

# Outbreak of a Highly Virulent Lassa Fever Virus in Kano State, Nigeria: An Investigation Report 2015-2016

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**Abstract— Background:** Lassa hemorrhagic fever is caused by the Lassa virus. An outbreak of Lassa fever was reported from Kano state in December 2015. Nigeria Field Epidemiology and Laboratory Training Program Residents were deployed to verify the existence of the outbreak and to describe the socio-demographic characteristics and management outcome of the cases. **Methods:** We defined suspected and confirmed case using established protocols. We actively searched for cases across the state and line-listed them accordingly. We administered a semi-structured questionnaire to adults in affected settlements. We described the outbreak in time, place, and person. We collected blood samples from suspected cases and submitted to a reference laboratory for Lassa fever detection using Polymerase Chain Reaction (PCR). **Results:** A total of 39 suspected and four confirmed cases were identified. The median age for suspected cases was 20 years with an age range of 2-80 years. Case fatality rate was 100% among confirmed cases. Of the 39 suspected cases, 27 (69%) had their blood samples taken for laboratory confirmation (PCR). Four samples tested positive for Lassa fever. Of 102 adults interviewed, 81 (79%) practiced bush burning while 84 (81%) practiced open food preservation. Only 22% had any knowledge on prevention of Lassa fever. The index case was seen on the 48th epidemiologic week of 2015. The highest number of suspected cases were seen on 52nd week of 2015 and the 3rd week of 2016, while the highest number of deaths were recorded in the 3rd week of 2016. **Conclusion:** Our investigation found a confirmed Lassa fever outbreak in Kano state, with a high case fatality rate (CFR: 100%) in confirmed cases. Poor knowledge of Lassa fever transmission and risky practices such as bush burning and open preservation of food items in affected settlements may have aided the spread of this Lassa fever outbreak.

**Index Terms—** Case Fatality Rate, Kano, Lassa fever, Outbreak, Virulent

## 1 INTRODUCTION

Lassa fever is a zoonotic viral infection caused by the Lassa virus, which belongs to the *Arenaviridae* family. The mammalian rodent vector, *Mastomys natalensis* is the primary animal host of the virus.<sup>1</sup> Clinical cases of Lassa fever have been known since the 1950s, but the virus was not linked to the disease or identified until 1969 when two missionary nurses died from Lassa infection in the town of Lassa, Borno state Nigeria.<sup>2</sup> The disease is asymptomatic in 80% of infected persons, while 20% are symptomatic and can take a complicated course.<sup>3</sup> Lassa fever has a case fatality rate (CFR) of 1% in the general population and 15% of hospitalized patients.<sup>4</sup> Symptoms of Lassa fever include fever, facial swelling, sore throat, muscle aches, and conjunctivitis. Bleeding is seen in 15%-30% of cases.<sup>5</sup> A maculopapular rash is often noted in light-skinned Lassa patients. Effusions are common, and male-dominant pericarditis may develop late in the course of the illness.<sup>6</sup> In pregnancy, the fetal death rate is 92% in the last trimester, when the maternal mortality rate is also increased from the usual 15%-30% to more than 50%. Deafness coincides with a clinical improvement in 20% of cases and is permanent and bilateral in some.<sup>7</sup> Lassa fever has an incubation period of 6-21 days.<sup>8</sup>

Lassa fever is uncommon outside of Africa. Most cases outside of the continent are linked to persons who have traveled to Africa before their onset of symptoms, hence are believed to

have contracted it from the continent.<sup>9</sup>

Lassa virus is known to be endemic in Nigeria, Sierra Leone, Guinea, and Liberia, although it is probably more widely distributed in West Africa. The virus is also known to cause recurrent epidemics in the West African region. Studies indicate that 300,000 to 500,000 cases of Lassa fever and 5,000 deaths occur yearly across West Africa.<sup>1,10</sup>

