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Original Article

Public Health Response to the Initial Outbreak of Lassa Fever in a Non-endemic Region of Nigeria

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Abstract

Background and aims: Despite the occurrence of Lassa fever (LF) outbreaks in Nigeria for over 54 years, Bayelsa State, located in the Niger Delta region, has not reported any instances of LF until now. This study aimed to describe the components of the public health response to the first outbreak of LF in Bayelsa State.

Methods: A descriptive observational study was conducted from February 8 to April 20, 2023. Sociodemographic, clinical, and relevant public health data on suspected and confirmed cases of LF, including information on their contacts, were collected using both quantitative methods and evidence review. Additionally, plans, activities, and experiences associated with the public health response to the outbreak were reviewed and documented by the researchers.

Results: During the study period, 37 suspected cases of LF were reported, of whom two tested positive via polymerase chain reaction. The index case was laboratory-confirmed approximately nine weeks after the onset of symptoms and, unfortunately, passed away five days after her third hospital admission and one day after the laboratory diagnosis. The second case was a contact of the index case, who fully recovered following a mild illness. A total of 95 contacts were identified, including family members and health workers, of which 70 were classified as high-risk contacts, and 15 exhibited symptoms. One death was recorded during the response.

Conclusion: Regardless of their prior outbreak status, all communities within LF endemic nations should strengthen their preparedness levels. Emphasis should be placed on the preemptive sensitization and training of healthcare workers (HCWs), as well as on investing in the sustainable availability of commodities necessary for LF epidemic response.

Keywords: Public health, Lassa fever, Outbreak, Nigeria

Introduction

Lassa fever (LF) is a viral hemorrhagic fever caused by the Lassa virus, which is primarily transmitted through a rodent reservoir known as *Mastomys natalensis*.[1] The virus was first identified in 1969 by a missionary nurse in the town of Lassa, located in Borno State, northeastern Nigeria.[2]

The virus is transmitted through direct contact with the secretions or excretions of infected rats on food items and water in human environments. Additionally, infection can occur through bruised skin or body parts that are directly exposed to infectious materials.[3] The incubation period for LF ranges from 6 days to 21 days.[4] LF poses a significant public health challenge in many countries in West Africa, including Ghana, Liberia, Benin, Guinea, Sierra Leone, Mali, and Nigeria. In these countries, LF causes endemic infections and recurrent outbreaks, with annual case counts ranging from 100 000 to 300 000 and an estimated 5000 deaths.[5,6] Seasonal peaks of LF occur during the dry season, from November to April, particularly in areas with poor housing and sanitation.[2] Healthcare workers (HCWs) are at risk of LF due to healthcare-associated exposures stemming from inadequate practices in infection prevention and control (IPC). Additionally, there is no established predilection for infection based on age or gender.[2]

Since 1969, Nigeria has experienced annual outbreaks of LF, with a progressive increase in both cases and mortality rates. This trend culminated in one of the largest outbreaks in 2017.[7] In 2022, Nigeria reported a cumulative total of 8,202 suspected cases of LF, which included 1067 confirmed cases and resulted in 189 deaths across 27 states.[8] To effectively prepare for future outbreaks of LF, health systems must focus not only on early detection, containment, and the maintenance of essential services but also prioritize building community resilience. Additionally, ensuring the safety of both HCWs and patients is crucial.[9]

Bayelsa State was created on October 1, 1996, from the old Rivers State. It is bordered to the east by Rivers State and the west by Delta State.[10] Since its establishment, the state has not reported a confirmed case of LF; therefore, it is classified as a non-endemic region for LF in Nigeria. The aim of this study is to describe the plans, activities, and challenges encountered in the implementation of various components of the public health response to the first outbreak of LF in Bayelsa State, Nigeria. It is anticipated that the findings of this study will provide valuable insights and lessons for managing LF outbreaks in non-endemic regions both within Nigeria and beyond.

