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Review

The response to re-emergence of yellow fever in Nigeria, 2017

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ABSTRACT

Yellow fever (YF) is an acute viral hemorrhagic disease caused by the YF virus (arbovirus) which continues to cause severe morbidity and mortality in Africa. A case of YF was confirmed in Nigeria on the 12th of September 2017, 21 years after the last confirmed case. The patient belongs to a nomadic population with a history of low YF vaccination uptake, in the Ifelodun Local Government Area (LGA) of Kwara State, Nigeria.

An active case search in Ifelodun and its five contiguous LGAs led to the listing of 55 additional suspect cases of YF within the period of the outbreak investigation between September 18 to October 6, 2017. The median age of cases was 15 years, and 54.4% were males. Of these, blood samples were collected from 30 cases; nine tested positive in laboratories in Nigeria and six were confirmed positive for YF by the WHO reference laboratory in the region; Institut Pasteur, Dakar.

A rapid YF vaccination coverage assessment was carried out, resulting in a coverage of 46% in the LGAs, with 25% of cases able to produce their vaccination cards. All stages of the yellow fever vector, *Aedes* mosquito were identified in the area, with high larval indices (House and Breteau) observed.

In response to the outbreak, YF surveillance was intensified across all States in Nigeria, as well as reactive vaccination and social mobilisation campaigns carried out in the affected LGAs in Kwara State. A state-wide YF preventive campaign was also initiated.

Background

Yellow fever is an acute viral hemorrhagic disease caused by the yellow fever virus, an arthropod-borne virus (arbovirus) which continues to cause severe morbidity and mortality in Africa despite the availability of an effective vaccine for more than 70 years (Obi, 2016; Tomori, 2002; Wiysonge et al., 2008; Fatiregun et al., 2010). The transmission of yellow fever in Africa is primarily through the bite of infected female *Aedes* mosquitoes (Ellis and Barrett, 2008; Tomori, 2004). The main reservoirs of the infection are human and non-human primates. Humans are a dead-end host for the virus which does not allow the virus to complete its life cycle (Ellis and Barrett, 2008). In rural areas, the virus typically causes sporadic cases and small-scale epidemics. If introduced into urban areas, it can cause large epidemics (WHO, 2013). Symptoms vary from mild ones that subside within a few days, to severe symptoms such as high fever, jaundice, abdominal pain, vomiting and bleeding from different body orifices. The mortality rate in those who develop these severe symptoms is about 50% (Germain et al., 1981; Garske et al., 2014).

The World Health Organization (WHO) estimates that yellow fever causes about 84,000–170,000 severe cases with about 60,000 deaths globally every year, of which more than 90% occur in Africa (Krishna, 2017; WHO, 2017). Control strategies include effective and timely yellow fever surveillance, strengthening laboratory services; high-coverage yellow fever routine immunisation; fast

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and comprehensive response to yellow fever outbreaks including easy access to vaccines for mass vaccination campaigns, improved and timely supportive management of cases, social mobilisation, communication and effective vector management (Muanya, 2016; WHO, 2013).

Over the past 40 years, many countries in the African region have witnessed series of yellow fever outbreaks (Muanya, 2016). The most recent large outbreak of yellow fever in Africa started in Viana Municipality, Luanda Province, Angola, in December, 2015. According to the WHO yellow fever situation report of September 23rd, 2016, there have been 6890 reported cases and 492 deaths of yellow fever since the onset of the outbreak. Of this, 960 were confirmed cases with 137 deaths among the confirmed cases (WHO, 2016).

The Angolan outbreak spread extensively to the Democratic Republic of Congo, (DRC) with other countries such as China receiving infected travelers which were the first yellow fever cases reported in China (Wilder-Smith and Leong, 2017). The 2016 yellow fever outbreak linked two urban yellow fever outbreaks — in Angola and DRC. The epidemic created an urgent need for more than 28 million doses of yellow fever vaccines which exhausted the existing global vaccine supply (WHO, 2017; Krishna, 2017)

In July, 2016, there were reports of ongoing autochtonous (reintroduction of the yellow fever into areas where it can survive, having been previously eliminated) outbreaks of yellow fever which included 68 cases and seven deaths in Uganda, 22 cases and five deaths in Ethiopia and four cases in Ghana (Obi, 2016; WHO, 2016).

WHO also observed that twelve countries in Africa, including Nigeria have large non-immune populations who are at high risk of yellow fever outbreaks, which required intensification of routine immunisation as well as the implementation of preventive vaccination campaigns in these countries (WHO, 2015).

