International Journal of Infectious Diseases 17 (2013) e1011–e1016

Contents lists available at SciVerse ScienceDirect

International Journal of Infectious Diseases

journal homepage: www.elsevier.com/locate/ijid

Containing a Lassa fever epidemic in a resource-limited setting: outbreak description and lessons learned from Abakaliki, Nigeria (January–March 2012)

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ARTICLE INFO

Article history:
Received 6 February 2013
Received in revised form 28 May 2013
Accepted 30 May 2013

Corresponding Editor: Eskild Petersen, Aarhus, Denmark

Keywords:
Lassa fever
Outbreak report
Case report
Epidemiology
Infection control
Nigeria

SUMMARY

Objectives: Despite the epidemic nature of Lassa fever (LF), details of outbreaks and response strategies have not been well documented in resource-poor settings. We describe the course of a LF outbreak in Ebonyi State, Nigeria, during January to March 2012.
Methods: We analyzed clinical, epidemiological, and laboratory data from surveillance records and hospital statistics during the outbreak. Fisher's exact tests were used to compare proportions and *t*-tests to compare differences in means.
Results: The outbreak response consisted of effective coordination, laboratory testing, active surveillance, community mobilization, contact and suspected case evaluation, and case management. Twenty LF cases (10 confirmed and 10 suspected) were recorded during the outbreak. Nosocomial transmission to six health workers occurred through the index case. Only 1/110 contacts had an asymptomatic infection. Overall, there was high case fatality rate among all cases (6/20; 30%). Patients who received ribavirin were less likely to die than those who did not ($p = 0.003$). The mean delay to presentation for patients who died was 11 ± 3.5 days, while for those who survived was 6 ± 2.6 days ($p < 0.001$).
Conclusions: The response strategies contained the epidemic. Challenges to control efforts included poor local laboratory capacity, inadequate/poor quality of protective materials, fear among health workers, and inadequate emergency preparedness.

1. Introduction

Lassa fever (LF) is caused by a single-stranded RNA virus of the family *Arenaviridae*. It is endemic in Guinea, Sierra Leone, Liberia, and parts of Nigeria, and also in other countries in the West African sub-region.[1] It is also a zoonotic disease, whose animal reservoir is a rat of the genus *Mastomys* (the 'multimammate' rat). People become infected through direct exposure to the excreta of infected rats, or by transmission from person to person via body fluids.[1] Lassa infection is asymptomatic in about 80% of cases, but causes an acute illness in the rest. Fever and general weakness are followed by headache, chest pain, vomiting, diarrhea, cough, pleural effusion, bleeding from orifices, and in the late stages sometimes disorientation and coma.[2] Deafness occurs in 25% of cases. In fatal cases, it kills rapidly – usually within 14 days. The overall case fatality rate is around 1%, rising to 15% of hospitalized cases.[1]

Worldwide, an estimated two million persons are affected every year, resulting in 5000 to 10 000 deaths.[3] It is estimated that 300 000 to 500 000 cases of LF occur annually across West Africa.[4] LF is endemic in West Africa and high rates of seroprevalence have been reported in Nigeria, Sierra Leone, Guinea, and Liberia.[5–8] In Nigeria, the seroprevalence of LF is about 21%.[8] It is an epidemic-prone disease dreaded by health workers and the community. The threat of LF as an epidemic-prone disease in Nigeria is indicated by an alert threshold of a

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1201-9712/$36.00 – see front matter
http://dx.doi.org/10.1016/j.ijid.2013.05.015

single suspected case and an epidemic threshold of a single confirmed case, by the Nigeria Federal Ministry of Health.[9] Since the identification of the virus in 1969, some outbreaks of the disease have been reported in various parts of Nigeria including Ekpoma, Aboh-Mbaise, Onitsha, Jos, and Lafia,[7,10,11] and more recently in Ebonyi, Taraba, Nasarawa, Yobe, Rivers, Ondo, and Edo states.[12–14]

Despite the epidemic nature of LF in Nigeria and other African countries, the details of outbreaks and subsequent responses to contain it have not been well documented in these places, and it is difficult to learn from these experiences to improve the management of future outbreaks. Available Nigerian reports have focused mainly on a nosocomial outbreak that occurred almost two decades ago,[7] or more recently on laboratory diagnosis of blood samples of suspected cases sent to a national reference laboratory.[12,13] Thus limited information exists regarding the containment and management of cases and suspects during outbreak situations.