Materials and Methods

This study was conducted in Bayelsa State, which is situated in the Niger Delta region of Nigeria. The state is bordered to the east and northeast by Rivers State, to the west and northwest by Delta State, and to the south by the Atlantic Ocean. Bayelsa State has an estimated population of 2 704 515 and covers a total area of 10 773 square kilometers. The state is divided into eight local government areas, namely, Southern Ijaw, Kolokuma Opokuma, Yenagoa, Nembe, Ogbia, and Sagbama.

A descriptive observational study was performed from February 8 to April 20, 2023. A mixed-methods design, incorporating both qualitative approaches and evidence review, was employed to assess the seven components of the public health response to LF, in accordance with the Nigeria Center for Disease Control (NCDC) guidelines for viral hemorrhagic fever response.[11] The seven components of the public health response assessed in the study included coordination, case management, IPC/safe burial, laboratory pillar, logistics pillar, risk communication pillar, and surveillance.

The study was conducted among health facilities that reported suspected and confirmed cases of LF, as well as within communities where these cases resided. Participants included HCWs who had direct or indirect contact with cases, community members connected to the cases, and public health stakeholders in the state.

Qualitative data collection involved key informant interviews with community members, close contacts of cases, and health stakeholders. These interviews aimed to gather information on the activities, experiences, and challenges faced during the public health response to the outbreak. Interviews were performed via phone calls or in-person meetings, depending on feasibility, and were documented and transcribed according to thematic areas corresponding to the various components of the LF public health response. Additionally, the researchers reviewed the operational plans, documented activities, and periodic situational reports from the state's Ministry of Health LF response team. Quantitative data regarding clinical management, types of exposure, and contacts were collected from health facility records and the Surveillance Outbreak Response Management and Analysis System. Contact investigation forms were completed for each identified contact, and follow-up calls and visits were conducted to monitor these contacts.

The NCDC guidelines for case definition and contact categorization were adopted as follows:

Suspected case: Any individual presenting with one or more of the following symptoms:

- Malaise, fever, headache, sore throat, cough, nausea, vomiting, diarrhea, myalgia, chest pain, hearing loss, and either:
  - A history of contact with the excreta or urine of rodents, or
  - A history of contact with a probable or confirmed LF case within 21 days of the onset of symptoms, or
  - Any person exhibiting inexplicable bleeding or hemorrhage.

Confirmed case: A suspected case that has received laboratory confirmation through one or more of the following methods:

- Positive immunoglobulin M antibody test
- Polymerase chain reaction (PCR) testing
- Virus isolation

Probable case: A suspected case who either died or absconded without the collection of specimens for laboratory testing.

High-risk contacts: Individuals who have experienced unprotected exposure of skin or mucosal membranes (e.g., mucosal exposure to splashes or needle-stick injuries) to blood or bodily fluids, including unprotected handling of laboratory specimens.

Low-risk contacts: Individuals who have had close direct contact with a confirmed case (e.g., routine medical or nursing care, handling of laboratory specimens while wearing personal protective equipment [PPE]), as well as contact with beddings and other potentially contaminated fomites.

No-risk contacts: Individuals who have had no direct contact with a confirmed case or any potentially infectious materials (e.g., those who shared a room with the case without any direct interaction).

Quantitative variables were represented as percentages, while qualitative variables were expressed as proportions, utilizing Microsoft Excel for data analysis and visualization.

Results

Clinical and Epidemiological History of the Index Case

On February 8, 2023, a 37-year-old Nigerian woman and civil servant presented to the Niger Delta University Teaching Hospital (NDUTH) in Yenagoa, Bayelsa State, with an eight-week history of recurrent illness characterized by fever, fatigue, joint pain, and hematuria. Upon presentation, she was conscious but exhibited lethargy, pallor, jaundice, and breathlessness at rest. Subsequently, her condition deteriorated, leading to a coma and the development of oliguria accompanied by hematuria. Prior to her admission at NDUTH, she

had visited two different private hospitals on separate occasions, and she was admitted to one of these facilities for 10 days before being referred to NDUTH (Figure 1).