Nigeria has recorded some outbreaks of yellow fever in the past. The earliest yellow fever outbreak in Nigeria was reported in Lagos in 1864. This was followed by several other outbreaks in Lagos in 1894, 1905, 1906, 1925 and 1926 (Obi, 2016). A major outbreak of yellow fever occurred in Jos, Nigeria in 1969 which spread rapidly to many other parts of the country leading to more than 100,000 people being infected. Similarly, between 1987 and 1996, yellow fever outbreaks affected approximately 120,000 persons in various parts of Nigeria including Jos, Azare, Ogoja in Cross River State, Oju in Benue State, Ogbomosho in Oyo State (WHO, 2016). There were no further confirmed cases until 2017.

After 21 years of not reporting a confirmed case of yellow fever in Nigeria, a case was confirmed in Ifelodun Local Government Area (LGA) of Kwara State in September 2017. This was in a seven-year-old patient who presented with fever and yellowish discoloration of eyes, and who belongs to the nomadic Fulani population, with low yellow fever vaccination coverage. Following this first case, the Nigeria Centre for Disease Control (NCDC) led a multi-agency rapid response team (RRT) to respond to the outbreak with the following terms of reference; to support the state surveillance team in conducting detailed yellow fever surveillance activities including verbal autopsy and an entomological survey in the affected LGA and its contiguous LGAs; to conduct rapid yellow fever vaccination coverage of children 1–10 years, assess immunisation profiles, develop a request to the International Coordinating Group (ICG) for a yellow fever reactive vaccination campaign in the LGA and its contiguous LGAs; support the State in conducting risk communication and social mobilisation activities for yellow fever.

The onset of yellow fever outbreaks in Nigeria followed a global trend of reports from other African countries marking the emergence of yellow fever a new re-emerging global threat in 2016. Large outbreaks of yellow fever were reported in Angola and DRC which highlighted the gaps and challenges of surveillance, rapid diagnosis and availability of global vaccine stockpiles. In addition, factors like porous borders and increased migration, the widespread distribution of Aedes mosquitoes and lack of efficient health policies and surveillance system, favour this complex epidemiological scenario of reemergence yellow fever (Ortiz-Martínez et al., 2017).

In 2017, WHO developed the Eliminating Yellow fever Epidemic (EYE) strategy to improve high risk country preparedness for surveillance, detection and response. Nigeria is considered as one of the high-risk countries for yellow fever in Africa.

Methods

A cross-sectional descriptive outbreak investigation was carried out in Ifelodun Local Government Area (LGA) of Kwara State, Nigeria. The study population included persons who met the case definitions of yellow fever as follows:

i. Suspected case of yellow fever (YF): any person with acute onset of fever, jaundice appearing within 14 days of onset of the first symptoms residing in Ifelodun LGA or any of the LGAs sharing boundaries with it between July 1 and to October 6, 2017.
ii. Probable case of yellow fever: a suspected case plus IgM positive on serology or PCR positive for viral RNA in the absence of YF vaccination within 30 days of onset of illness.
iii. Confirmed case of yellow fever: a probable case and presence of YF virus RNA or detection of YF-specific IgM, and/or detection of YF virus-specific neutralizing antibodies at the WHO Regional Laboratory, Institut Pasteur, Dakar.

Following the establishment of case definitions for the outbreak, the activities detailed below were subsequently carried out during the outbreak investigation.

Active case search

A house-to-house active case search for suspected cases of yellow fever was carried out in all the affected communities. Initial advocacy visit to community leaders was carried out by the rapid response team (RRT). This was to inform them of the nature and risks associated with the disease, as well as activities to be conducted. The visits also helped to facilitate successful engagement with households through the household heads or their representatives. Family members were asked for history of jaundice and fever from the period of July 1 to October 6, 2017. Detailed information of cases that met the standard case definition were included in a line list. Respondents who indicated they had relevant symptoms/signs which had resolved without any associated proof were excluded.

A similar active case search was carried out by the RRT in all health facilities in the affected communities through a retrospective review of hospital records from the period July 1 to October 6, 2017. Facility records were obtained from the medical records of the outpatient and the laboratory units of the facilities. Patients who met the case definition were listed using a specific yellow fever outbreak line list.

Rapid yellow fever vaccination coverage assessment

A rapid yellow fever vaccination coverage (RVC) assessment was carried out to determine the yellow fever vaccination status of children aged ten years and below in the community. The communities were purposively selected based on information of reporting a suspected yellow fever case(s). A systematic sampling of alternate houses was used to identify those to be included,

starting from the meeting point of the RRT with the community leader and subsequently moving in a clockwise direction. Children under one year and those over 10 years of age were excluded. A living first-born child in each house was assessed until 10 children per community were identified and their caregivers interviewed. A caregiver at each selected house was asked for the history of yellow fever vaccination as well as documentary evidence in the routine immunisation (RI) cards to show that the child had YF vaccination. A check list was used to collect data on vaccination status comparing yellow fever vaccine with other antigens.