We report on the investigation and management of the LF outbreak that occurred from January 1 to March 25, 2012 in Ebonyi State, Nigeria. Our specific objectives were: to describe the socio-demographic characteristics, clinical characteristics, and the management outcome of the cases seen, to describe the outbreak response, and to attempt to draw lessons for future outbreaks.

2. Methods

2.1. Study area and population

Ebonyi State is located in the southeastern geopolitical zone of Nigeria. It has 13 local government areas and an estimated population of 2.5 million people.[15] About 80% of the population are subsistence farmers and a similar proportion resides in rural areas.[15] The patients studied were managed at the Federal Teaching Hospital, Abakaliki (FETHA), Ebonyi State, in southeastern Nigeria. The hospital services the urban and semi-urban agrarian communities in Ebonyi State. It is the only tertiary referral center serving an estimated three million population in the southeastern region of Nigeria and receives referrals from neighboring states including Cross River and Akwa Ibom.

2.2. Data sources and methods

We retrospectively analyzed surveillance data, hospital records, and the outbreak response activities. Additional information about the affected LF patients was collected from the individual clinical records. We collected data on the onset of the outbreak and the management of individual patients. For suspected and confirmed LF cases, we collected data on their socio-demographic and clinical characteristics (age, sex, residence, occupation, most likely source of exposure, clinical presentation, and laboratory data), as well as the final outcome of their management. Additional information related to timing of events was also collected.

2.3. Diagnosis

All patients/contacts with features suggestive of LF (alert cases) were evaluated clinically and were classified using the World Health Organization (WHO)/Integrated Disease Surveillance and Response (IDSR) guidelines as suspected cases[16] (Table 1). Confirmation was based on a positive test using Lassa virus-specific reverse-transcriptase PCR (RT-PCR), or epidemiologically (Table 1).[16] Laboratory confirmation was performed at the Institute of Lassa Fever Research and Control, Irrua Specialist Teaching Hospital, Edo State, Nigeria. The Lassa virus-specific RT-PCR was performed as described previously.[17]

2.4. Data analysis

The data analysis was conducted using Epi Info. Continuous variables were summarized using means ± standard deviations and medians, and categorical variables were summarized as proportions. Categorical group comparisons were made using Fisher's exact tests, and continuous variables were compared using the *t*-tests for differences in means.

3. Results

3.1. Outbreak detection

On January 9, 2012, the FETHA notified the Ebonyi State and Federal Ministry of Health (MoH) of a laboratory confirmed LF case. The individual was a 25-year-old university graduate

Table 1
Definitions used in the study

Variable	Definition
Lassa fever diagnosis[a]	
Alert case	Unexplained fever for 5 days or more not responding to antimalarial/antibiotics (for malaria, typhoid fever) from the community or hospital Action to be taken: invite the Lassa fever technical committee to review the case
Suspected case[a]	Illness with gradual onset with one or more of the following: malaise, fever, headache, sore throat, cough, nausea, vomiting, diarrhea, myalgia, chest pain, hearing loss, bleeding tendency, and a history of contact with excreta of rodents or with a suspected case of Lassa fever. And has received standard treatment for fever (above) without response Action to be taken: declare 'suspected' case, send for laboratory confirmation, and may start Lassa fever treatment
Laboratory confirmed case	A suspected case that is laboratory confirmed (positive IgM antibody, PCR, or virus isolation) Action to be taken: for Lassa fever treatment
Epidemiologically confirmed case	A suspected case that is epidemiologically linked to a laboratory confirmed case (for example, contacts of a laboratory confirmed case, with signs and symptoms consistent with Lassa fever, whose confirmatory laboratory results were either unavailable or tested negative) Action to be taken: for Lassa fever treatment
Final outcome	
Dead	Confirmed/suspected cases who died from Lassa fever and/or its complications
Survived	Confirmed/suspected cases who recovered from Lassa fever following treatment
Contact[a]	
Contact	Someone who slept in the same household as the case within 1 month, or had direct contact with the case (dead or alive), or touched his/her linens or body fluids

[a] Definitions based on: Centers for Disease Control and Prevention and World Health Organization. Technical guidelines for integrated disease surveillance and response in the African region. Atlanta, GA: CDC; 2010, p. 1–416.[16]