After five days of admission at the NDUTH, LF was suspected, and a blood sample was collected for laboratory testing on February 13, 2023. Unfortunately, the patient passed away the following day, February 14, 2023 (Figure 1). The test results, which confirmed a positive diagnosis for LF via PCR, were received on February 18, 2023, five days after collecting the sample. These results were obtained from the National Reference Laboratory (NRL) in Abuja, Nigeria (Figures 1 and 2). Notably, the patient reported no travel history and had no known contact with rodents, as indicated on her investigation forms.

Establishment of the Lassa Fever Response Team

The confirmation of an LF case in the state prompted the establishment of an LF emergency response team and the activation of the state's Public Health Emergency Operations Center (PHEOC). Immediate actions included the implementation of surveillance, case finding, contact tracing, and risk communication activities.

A comprehensive line list was created, detailing all contacts of the patient, which included family members, HCWs, and others who had close physical contact with her from the onset of illness through her presentations at various private hospitals and at the NDUTH.

Subsequently, the samples were collected from symptomatic HCWs (Table 1). A total of 84 HCWs were identified as having been exposed, comprising 29 from private hospitals and 55 from NDUTH. Additionally, 11 family members were documented and closely monitored (Table 2).

Samples from symptomatic household and family contacts were collected and sent to the NRL in Gaduwa, Abuja, for PCR testing for LF (Table 1). All contacts, including HCWs categorized as HR due to their level of exposure, were placed in isolation.

Simultaneously, close observation was maintained to monitor their health status. Those exhibiting symptoms were provided with appropriate treatment after their samples were collected and sent to the NRL for testing (Figure 3 and Table 1). This approach ensured that symptomatic individuals received timely medical attention while preventing potential further transmission of the virus within the community and healthcare settings. To prevent any potential spread of the virus, the hospital staff implemented disinfection procedures for the beds and other equipment used by the confirmed case prior to her demise. Additionally, staff working in the mortuary were

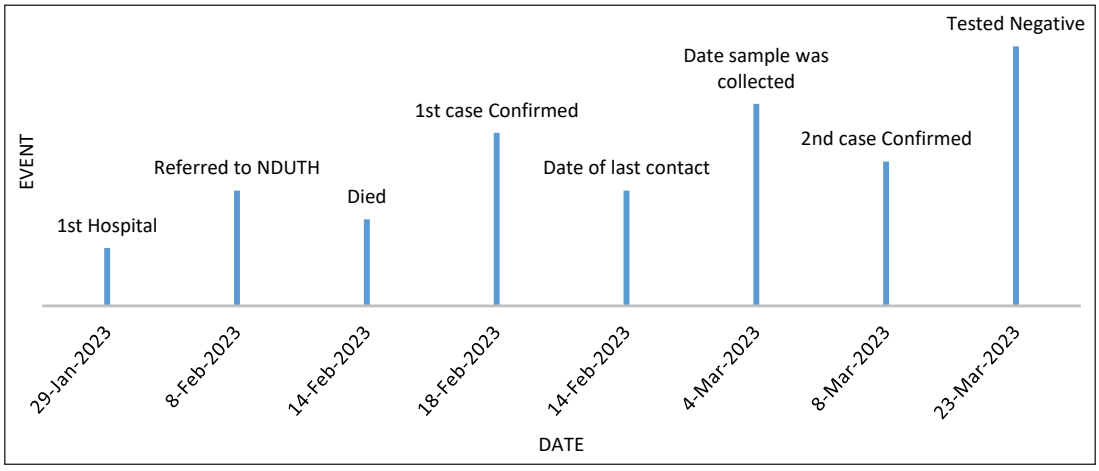

Figure 1. Timeline of Events and Key Occurrences During the First LF Outbreak in Bayelsa State

