. Delay in the referral systems, limited quick access to patient care. Lack of capacity building for surge staffs and workforce limited the effectiveness of the response phase of the health system in the state.

Surveillance System Performance

The adoption of SORMAS significantly improved real-time reporting and outbreak monitoring. However, challenges remain in data completeness and timeliness at primary health care facilities, likewise low provision of internet bundles to the surveillance team for data entry at all levels.

Case Management Challenges

Late health-seeking behavior among affected individuals or Lassa fever cases reflects high mortality. Also, delay in diagnostic analysis of samples further worsened clinical outcomes of patients with Lassa virus and limited quick access to isolation/ treatment centers contributed to poor outcomes. Early initiation of treatment of patients with the disease remains critical in reducing fatalities [3,7].

Infection Prevention and Control (IPC)

Weak practices of IPC measures contributed to nosocomial transmission during the outbreak of Lassa fever across various health facilities in the state. Due to inadequate supplies of IPC equipments and personal protective equipments (PPEs), healthcare workers are faced with increased risk exposure of the disease. Improving IPC infrastructures and trainings is essential for outbreak control and mitigation [7,11].

Workforce Capacity

Due to insufficient surge capacity during the Lassa fever outbreak, healthcare workers were overburdened. Thus, leaving a gap across all response phase.

Health System Resilience

The health system highlights partial resilience in response phase while the coordination systems were relatively strong during the outbreak. However, weaknesses remained in the service delivery components, thus, strengthening all the health system pillars is key to achieve full resilience of the health system during outbreaks.

Implications For Policy and Practice

Improving and Strengthening IPC through continuous training and provision of PPE is essential. Ensuring decentralization of testing laboratory networks will improve response efficiency and effectiveness. Building workforce surge capacity through emergency staffing plans with trainings and retrainings will improve response phase. Adequate supplies and quick availability of medicines, other consumables and commodities for preposition will strengthening supply chains pillar during outbreaks. Risk communication and community engagement strategies will promote early health-seeking behavior and improve prevention measures.

Limitations

The retrospective study design limits causal inference. There were silent LGAs where reports did not come from which may be as a result of underreporting of cases from those areas and incomplete data from some LGAs might have affected some findings.

Programmatic Interventions and Response Actions

The coordination of disease outbreak response activities in Kaduna State is led by the respective state authorities. In Kaduna State, response activities were led by the Kaduna State Ministry of Health, in collaboration with the Nigeria Centre for Disease Control and Prevention (NCDC) and with support from the World Health Organization (WHO) and other partners. These activities included active case finding, contact tracing, strengthening of infection prevention and control (IPC) measures, community sensitization, clinician sensitization and healthcare workers training.

In Kaduna State, response activities were intensified following the identification of healthcare worker infections, including IPC training, provision of personal protective equipment (PPE), rapid deployment of response teams, prompt case isolation, and effective contact monitoring and supervision of treatment facilities.

Conclusion

In conclusion, the 2024 Lassa fever outbreak in Kaduna State highlights both improvement progression and gaps in emergency preparedness. The coordination and surveillance mechanisms have improved while weaknesses in IPC measures, workforce capacity, and referral systems continue to hinder effective respons. Strengthening all of these areas will improve and build a resilient health systems which will be capable of responding to future outbreaks. Strengthening surveillance systems, and expanding One Health interventions through multi-sectoral collaboration during Lassa fever outbreak are key in improving emergency preparedness and response activities.

What is already known about this topic

- Lassa fever is endemic in Kaduna State, Northern Nigeria.
- Healthcare workers are at increased risk of infection due to limited infection prevention and control (IPC) practices and inadequate use of personal protective equipment (PPE).
- Intensified surveillance (active case finding and contact tracing) help to mitigate outbreak.
- Risk communication and community engagement is critical for reducing transmission and preventive measures.
- Quick access to treatment centres and early case presentation to treatment centres will reduce fatalities.