(subsequently referred to as the index case) undergoing her national service in Rivers State, Nigeria, who had returned from her place of assignment for the holidays. She presented to the hospital with an 8-day history of severe body weakness, low-grade fever, and abdominal pains. Prior to presentation, she had received antimalarials and antipyretics based on a positive test for malaria parasites in her blood. A pregnancy test was found to be positive, and on further evaluation, a diagnosis of ruptured ectopic pregnancy was made. She was subsequently booked for emergency surgery, which was done on January 3, 2012. However, during the operation, no evidence of a ruptured ectopic pregnancy was found. The appendix was highly inflamed and there was a copious intraperitoneal fluid collection; a second surgical team continued with the operation. An appendectomy was done and the peritoneal cavity cleaned. Postoperatively, she went into shock and had to be re-explored by the general surgeons for continuing intraperitoneal bleeding. Towards the end of the third surgery, she developed disseminated intravascular coagulopathy. An experienced member of the team suggested that in addition to other management, her blood samples be investigated for LF. She was subsequently moved to the intensive care unit. That same day she died. The Lassa virus RT-PCR investigation results, which returned on the fourth day post-operation, confirmed that she had had LF.

On January 8, 2012, one of the health personnel who had performed the surgery developed high-grade fever, marked body weakness, sore throat, and vomiting. Laboratory investigations for malaria tested positive; this was treated with antimalarials and antibiotics without any improvement. He was admitted to an interim isolation ward and was evaluated by an experienced physician who made a diagnosis of 'suspected LF'. Blood samples were collected and sent for laboratory confirmation of LF and he was commenced on parenteral ribavirin. Beyond this case, five other members of the team that performed the surgery came down with similar symptoms within the next 7 days. Laboratory results of the first surgeon to become ill returned and did not confirm that he was infected with LF initially; however a repeat test carried out 2 days later was positive. He was transferred to a makeshift isolation ward in the hospital. Blood samples of the remaining members of the surgical team were collected and submitted for confirmation of LF, and all except one was confirmed by RT-PCR. This was when the LF Management Committee was established and local and national resources mobilized to respond to the outbreak.

3.2. Outbreak response strategies

3.2.1. Coordination

The response strategies were coordinated by the hospital LF Management Committee – a multidisciplinary technical committee consisting of physicians, surgeons, pediatricians, epidemiologists, and community physicians. This technical committee was charged with the evaluation and management of suspected LF cases. The committee met three times weekly and updated all sectors of the hospital involved in the response. It also liaised with the national task-force team involved in the national response to the LF outbreak nationwide for personal protective equipment, ribavirin, etc., and with the Ebonyi State MoH, which had already set-up a task-force charged with public mobilization and education, active surveillance, and contact investigation.

3.2.2. Active surveillance and community mobilization

Several programs for public advocacy were conducted at the state and district levels. Information on LF was disseminated to the public through various channels – print and electronic media, television adverts and radio, posters and banners, as well as person-to-person communication. The main content of the messages was the discouragement of eating rats and poorly stored/rat-infested foods, symptoms of LF, and routes of transmission. Community and religious leaders were mobilized and empowered to inform and educate their members. Information on safe referral practices to the nearest hospital was also disseminated. At the community level, health care workers were trained on how to identify and appropriately refer alert cases brought to their various hospitals. They also reported any such cases to the Ebonyi State MoH task-force committee, who arranged for their transportation to FETHA for evaluation. Algorithms were provided to the health workers for the evaluation of alert cases.

3.2.3. Suspect and contact evaluation

Twenty-four 'alert' cases of community-acquired LF were admitted to the hospital. Of these, 13 were classified as 'suspected' cases, and three of them were tested and laboratory confirmed. Overall, 20 cases (10 suspected and 10 confirmed) were identified, consisting of the index case plus the 6 nosocomial cases and a further 13 from the community. Of these, nine were laboratory confirmed LF (i.e., the index case, five nosocomial cases, and three of the 13 community-acquired cases); one case was epidemiologically confirmed (by positive signs and symptoms, and contact with a confirmed case) and the remaining 10 cases were classified as 'suspected' LF based on clinical criteria because laboratory confirmation was not possible for logistical reasons (Figure 1). Furthermore, a total 110 individuals were identified as high-risk contacts of LF cases (70 family contacts and 40 hospital contacts). One of the contacts, a health care worker, had evidence of LF infection (based on Lassa virus RT-PCR), but without any symptoms.