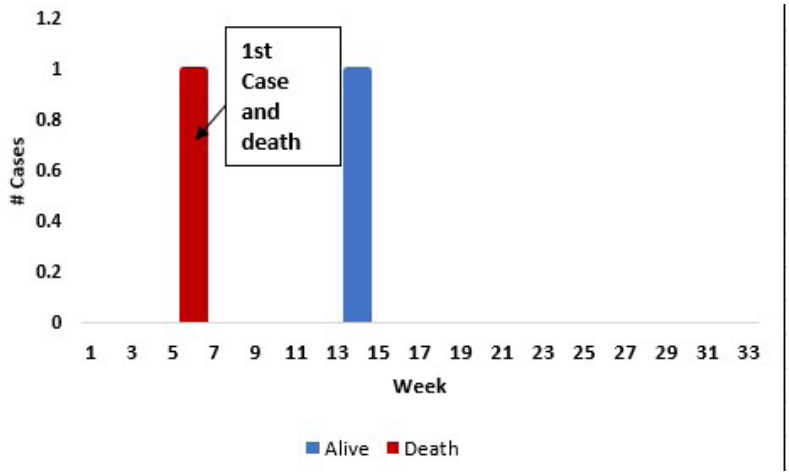

Figure 2. Epidemiological Curve Displaying Positive Lassa Fever Cases From Week 1 to Week 33 (2023)

strictly instructed to adhere to appropriate IPC measures while handling the deceased's body. Measures were also taken to prevent family members from coming into contact with the body of the deceased individual. Following further investigations, a family contact of the index case, specifically his brother, also tested positive for LF (Table 1). The index case's brother, who resided elsewhere, visited her in the hospital on February 14, 2023, the day of her death. He reported that he did not have physical contact with her during the visit. Approximately one month prior, he experienced mild symptoms, including fever, malaise, and headache, which he self-treated as malaria. Following his visit, he was advised to self-isolate at home, where he was monitored. The samples were collected from him during his subsequent visit on March 4, 2023, and he tested positive for LF on March 8, 2023. He later tested negative on March 23, 2023 (Figures 1 and 2).

Table 1. Frequency of Symptoms, Testing Outcomes, and Risk Categorization of Contacts of Suspected LF Cases in Bayelsa, Nigeria

Risk Level	Number of Contacts (%)	Number of Contacts With Symptoms (%)	Number of Tested Contacts (%)	Number Positive (%)
High	70 (73.7)	13 (86.7)	13 (61.9)	0 (0)
Low	11 (11.6)	1 (6.7)	7 (33.3)	1 (1)
No	14 (14.7)	1 (6.7)	1 (4.8)	0 (0)
Total	95	15	21	1

Note. LF: Lassa fever. High-risk contacts included 52 in NDUTH, 14 in a private hospital, and 4 at home (family members).

Table 2. Risk Categorization of Contacts According to Place of Contact with the Index Case

Risk Categorization	Family Care	NDUTH	Home (Family)
High	14 (48.3%)	52 (94.5%)	4 (36.4%)
Low	1 (3.4%)	3 (5.5%)	7 (63.6%)
No	14 (48.3%)	0 (0.00%)	0 (0.00%)
Total	29	55	11

Note. NDUTH: The Niger Delta University Teaching Hospital.

Activities of the State's Public Health Emergency Operations Center

The incident management system was established following the confirmation of the LF outbreak, with the incident manager appointed by the Commissioner of Health. The operations of the PHEOC were coordinated across seven pillars, namely, coordination, case management, IPC/safe burial, laboratory, logistics, risk communication, and surveillance (Table 3). Table 3 outlines the activities conducted by the PHEOC.

Figure 2 illustrates the confirmed cases of LF reported from epidemiological week 1 to week 33. The first case, which also resulted in the first death, and the second case, which resulted in survival, were reported in weeks 6 and 14, respectively. A total of two confirmed cases were reported from week 1 to week 33.

Figure 3 depicts the line listing of contacts associated with the index case. All contacts of the index case are categorized into high-, low-, and no-risk categories, respectively. High-risk contacts are defined as individuals who had direct exposure to the index case without the appropriate use of PPE. No-risk contacts are individuals who were determined not to have had any contact with the index case. Low-risk contacts are those who had direct exposure to the index case but were wearing PPE at the time of contact.