There are recurrent Lassa fever outbreaks in Nigeria.<sup>11</sup> The most recent outbreak in Nigeria started in 2015 to 2016. As at 14 March 2016, the total number of reported cases was 254 (129 of which confirmed by lab tests), and the total number of deaths (suspected, probable and confirmed) was 137, with a Case Fatality Rate (CFR) of 53.9%. Twenty-two states were affected as at the second week of March 2016.<sup>12</sup>

On December 14, 2015, the Kano State epidemiologist received notification of two suspected cases of Lassa fever that were admitted on December 3, 2015, at the Aminu Kano Teaching Hospital (AKTH). Both cases had died on December 4, but blood samples had been taken for laboratory confirmation. A notification report was subsequently sent to the Nigeria Field Epidemiology and Laboratory Training Program (NFELTP) in Abuja. A team of NFELTP Residents was sent to Kano State on December 22, 2015, to verify the existence of the outbreak, describe the socio-demographic characteristics and management outcome of the cases. We report on their investigation.

## 2 METHODS

### 2.1 Study Settings

Kano State is in the northwestern part of Nigeria. It has a population of 9,401,288 (projected from Nigeria 2006 census) and an area of 20,131 square kilometers with a population density of 467 inhabitants per square kilometer.<sup>13</sup> Kano State has 44 Local Government Areas (LGA). Kano State borders Jigawa State to the northeast, Katsina State to the northwest, Kaduna State to the southwest and Bauchi State to the southeast.

Kano City (the capital of Kano State) is a cosmopolitan city. However, the city and state are mostly inhabited by the Hausa /Fulani ethnic group, who are predominantly Muslim. The city has various professionals including civil servants and military. Others are farmers, petty traders, students, and artisans. Although English is the official language, Hausa is the main spoken language in the state.

Dakasoye, where the first case came from, is a village located along Kano-Zaria road (31 kilometers from Kano city) with an estimated total population of 5,335. The majority of the inhabitants are farmers, and store food crops at home or in local storage facilities.

### 2.2 Study Population

All settlements within the 44 LGAs were within the scope of the outbreak investigation

### 2.3 Study Design

The outbreak investigation commenced on December 23, 2015, in Kano State starting from Dakasoye settlement. Advocacy visits to stakeholders, and a community sensitization campaign were carried out in the settlement. We traced the household of the index case-patient and traced and line-listed all his contacts. These same activities were subsequently extended to other affected settlements, and all suspected cases and primary contacts were line-listed.

#### Case definition:

**Suspected case:** Any person with severe illness and fever, and at least one of the following: bloody stools, vomiting of blood, or unexplained bleeding from gums, nose, vagina, skin, eyes or urine in Kano State, from November 1, 2015.

**Community case definition:** Any person who had an unexplained illness with fever and bleeding or who died after an unexplained severe illness with fever and bleeding.

**Confirmed case:** Any suspected case with laboratory confirmation (IgM or PCR) of Lassa virus in blood or serum.

We actively searched for cases across all LGAs of the state. All the state's surveillance system apparatus were directed to report any case that fit into the case definitions to the state epidemiologist or the epidemiology unit immediately.

For each suspected case-patient, we collected information on age, sex, residence, and time of onset of illness. Also, all primary contacts of suspected and confirmed cases were traced and followed up with daily body temperature recorded. A self-applied reusable mercury thermometer was given to each contact after they were taught on how to measure and record their body temperature with the thermometer. Each of the contacts was visited on a daily basis, and records of their body temperature were collected.

We administered a semi-structured questionnaire to adults in affected settlements. The questionnaire was designed to assess the knowledge and practices of adults in the affected communities with regards Lassa fever and its transmission. We described the outbreak by time, place, and person using Microsoft Excel 2013, Epi Info 7, and Health Mapper.

### 2.4 Laboratory Investigation

We collected venous blood samples from all suspected cases and sent the samples for Lassa virus infection confirmation tests at the Lagos University Teaching Hospital, Lagos. The samples were tested for Lassa fever using Reverse Transcriptase Polymerase Chain Reaction (RT-PCR). All blood samples were collected using standard aseptic procedures.