3.2.4. Epidemiological characteristics

The age of the suspected and confirmed cases ($n = 20$) ranged from 12 to 47 years, with a median of 36 years. Fourteen (70%) were males, 15 (75%) resided in the urban area, and 10 (50%) were health care workers (seven doctors, one nurse, and two auxiliary nurses). Also, six (30%) had had contact with a confirmed case

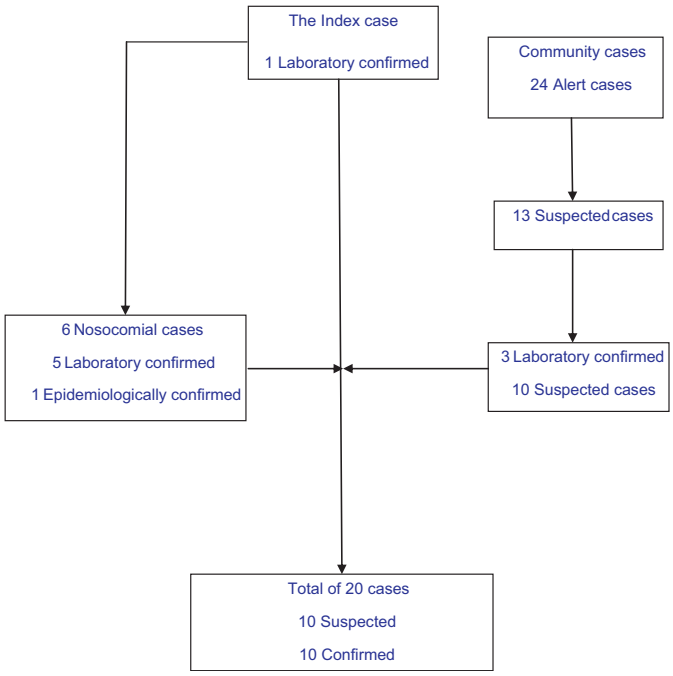

Figure 1. Flow chart for alert, suspected, and confirmed Lassa fever cases seen during the outbreak, southeast Nigeria, 2012.

Table 2
Demographic and clinical characteristics of Lassa fever cases, southeast Nigeria, 2012

Variable	Frequency ($N=20$)	Percentage (%)
Gender		
Male	14	70
Female	6	30
Age group, years		
10–19	2	10
20–29	2	10
30–39	12	60
≥40	4	20
Residence		
Urban	15	75
Rural	5	25
Occupation		
Health care worker	10	50
Student	3	15
Cleric	2	10
Laborer	2	10
Youth corps	1	5
Other (farmer, artisan, etc.)	2	10
Case type		
Confirmed	10	50
Suspected	10	50
Source of infection		
Exposure to confirmed case	6	30
Unknown	14	70

(Table 2). The mean incubation period was 10 (range 5–18) days. The initial case occurred in the first epidemiological week of 2012 in the hospital (Figure 2). Epidemiological investigations were commenced in the first epidemiological week of 2012 with the evaluation of the index case. In the following weeks, there was an initial rapid increase in cases (nosocomial cases) reaching a plateau in the second week of 2012, and subsequently a gradual decrease. The number of cases reported declined from the sixth epidemiological week to the thirteenth epidemiological week of 2012. Laboratory confirmation was made in the first epidemiological week of 2012.

3.2.5. Clinical characteristics

The most common symptom in this outbreak was fever, which occurred in 20 (100%) of the cases. This was followed by abdominal pain (17; 85%), sore throat (14; 70%), and vomiting (10; 50%) (Table 3). The admission temperature of the cases ranged from 38 to 40 °C with a median of 39 °C. Hemorrhagic symptoms such as bloody vomiting and bloody stools were less common, occurring in three (15%) of the cases. Also, two female cases presented with fever and prolonged menstruation (more than 10 days, unlike their usual 3–4 days of menstrual flow). Furthermore, two pregnant women who presented with fever with spontaneous abortion and who died within 2 h of presentation were later confirmed to have been infected with LF. At presentation, only a few of the patients had a low hemoglobin level (15%); 25% had low platelets, 25% had lymphocytosis, 35% had lymphopenia, 30% had neutropenia, and 15% had leukopenia (Table 4). Liver transaminases were raised in 45% of cases for alanine aminotransferase (ALT), 40% of cases for aspartate aminotransferase (AST), and 35% had both enzymes elevated. Furthermore, 30% had raised creatinine and 35% had raised urea. All the patients (100%) had proteinuria.