Discussion

This study described the first outbreak of LF in a non-endemic state in Nigeria, occurring 54 years after LF was first confirmed in the country. Bayelsa State is the only state within the South-South region of Nigeria that had not reported a confirmed case of LF prior to this report. Several factors may contribute to the non-detection of LF in the state, including low levels of the circulating LF virus in susceptible rodent reservoirs,[12] a poor index of suspicion among clinicians, and inadequate surveillance capacity, which has also been associated with underreporting of LF cases.[13] This study also revealed a prolonged turnaround

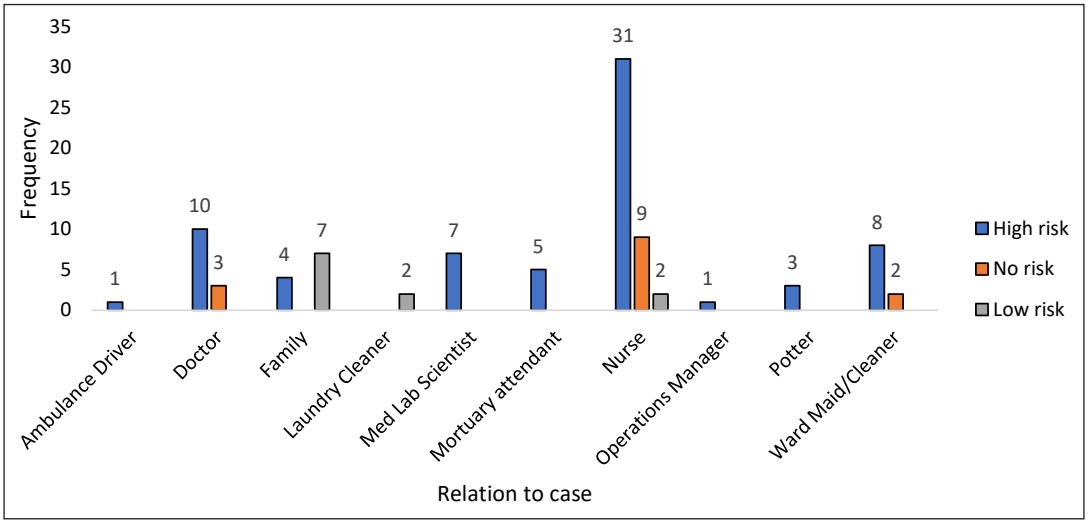

Figure 3. Risk Categorization of Contacts of the Index Case in Relation to Their Profession or Status