## 3 RESULTS

The index case was a 32-year old newly admitted student of Ahmadu Bello University Zaria, whose illness started on November 18, 2015, with fever and headache. He was taken to a local medicine vendor at Kura town, Kura LGA on November 23, and then to general hospital Kura on November 26, 2015. He was subsequently referred and taken to Aminu Kano Teaching Hospital on December 3, 2015, from where his case was reported as a suspected Lassa fever to the Kano State Epidemiology Unit on December 14, 2015.

As of March, 17 2016, a total of 39 suspected cases (24 males and 15 females) and four laboratory-confirmed cases were recorded. The median age of suspected cases was 20 years, with an age range of 2-80 years. There were 21 deaths recorded among suspected cases giving a CFR of 54%. All four confirmed cases died (CFR 100%). No fatality was recorded among primary contacts (Table 1). The CFR was 67% in males and 33% in females. The majority of suspected cases (69.2%) were within the 5-39years age group, followed by the 40-79years age group (20.5%). The extreme age groups had the lowest percentage of cases (Table 1). Out of the 603 primary contacts listed (as at March 17, 2016), 61.7% were close family members of the suspected cases, while healthcare workers make up 38% of the primary contacts.

Of the 102 adults interviewed in affected communities, 81 respondents (79%) practiced bush burning, while 84 respondents (82%) practiced open food preservation and drying. Also, 69 (68%) respondents had heard of Lassa fever. However, only 27 (26%) had knowledge on Lassa fever transmission, and 22 (22%) knew how to prevent transmission of Lassa fever (Table 2).

A summary of contact tracing activities for the Kano Lassa

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fever outbreak as of March 17, 2016, showed the cumulative contacts listed were 631, with additional 28 contacts listed on March 14. Also, 151 (24%) contacts were dropped after negative results. A total of 452 (72%) contacts had completed 21 days of follow-up, and 28 (4%) contacts were lost to follow-up (Table 3).

Among the 39 suspected cases, 27 (69%) had their blood samples taken for laboratory confirmation, of which laboratory results for 24 (89%) samples were received and recorded, and four samples (17%) tested positive for Lassa fever.

Suspected cases were recorded as early as November 19, 2015 (which was 46th epidemiologic week—each year has 52 weeks, with the first week of the year being epidemiologic week 1 and the last week of the year being epidemiologic week 52). But the first case seen at a health facility was on December 3 (48th epidemiologic week), 2015 and was reported on the December 14 (50th epidemiologic week). The highest numbers of suspected cases per week (six cases) were recorded in the 52nd epidemiologic week of 2015 and the 3rd week of 2016. Also, deaths among suspected cases occurred from the 46th epidemiologic week of 2015, with the highest number of deaths per week (five deaths) seen in the 3rd week of 2016 (Figure 1). The epidemic curve seems to be a point source outbreak based on the shape. The epidemic curve had two distinct peaks at epidemiologic weeks 52 (of 2015) and 3 (of 2016). Death cases had the same pattern, with deaths occurring in every week except for week 48 (Figure 1).

Of the 44 LGAs in the state, 19 LGAs (43%) were involved in the Lassa fever outbreak as at February 29, 2016; contact tracing involved 21 LGAs (48%). Three of the confirmed cases were from Garum Mallam LGA (two from Dakasoye and one from Cikin Gari Ward), while one confirmed case was from adjacent Dawakin Kudu LGA. Cases were spread mostly across the central senatorial zone of the state, with clustering mostly in the metropolitan LGAs (Figure 2).

## 4 DISCUSSION

We confirmed a Lassa fever outbreak in Kano state. The outbreak had a high CFR of 100% among the four confirmed cases and involved about half of the LGAs of the state. The adult population in affected settlements was mostly affected, with twice the fatality in men compared to females. Also, family members and healthcare workers constituted the majority of primary contacts on follow-up, which buttresses the fact that close contact with infected Lassa fever patients promotes the transmission of Lassa fever.