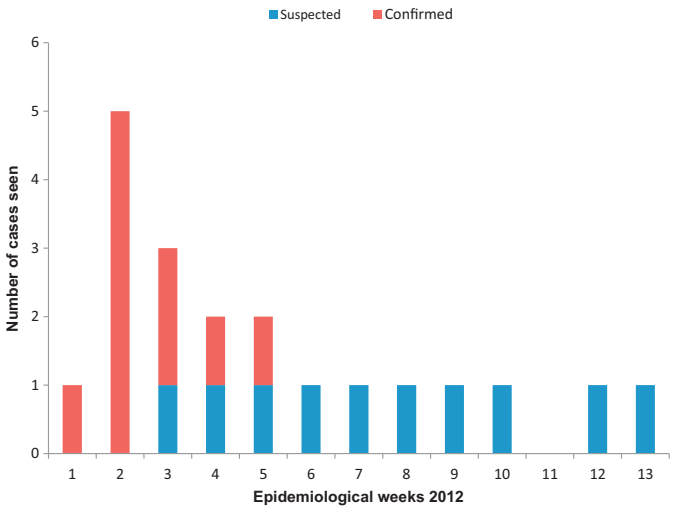

Figure 2. Suspected and confirmed Lassa fever cases by week of presentation during the outbreak, southeast Nigeria, 2012.

Table 3
Clinical presentation of Lassa fever cases, southeast Nigeria, 2012

Clinical presentation	Frequency ($N=20$)	Percentage (%)
Fever	20	100
Sore throat	14	70
Abdominal pain	17	85
Headache	7	35
Vomiting	10	50
Bloody vomiting	3	15
Bloody stool	3	15
Body pains	5	25
Body weakness	5	25
Prolonged menstruation	2	10
Spontaneous abortion	2	10

3.2.6. Case management

No isolation ward was available at FETHA at the onset of the outbreak. However, parts of the private wards (consisting of 12 private rooms) were not in use and were converted to an interim isolation ward exclusively for suspected and confirmed LF patients. All except the index case and three other cases who died within a few hours of presentation were treated with ribavirin, and all received supportive therapy (Table 5). Patients who received ribavirin were less likely to die than those who did not (Fisher's exact test; $p = 0.003$). The mean delay to presentation for patients who died was 11 ± 3.5 days, while for those who survived was 6 ± 2.6 days (t-statistic 4.3; $p < 0.001$). The mean duration of treatment before the patients became afebrile was 8.2 ± 3.8 days. Overall, there was high case fatality rate among all cases (6/20; 30%) and among confirmed cases (4/10; 40%). Sudden progression to

Table 4
Interpretations from basic investigations on Lassa fever cases, southeast Nigeria, 2012

Parameter	Frequency ($N=20$)	Percentage (%)
Low hemoglobin	3	15
Low platelets	5	25
Leukocytosis	2	10
Leukopenia	3	15
Neutrophilia	7	35
Neutropenia	6	30
Lymphocytosis	5	25
Lymphopenia	7	35
Raised creatinine	6	30
Raised urea	7	35
Raised urea and creatinine	4	20
Raised ALT	9	45
Raised AST	8	40
Raised ALT and AST	7	35
Raised total bilirubin	6	30
Proteinuria	20	100

ALT, alanine aminotransferase; AST, aspartate aminotransferase.