Table 3. Activities of the PHEOC, Along with Associated Challenges and Remarks

Pillar	Activities Conducted	Challenges	Remarks
Coordination	Promptly activating the IMS at response level one, following the confirmation of the first case of LF Informing the public about the outbreak through official announcements and press briefings by the state government Inaugurating the State's PHEOC LF One Health Rapid Response team (RRT) by the commissioner of health Meeting with stakeholders from the ministries of health, environment, and agriculture to discuss strategies for containing the outbreak Developing the incident action plan and engaging with partners for support and funding	No immediate funds for response	Partners provided logistical support to the response teams for outbreak investigation and contact tracing.
Case management	Activating isolation centers in two tertiary hospitals in the State: Federal Medical Center Yenagoa and NDUTH Okolobiri Disseminating reviewed case management guidelines and sensitizing clinicians on IPC measures for suspected and confirmed cases of LF Training the case management team at NDUTH Okolobiri Training health workers on LF management and psychosocial support	Reports indicated fear and anxiety among certain HCWs.	The health facility management assisted the PHEOC in monitoring staff exposed to the LF case.
IPC/safe burial	Training HCWs on IPC and distributing PPE and other IPC materials to health facilities Conducting a safe burial for the first confirmed case of LF Monitoring the disinfection of the ambulance and mortuary used for transporting and storing the body of the deceased LF case	Insufficient PPE was available to supply facilities beyond the two tertiary health centers in the State.	The family of the deceased fully cooperated to ensure strict adherence to IPC measures.
Laboratory pillar	Training laboratory scientists on the collection, packaging, and transport of LF samples	Logistical and funding challenges resulted in prolonged turnaround times for laboratory tests.	Commodities were procured, and logistics were established for sample collection and transportation.
Logistic Pillar	Distributing PPE and medical supplies: PPE: Goggles, face shields, face masks, scrubs, coveralls, rubber gloves, head covers, gowns, and boots. Medical supplies: Ribavirin (injection and tablets), body bags, thermometers, hypochlorite, hand sanitizers, and sample collection materials including EDTA bottles, needle and syringe systems, tourniquets, skin antiseptic solutions, markers, gloves, cotton wool, sharp boxes, plastic leak-proof packaging containers, disposable paper towels, and cold boxes Developing and updating contingency plans for outbreaks, including detailed logistical strategies to ensure a rapid and effective response Collaborating with other pillars and response teams to ensure seamless integration of logistical efforts with medical, epidemiological, and communication activities	Shortage of certain commodities, including oral Ribavirin and sample collection materials	Funds were made available to procure some materials, though they were insufficient and not disbursed as promptly as needed.
Risk communication Pillar	Engaging in media and distributing social behavior change materials across the state Sensitizing market women in Kpansia and Tombia markets on LF and proper food storage practices Having radio presentations and talk shows on people's FM and Rhythm FM focused on LF and other priority diseases Advocating the commissioner of agriculture to discuss strategies for preventing zoonotic diseases in the state Sensitizing the community of the deceased, along with the advocacy and mobilization of community members Airing jingles on LF and other priority diseases on Rhythm 94.7 and people's FM 93.1 Raising awareness among healthcare personnel across the state about LF and IPC through social media channels, such as WhatsApp groups Partnering with organizations such as the Nigeria Medical Association, the National Association of Nigerian Nurses and Midwives, and the Medical and Health Workers Union of Nigeria to enhance awareness and raise the level of caution Engaging and educating healthcare personnel in tertiary healthcare facilities across the state about LF through focus group discussions and specialized seminars for medical professionals, emphasizing conversations on LF and other VHFs	Initial funding was not available for airing jingles and radio talk shows.	Funds were eventually made available for airing jingles, radio talk shows, and other risk communication activities.
Surveillance	Conducting an outbreak investigation of the confirmed case, visiting a private hospital and NDUTH Okolobiri for further information about the case, and compiling a list of contacts for follow-ups Conducting an active case search in health facilities and communities across all 8 LGAs for three months Constituting and deploying a contact tracing team to follow up on contacts and monitor symptoms Holding training sessions for Disease Surveillance and Notification Officers (DSNOs), WASH focal persons, and health educators on LF surveillance, reporting, risk communication, and WASH activities during outbreaks Reactivating and orienting the LGA RRT Training clinicians on the identification, reporting, and management of LF cases	Lack of funds for surveillance activities at the start of the response	Funds were subsequently made available for DSNOs and other surveillance officers to conduct active case searches across all LGAs.

Note. LF: Lassa fever; IMS: Incident management system; VHF: Viral hemorrhagic fever; PHEOC: Public Health Emergency Operations Center; PPE: Personal protective equipment; LGA: Local government areas; NDUTH: The Niger Delta University Teaching Hospital; HCW: Healthcare workers; IPC: Infection prevention and control; WASH: Water, sanitation, and hygiene; EDTA: Ethylenediaminetetraacetic acid.

time of five days, attributed to delays in sample transportation. Our findings demonstrated that HCWs may not be sufficiently vigilant regarding the possibility of LF in non-endemic regions. This is exemplified by the case of the index patient, who was diagnosed only seven weeks after the onset of symptoms, despite having visited three different hospitals. Research indicates that delays in sample transport impede the timely diagnosis of LF.[14] According to a study by Ogoina, states that have not reported LF cases since 1969, when the first outbreak was recorded, may have experienced unrecognized or unreported cases.[2]