Most studies have put the CFR for Lassa fever to be between 10-65%.<sup>1,4,12,14</sup> These values are below the CFR recorded in the Lassa fever outbreak in Kano state, 2015-2016. Considering that Kano State has never had an outbreak of Lassa fever in the past, there is a serious cause for concern, especially with regards infection prevention and control among health workers within the state. Genetic mapping of the virus involved in this outbreak will be required to rule out genetic mutation in the virus. Also, delay in seeking medical care and poor case management may also be responsible for the high CFR recorded for this outbreak,

We also found a delay in identification of index case by the states' surveillance system. The index case was first seen at a secondary health facility (General Hospital, Kura) on November 26, 2015, and subsequently referred to a tertiary health facility (AKTH) on December 3, 2015. But he was only reported to the states' epidemiologist as a suspected Lassa fever case on December 14, 2015 (with about 11 days' delay). This delay may have aided the spread of the infection.

Risky practices (such as bush burning and open food drying) among adults in affected settlements, as we have found in our study, may have been responsible for contracting and spread of Lassa fever within the affected settlements. The rodent vectors that live in the bushes will be forced into homes when bushes are burnt down. This behaviour coupled with open food drying on which the rodents also feed may have transmitted the Lassa fever virus.

The low level of knowledge on Lassa fever and its transmission and prevention among adults in affected settlements, as found in this study, are factors that may have aided the rapid spread of this virus.

More than half of the suspected cases had their blood samples taken for laboratory confirmation, and almost all of them had the result of the test recorded. Lassa fever was confirmed in four blood samples. Based on the severity of Lassa fever and its propensity to cause rapid and wide spreading outbreaks and the importance of early diagnosis which help in early treatment and isolation of patients, this is a welcome development.

We recognize the following limitations to our study: first, blood samples could not be collected from some suspected cases because they died and were buried before investigation teams reached the settlements. Hence, they cannot be confirmed. Secondly, some primary contacts may have concealed their status for fear of stigmatization hence, they may have been missed. Thirdly, delay in sample transportation to the Reference Laboratory in Lagos State, which is about 1,000 km from Kano may have affected the laboratory outcome of some samples. To minimize above limitations, we collected blood samples from >60% of suspected cases for confirmation of Lassa fever. Also, we conducted follow-up visits to the settlement of most absconded patients and did a public health enlightenment on Lassa fever. Primary contacts were subsequently identified and listed. Also, radio jingles were done across the state to enlighten locals on the dangers of concealment of Lassa fever. Air transportation of samples to the laboratory in Lagos was arranged.

Based on findings from our study we recommended the strengthening of the Kano State disease surveillance system for early detection of highly infectious diseases such as Lassa fever in the future. The government, through the Ministry of Health, should organize frequent public health campaigns and enlightenment across the state on Lassa fever and other infectious diseases. We recommended that the state improves the capacity of state-owned laboratories to be able to test and confirm Lassa fever during disease outbreaks. The state should provide standard isolation facilities and commodities and strengthen Infection Prevention and Control practices in local health facilities across the state.

## 5 CONCLUSION

The management of the 2015-2016 Lassa fever outbreak in Kano state had its challenges and lessons learned. The virulence of the virus responsible for this outbreak is something of great concern, a gene mapping of the virus is needed to rule out new mutation. Therefore, concerted efforts are needed at both the state and federal level to improve on shortcomings so as to prevent future outbreaks of this nature.

## 6 ACKNOWLEDGEMENT

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## 7 CONFLICT OF INTEREST

Authors declare no conflict of interest

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## TABLES AND FIGURES

**Table 1:** Distribution of case fatality rate by category of cases and Gender with the age group of cases of Lassa fever cases, Kano 2015-2016.