Table 5
Prognosis and treatment outcome of Lassa fever cases, southeast Nigeria, 2012

Treatment given	Clinical outcome		Fisher's exact *p*-value
	Survived *n* (%)	Died *n* (%)	
Suspected cases only (*N* = 10)			0.2
Ribavirin	8 (80)	1 (10)	
No ribavirin	0 (0)	1 (10)	
Total	8 (80)	2 (20)	
Confirmed cases only (*N* = 10)			0.03
Ribavirin	6 (60)	1 (10)	
No ribavirin	0 (0)	3 (30)	
Total	6 (60)	4 (40)	
All cases (*N* = 20)			0.003
Ribavirin	14 (70)	2 (10)	
No ribavirin	0 (0)	4 (20)	
Total	14 (70)	6 (30)	

multiple organ involvement occurred within a week among some of the cases. Even during treatment, neurological disturbances and deterioration in the respiratory system, kidneys, and lung function were rapid. Death occurred due to multiple organ failure. The median stay on the ward was 7 (range 0–12) days for fatal cases, and 10 (range 5–36) days for survivors. The contacts with asymptomatic infection received prophylactic treatment with oral ribavirin. Alert cases who turned out to be non-cases stayed for an average of 4 days on the ward. All the surviving health care workers requested discharge and transfer to the national center for LF management and care after 4–6 days of care. At the time of discharge, they no longer had fever, but some had deterioration of their renal and hepatic function. One of the transferred cases died at the referral center.

4. Discussion

4.1. Achievements

The outbreak in a Nigerian State described here, which was successfully contained by a multidisciplinary collaboration between the FETHA LF technical committee, the Ebonyi State MoH task-force, Irrua Specialist Teaching Hospital, Edo State, and support from the Federal Ministry of Health, confirmed the susceptibility and limitations of the health system in a resource-poor setting. The spread of LF in the hospital and community was limited through the outbreak response efforts, which substantially contributed to this containment. The backbone of the response strategies was a strong collaboration of different sectors, resulting in coordinated efforts and resource mobilization. Also, the Ebonyi State government provided leadership with support from the Federal Ministry of Health. Implementation relied substantially on surveillance for cases and contacts, case management and infection control, and availability of a Lassa virus diagnostic facility in the country, as well as effective public information and communication. Some of these approaches have been adopted previously to contain other outbreaks of viral hemorrhagic fevers.[18–21]

The epidemic was recognized within a week of onset. This early detection of the outbreak by the health care delivery system in cooperation with a diagnostic center in Nigeria is illustrated by the epidemic curve, which shows no time lag between presentation of the earliest case (January 1, 2012) and when the MoH was first notified (January 9, 2012). This early detection was a result of the strong surveillance system and the high index of suspicion maintained by all of the health care workers in FETHA due to previous deaths among health workers in the center.[12,13] Although some of the health care workers who participated in the surgery of the index case were inadvertently exposed to her body fluids, resulting in infection/disease, early detection of the outbreak ensured that they were evaluated during the incubation period until they developed the disease.

Another important factor in our success in containing the outbreak was the strong advocacy and community information and mobilization. This helped to alter the health care-seeking behavior of the population and ensured that community health workers were informed early of alert cases of LF for evaluation and onward referral to our tertiary center. As previously documented,[18,19] early detection of viral hemorrhagic fever outbreaks can be improved by involving local communities in surveillance activities. This strategy is currently recommended by the World Health Organization (WHO) through the Integrated Disease Surveillance Strategy.[16] A community-based disease surveillance strategy was thus initiated in Ebonyi State as part of an early warning system for future LF outbreaks.

Four of the patients who died during the outbreak did not receive ribavirin therapy. The index case was not treated because the confirmatory diagnosis did not return until her death. The other three patients died within a few hours of presentation. The lack of laboratory capacity for Lassa virus detection directly at the hospital led to the suspected cases being treated empirically with ribavirin. Overall, we had a good management outcome. Two other patients who received ribavirin but died, presented 2 weeks after the onset of the illness. Previous studies have documented that the case fatality rate among LF patients increases with increasing delays before presentation.[22–24] This underscores the importance of early presentation and treatment with ribavirin in the management of LF.[22,24]

Most of the health workers directly involved in the surgery came down with LF. This underscores the fact that direct contact with body fluids of an infected patient is a major source of secondary infection.[24] This also suggests that surgery for untreated cases of LF may increase the likelihood of disease transmission. Only one health worker involved in the management of the nosocomial cases had evidence of Lassa virus infection confirmed by Lassa virus RT-PCR. The referral and transportation of cases also presented special risks, but adopting standard precautions ensured that none of the non-medical/medical workers involved were infected with the disease.