What this study adds

- Activation of State Public Health Emergency Operations centre (SPHEOC) to constitute the incident management system (IMS) structure for effective coordination of the outbreak in Kaduna State.
- Designation and quick activation of isolation and treatment centres across the state.
- Demonstrates how coordinated inter-agency response, strong contact tracing, and effective risk communication can rapidly contain outbreaks.

Author Contributions

- Isiaq Hadji Shehu: Conceptualization, data collection, manuscript drafting, and critical review.
- Isiaq Hadji Shehu: Investigation, supervision, and data management.
- Zainab Dambazau: Technical oversight and guidance.
- Jeremiah Daikwo: Field investigation, supervision, and data validation.
- Abdullahi Musa Garba: Field investigation, supervision, and data validation.
- Amina Birma: Field investigation, supervision, and data validation.

All authors read and approved the final version of the manuscript.

Competing Interests

The authors declare no competing interests.

Funding

This study did not receive external funding. Data collection and analysis were supported through routine surveillance activities conducted by the Kaduna State Ministry of Health, Nigeria Centre for Disease Control and Prevention, the World Health Organization and other partners.

Acknowledgements

The authors acknowledge the Kaduna State Ministry of Health and the Nigeria Centre for Disease Control and Prevention (NCDC) for their technical collaboration and support in accessing and validating surveillance data.

Ethical Considerations

Ethical approval for this study was obtained from the Kaduna State Ministry of Health. Data were secured to ensure confidentiality.

References

1. World Health Organization (2021) Lassa fever – Nigeria. Disease outbreak news. Geneva: WHO.
2. McCormick JB, Fisher-Hoch SP (2002) Lassa fever. Curr Top Microbiol Immunol 262: 75-109.
3. Iroezindu MO, Iroh TO, Okeke IN, Happi CT (2022) Lassa fever in Nigeria: Epidemiology, clinical features, and public health response. Front Public Health 10: 889-400.
4. Nigeria Centre for Disease Control and Prevention (NCDC) (2024) Lassa fever situation report, Nigeria, 2024. Abuja: NCDC. https://ncdc.gov.ng
5. Kanu JE, Nwankwo IU, Nduka FO, Okeke IN (2021) Assessing subnational response to viral hemorrhagic fevers in Nigeria. Pan Afr Med J 40: 210.
6. Krause G, Ropers G, Schenkel K (2021) Surveillance Outbreak Response Management and Analysis System (SORMAS) to support control of outbreaks in Nigeria and Ghana. Front Public Health 9: 652-858.
7. NCDC (2023) National guidelines for Lassa fever case management and IPC. Abuja: NCDC.
8. Sogoba N, Rosenke K, Adjemian J (2012) Lassa fever in West Africa: evidence for an expanded region of endemicity. Zoonoses Public Health 59: 43-47.
9. Dean AG, Sullivan KM, Soe MM (2013) OpenEpi: Open-source epidemiologic statistics for public health. Version 3.01. Public Health Rep 124: 471-474.
10. Adepoju P (2020) Nigeria responds to Lassa fever outbreaks amid COVID-19. Lancet Microbe 1: e12.
11. Olayinka AT, Dan-Nwafor C, Abimbola T (2020) Lessons from Nigeria's response to Lassa fever outbreaks. BMJ Glob Health 5: e002627.
12. Talisuna AO, Yahaya AA, Rajatonirina S, Mary Stephen, Antonio Oke (2019) Joint external evaluation of the International Health Regulation (2005) capacities: current status and lessons learnt in the WHO African region. BMJ Glob Health 4: e001312.
13. World Health Organization (2023) Lassa fever fact sheet. WHO.
14. Frame JD, Baldwin JM, Gocke DJ, Troup JM (1970) Lassa fever, a new virus disease of man from West Africa. I. Clinical description and pathological findings. Am J Trop Med Hyg. 19: 670-676.
15. Centers for Disease Control and Prevention (CDC) (2023) Lassa fever.
16. Olayemi A, Daniel Cadar, N'Faly Magassouba, Adeoba Obadare, Fode Kourouma, et al. (2016) New hosts of the Lassa virus. Sci Rep 6: 25280.
17. Nigeria Centre for Disease Control (NCDC) (2024) Lassa fever situation report.
18. NCDC (2023) National Lassa fever epidemiological reports.
19. Ilori EA, Christina Frank, Chioma C Dan-Nwafor, Oladipupo Ipadeola, Amrei Krings, et al. (2019) Increase in Lassa fever cases in Nigeria. PLoS One 25: 1026-1027.
20. Richmond JK, Baglole DJ (2003) Lassa fever: epidemiology and clinical features. BMJ 327: 1271.
21. WHO (2023) Lassa fever epidemiology overview.
22. Knobloch J, McCormick JB, Webb PA, Dietrich M, Schumacher HH, et al. (1987) Clinical observations of Lassa fever. J Infect Dis 31: 389-98.
23. World Bank (2020) Economic impact of epidemics in Africa.
24. WHO (2022) Infection prevention and control guidelines.
25. Kaduna State Ministry of Health (2023) Annual health report.
26. CDC (2023) Lassa fever endemic regions.
27. NCDC (2022) IDSR annual report.
28. NCDC (2023) Surveillance systems overview.
29. Fichet-Calvet E, Rogers DJ (2009) Risk factors for Lassa fever. Trans R Soc Trop Med Hyg.
30. Andersen KG, Jesse Shapiro B, Christian B Matranga, Rachel Sealfon, Aaron E Lin, et al. (2015) Clinical