Category	Cases	Alive	Deaths	CFR %
Suspected	39	18	21	54
Confirmed	4	0	4	100
Contacts	603	603	0	0
Gender	Cases	Alive	Deaths	CFR %
Male	24	8	16	66.7
Female	15	10	5	33.3
Total	39	18	21	53.8
Age Group	Frequency	Percentage		
<5	3	7.7		
5-39	27	69.2		
40-79	8	20.5		
80+	1	2.6		
Total	39	100		

**Table 2:** Practices and knowledge of adults in affected communities of Lassa fever outbreak, Kano 2015/2016.

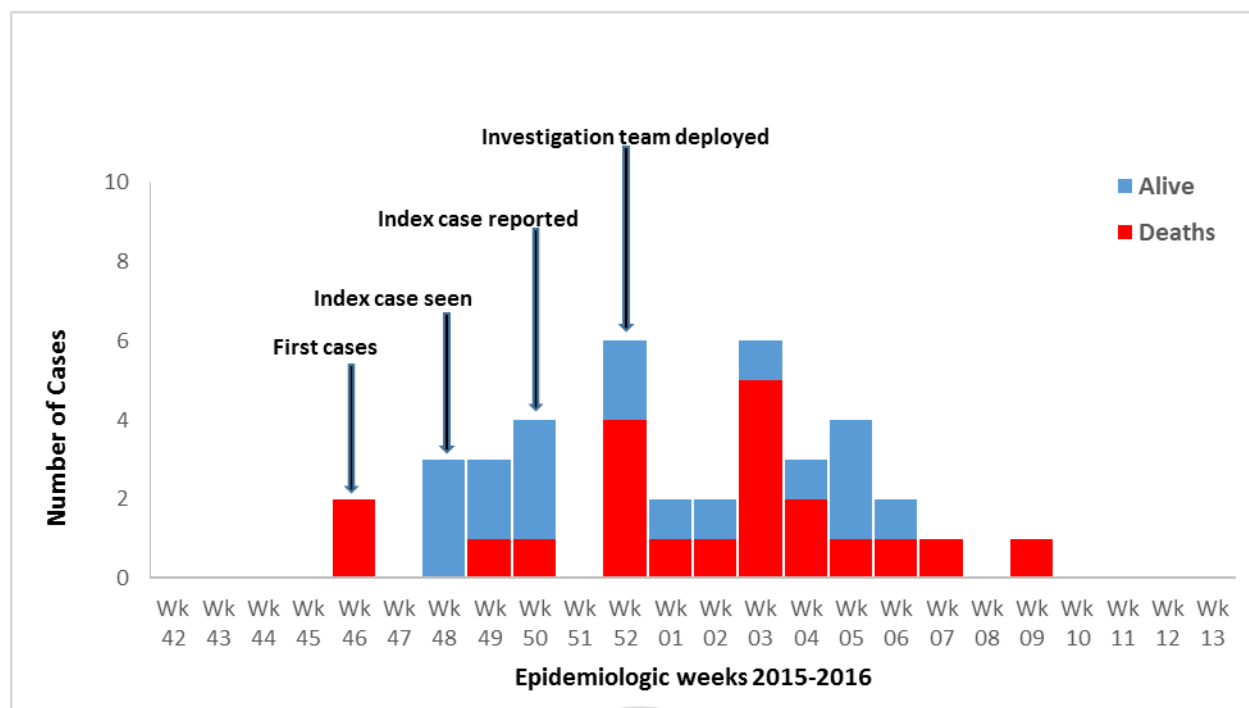
Practices	Frequency (n=102)	Percentage
Bush burning	81	79
Open food drying	84	82
Knowledge		
Ever heard of Lassa Fever	69	68
Know how Lassa Fever is transmitted	27	26
Know how to prevent Lassa Fever	22	22