The outbreak prompted informative seminars and workshops for health workers to promote infection control in the hospital and health facility settings. A number of approaches have been adopted to improve infection control at the hospital since the outbreak. First, as meticulous barrier nursing procedures and universal precautions are usually effective in preventing infection with LF,[23] protective clothing, face masks, and disposable gloves have been provided for use during the clinical evaluation of patients in the emergency department. Second, patients with fever who do not respond to treatment (for common causes of fever in our environment such as malaria and common bacterial infections) are classified as alert cases and are isolated and further evaluated for LF. Third, a dedicated ward (away from the medical and surgical wards) for LF has been provided for admission and further evaluation of suspected LF cases. Finally, after the outbreak, the surgical operation rooms in the hospital were cleaned and sterilized. Besides extensive training to exclude 'suspected' LF based on clinical criteria among patients who require surgery and the use of goggles during surgery, no other specific intervention has been carried out for health workers who perform surgical procedures.

4.2. Challenges

One of the major challenges faced during the outbreak was the inability to confirm some of the suspected cases due to financial and logistical reasons. Although the Lassa virus RT-PCR is provided

for free, the national reference laboratory for confirmatory testing was located approximately 300 km from the epicenter of the outbreak. Confirmatory diagnosis and screening of contacts required collection of blood samples, storage, and transportation to the reference laboratory. We had difficulties during these processes. There is a need to site a diagnostic laboratory in all of the states where LF outbreaks have occurred. This will improve early diagnosis and confirmation of cases and ensure appropriate treatment.

Secondly, inadequate quality and/or unavailability of personal protective materials, especially at the onset of the outbreak, were major problems. This probably contributed to the nosocomial transmission of the Lassa virus to one of the health care professionals involved in the management of the LF patients during the outbreak. There is need to ensure the availability of quality personal protective materials, especially masks, goggles, and gloves, and for these to be worn during outbreak situations.

Thirdly, inadequate knowledge of the disease among the community and health workers resulted in fear of contracting the disease. This led to a high rate of apprehension and anxiety among the clinical staff involved in the management of the cases. It took several education seminars and clear evidence that the barrier nursing currently being used for the management of cases is effective, for the confidence of some of the clinical staff to return.

Fourthly, another major challenge was the inability to trace the origin. Investigation of contacts of the cases did not yield evidence of transmission of LF between family members and close relatives. It is likely that the cases were infected through the consumption of infected foods.[25] Education of the community on safe handling of foods and to stop eating rats may play a role in curtailing future outbreaks.

Finally, the lack of epidemic preparedness for LF affected the early containment of the outbreak. There is a need for a dedicated ward for suspected LF cases in the State. Also, for post-outbreak control interventions, there is a need to improve the epidemic preparedness and response in case of a resurgence or a new LF epidemic. Furthermore, there is a need to update the registration of vital statistics (birth and deaths) in Ebonyi State. In the future this will complement the efforts of ongoing active surveillance for the early warning of epidemics.[16,19] The data collected will show the pattern of the disease burden in the community by identifying sudden changes in the epidemiology of diseases in the State.

5. Conclusions

Several lessons learned in this outbreak could be useful in tackling future outbreaks. These lessons include: (1) the need to ensure effective coordination and early mobilization of resources at the local level, involving the media and local communities in outbreak control strategies; (2) providing efficient laboratory capacity for confirmation of LF; (3) empowerment of health workers on knowledge and preventative measures of LF; (4) ensuring that active surveillance, a high index of suspicion, and infection control measures are emphasized on hospital wards and in surgical theatres; and (5) the need to sustain epidemic preparedness in LF-prone states. There is also a need to address legal issues, especially in relation to health workers and others involved in outbreak control, in terms of insurance and compensation of health workers who contract the disease.

Acknowledgements

We thank the management of the Federal Teaching Hospital Abakaliki, Ebonyi State, The Ebonyi State Ministry of Health, and the Nigeria Federal Ministry of Health for their support in controlling the outbreak. The confirmatory laboratory testing was supported by grant GU 883/1-1 from the German Research Foundation (DFG). The Department of Virology of the Bernhard-Nocht-Institute is a WHO Collaborating Centre for Arbovirus and Haemorrhagic Fever Reference and Research (DEU-000115).

Ethical approval: Approval for the study was obtained from the Federal Teaching Hospital Abakaliki Health Research and Ethics Committee. Patients and health care workers who were affected were informed that a report would be published with their privacy protected.

Conflict of interest: All authors confirm that they have no conflict of interest to declare.

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