In this study, two confirmed cases were reported during the outbreak, out of a total of 37 suspected cases identified within the outbreak period (Figure 2). The two confirmed cases occurred in epidemiological weeks 6 and 14, corresponding to February and March, respectively (Figure 2). LF occurs year-round in Nigeria, with a higher incidence observed during the dry season, particularly from November to May.[15]

In this study, a total of 95 contacts were identified, of which 70 were classified as high-risk contacts. Among these high-risk contacts, 13 were symptomatic but tested negative (Tables 1 and 2). Studies conducted in Edo State, Nigeria, indicated that 15 out of 67 symptomatic contacts tested positive for LF. It is recommended that PCR testing be performed for symptomatic contacts within 21 days of their last exposure.[16,17]

The findings of this study confirmed that the risk of exposure to LF was higher among specific HCWs, including doctors, nurses, ward maids, and laboratory scientists (Figure 3). According to Ogoina, LF outbreaks have frequently resulted in the infection and death of HCWs, including doctors, nurses, and other allied health professionals. HCWs who do not adhere to standard precautions are at an increased risk of contracting LF.[2,18]

The Emergency Operations Center (EOC) implemented a one-health approach in its response to the LF outbreak. Research indicates that a well-organized incident management strategy that engages diverse stakeholders across the human, environmental, and animal health sectors has resulted in improved outcomes when responding to outbreaks, particularly those associated with zoonotic diseases.[19]

To prepare for potential additional cases, the isolation center was activated for use by the case management pillar. Studies have demonstrated that LF patients during outbreaks should receive care in specialized isolation units equipped for advanced medical care, as this approach can significantly reduce mortality and morbidity.[20]

In this study, the IPC and laboratory pillar conducted training sessions for HCWs and facilitated safe burial practices for deceased LF cases. Nosocomial infections have been identified as a significant driver of LF transmission in Nigeria.[21,22] According to evidence, training HCWs regarding the application of standard precautions during patient care significantly reduces the risk of exposure to infectious diseases.[23] Unsafe burial practices have been linked to the secondary spread of LF infection; therefore, it is essential to ensure the safe burial of confirmed LF cases.[17]

The risk communication pillar is responsible for the communication and sensitization of both the public and HCWs. Research has demonstrated the importance of raising health awareness among the general public and healthcare professionals in effectively managing disease outbreaks.[24,25] Enhancing community awareness and providing health education to prevent contact with reservoir sources, particularly rodents, are crucial for LF prevention. This should be complemented by measures such as preventing rodent infestations in food supplies, practicing food safety, managing waste effectively, and improving water, sanitation, and hygiene programs.[26]

Several challenges identified during the response included insufficient PPE, shortages of commodities for sample collection, and a lack of funding for active case searches at the onset of the response. Based on our experience, cases of LF are most likely to be detected in healthcare facilities located in non-endemic areas. Therefore, HCWs are advised to maintain a high index of suspicion for LF. Additionally, creating awareness and building the capacity of HCWs are essential for the prompt identification and reporting of suspected LF cases to the appropriate authorities for testing.

It is recommended that the government ensure the availability of PPE for HCWs to facilitate the safe execution of their duties by procuring and prepositioning necessary commodities in healthcare facilities. Furthermore, funding should be made readily accessible by the government in the event of an outbreak. This study utilized data from interviews, which may be subject to inaccuracies due to recall bias. Eventually, secondary data on LF cases may not accurately reflect the true incidence of the disease due to inadequate case reporting.

Conclusion

In general, it is recommended that LF non-endemic regions maintain a high index of suspicion and strengthen their surveillance and preparedness levels. Emphasis should be placed on proactive sensitization and training of HCWs and investment in the sustainable availability of commodities necessary for responding to LF epidemics.

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Competing Interests

The authors declare that there is no conflict of interests.

Ethical Approval

Ethical approval for conducting this study was granted by the State Health Research Ethics Committee (with the approval number BSHREC/Vol.1/24/05/008).

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