**Table 3:** Summary of Lassa fever outbreak activities in Kano state as at March 17, 2016.

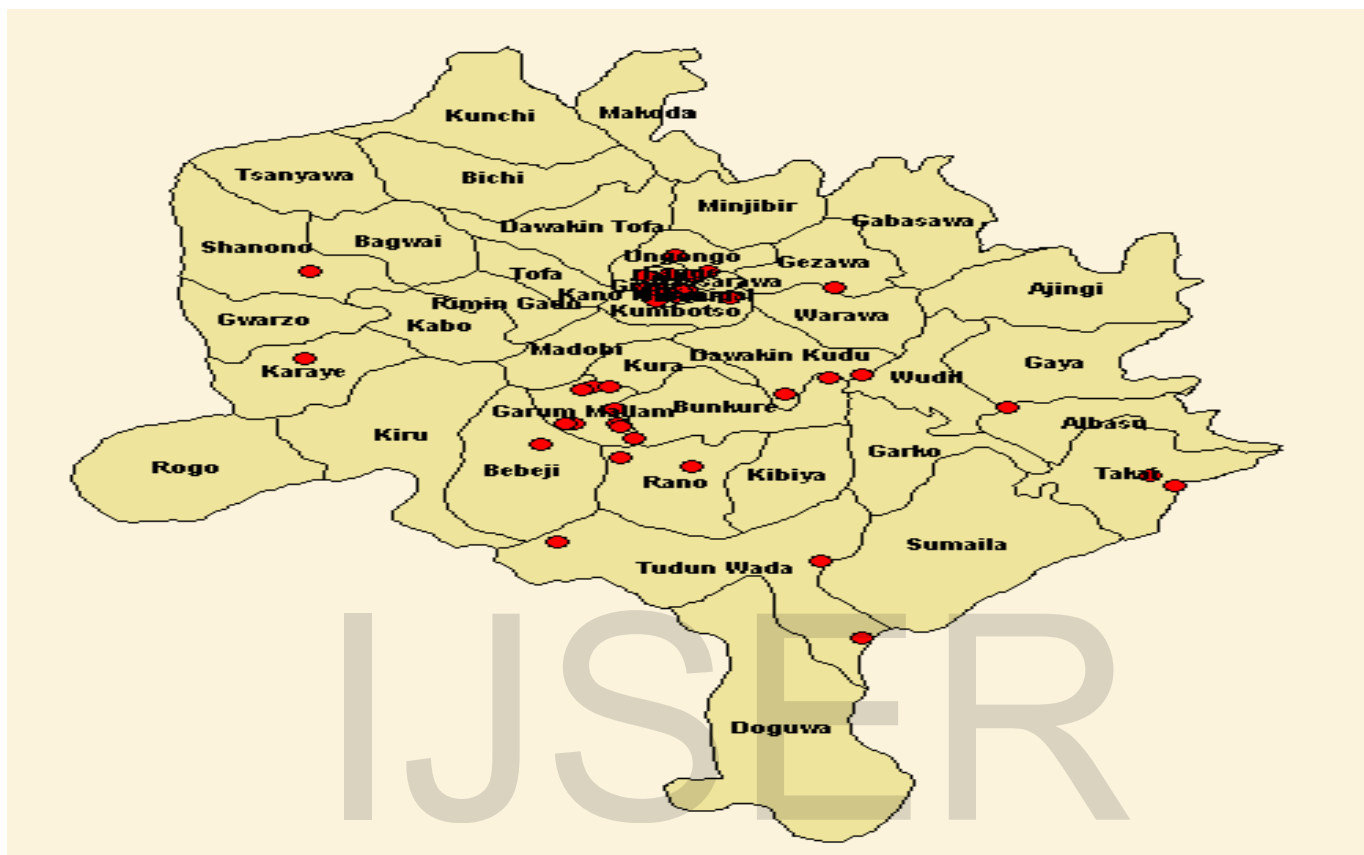
Activities	Number (%)
New contacts listed on March 17, 2016	28
Cumulative contacts listed	631
Contacts dropped after negative result	151(24)
Contacts who complete 21 days of follow-up	452(72)
Contacts lost to follow-up	28(4)
Contacts currently under follow up (March 17, 2016)	28
<b>Laboratory Test</b>	
Total specimen tested	27
Total confirmed (positive) cases	4
Specimen pending	0

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**Figure 1:** Epicurve of Lassa outbreak cases and deaths through the epidemic weeks in Kano state, 2015-2016.



**Figure 2:** Spot map showing distribution of Lassa fever cases across Kano state, 2015-2016.