sequencing uncovers origins and evolution of Lassa virus. Cell 162: 738–750.
31. Monath TP (1975) Lassa fever: review of epidemiology and epizootiology. Rev Infect Dis. Bull World Health Organ 52: 577–592.
32. Bonwitt J, Kelly AH, Ansumana R, Agbla S, Sahr F, et al. (2016) Rat-atouille: A Mixed Method Study to Characterize Rodent Hunting and Consumption in the Context of Lassa Fever. Emerg Infect Dis. Ecohealth 13: 234-247.
33. CDC (2023) Transmission of Lassa virus.
34. WHO (2023) Lassa fever transmission.
35. Fichet-Calvet E (2007) Environmental risk factors.
36. CDC (2023) Prevention of Lassa fever.
37. NCDC (2023) Seasonal trends of Lassa fever.
38. WHO (2022) Endemic disease patterns.
39. WHO (2023) Global burden estimates.
40. Ilori EA, Furuse Y, Ipadeola OB, Dan-Nwafor CC, Abubakar A, et al. (2019) Epidemiologic and Clinical Features of Lassa Fever Outbreak in Nigeria, January 1–May 6, 2018. Emerg Infect Dis 25: 1066–1074.
41. WHO (2022) Clinical management of Lassa fever.
42. CDC (2023) Symptoms of Lassa fever.
43. Richmond JK (2003) Differential diagnosis.
44. WHO (2022) Clinical features of viral hemorrhagic fevers.
45. McCormick JB, King IJ, Webb PA, Johnson KM, Sullivan RO', et al. (1987) A case-control study of the clinical diagnosis and course of Lassa fever. J Infect Dis 155: 445-455.
46. Mateer EJ, Cheng Huang, Nathan Y Shehu, Slobodan Paessler (2018) Lassa fever–induced sensorineural hearing loss: A neglected public health and social burden. PLoS Negl Trop Dis.
47. World Bank (2020) Health system burden in epidemics.
48. WHO (2021) Socioeconomic impact of infectious diseases.
49. UNICEF (2022) Risk communication during outbreaks.
50. WHO (2023) R&D Blueprint priority diseases.
51. Coalition for Epidemic Preparedness Innovations (CEPI) (2024) Lassa vaccine development.
52. National Bureau of Statistics (Nigeria) (2023) Demographic data.
53. Kaduna State Health System Assessment Report (2022).