A yellow fever vaccine request was developed for the International Coordinating Group (ICG) on vaccine provision to support a yellow fever reactive vaccination campaign. Approval was granted for Ifelodun LGA and the contiguous wards in its six contiguous LGAs. The yellow fever reactive vaccination campaign (RVC) strategy adopted was the fixed posts and temporary fixed posts as identified in the daily implementation plan (DIP).

Verbal autopsy

Verbal autopsy (VA) was carried out to estimate the burden of disease, mortality and under-reporting of yellow fever. A case eligible for VA was defined as "any death of a family member(s) who prior to death developed acute onset of fever and jaundice with or without bleeding appearing within 14 days in a person who resided in Ifelodun or any other part of Kwara State between 1 July to 6 October-2017". Any death in the community that met the case definition above was included. All the cases were epidemiologically linked to a single case confirmed at the Institute Pasteur (IP) Dakar. A structured-interviewer-administered questionnaire was used to collect data from eligible cases. Grave sighting was also used to confirm history of deaths from relatives.

Human blood sample collection

Blood samples were collected from patients with active disease (presenting with fever and jaundice) with or without bleeding, who had not been tested. Five millilitres of whole blood were collected from these patients, aliquoted in two parts and sent to the testing laboratories [Central Public Health Laboratory (CPHL Lagos) for IgM serology and Lagos University Teaching Hospital (LUTH Lagos) for real time polymerase chain reaction (RT PCR)]. Serology testing was carried out using IgM ELISA methods and real-time polymerase chain reaction (RT-PCR). Samples which tested positive and inconclusive in Nigerian laboratories were sent to the WHO regional reference laboratory IP Dakar, Senegal. The WHO reference laboratory IP Dakar retested these samples using the IgM ELISA and (RT PCR) methods. Positive cases from the retested samples were finally tested using the plaque reduction neutralization test (PRNT) for confirmation.

Entomology surveillance

An entomological survey was carried out to determine the presence of the YF vector (*Aedes* mosquitoes) in the affected area. The methods used include arval sampling; ovitraps placed within or underneath tall grasses/flowers or shaded areas around houses; modified human landing catch (HLC); and adult collection traps [CDC UV Light trap, BG-Sentinel trap (Biogent trap), and CDC Light trap]. The purpose was to determine the larval risk indices, the risk of disease outbreaks, and to delimitate the areas at risk; this will lead to good planning and a rational management of the vaccination programme. The BG traps were placed in shaded areas around houses as well as outdoors in locations close to the human dwellings. Determination of mosquito larval indices and mosquito identification were subsequently carried out (Hoel et al., 2009 and (The yellow fever handbook, WHO, 2014) and Technical handbook for dengue surveillance, WHO, 2016).

Risk communication and social mobilisation

Risk communication and social mobilisation involved advocacy to key stakeholders, community engagement, media (traditional and modern) monitoring, radio and television phone-in programmes, distribution of information education and communication (IEC) materials, and use of key messages to targeted audience. In addition, advocacy visits were paid to heads of secondary and tertiary healthcare facilities and training conducted among healthcare workers on the epidemiology, reporting and management of yellow fever.

Data management

The data management tools used in the study include:

- Active case search: the yellow fever specific line-list in Excel template was used and analysed with Microsoft Excel software.
- Verbal autopsy: data was collected using a structured-interviewer-administered questionnaire. Data was entered and analysed using Microsoft Excel software.
- Rapid yellow fever vaccination coverage assessment: a checklist was used to collect data. Data was entered and analysed using Epi-Info software.

Results

Response timelines

The confirmation of yellow fever in Nigeria after 21 years led to the initiation of urgent response activities. Figure 1 below shows the timeline for these response events.

- Figure 1: Timeline of events in yellow fever outbreak in Kwara State, 2017.

The active case search in hospitals and communities showed a total of 55 cases [Figure 2] which met the standard case definition for suspected cases of yellow fever, 30 (54.4%) were males with male to female ratio 1.2:1. The age groups mostly affected were those aged less than 20 years of age (63.6%) [See Figure 2], while the median age was 15 years (range <1 year to 50 years). The most affected LGA was Ifelodun with 43 cases (78.2%), while other LGAs affected included Irepodun: four cases (7.3%), Ilorin East: two cases (3.6%), Edu: one case (1.8%), Oke–Ero: one case (1.8%), Pategi: two cases (3.6%), [Figure 3] while [Table 1] shows some of the surveillance performance indicators.

Among the 55 suspected cases, 32 (58.2%) had their blood samples collected and sent to the laboratory for analysis. Ten (18.2%) presumptive positive and one (1.8%) inconclusive results from Nigeria laboratories were reported, of which seven were confirmed positive in the reference laboratory-Institut-Pasteur Dakar. Six deaths were recorded among all suspected cases while two deaths were recorded among confirmed cases. The case fatality rate (CFR) was 10.9% in suspected cases and 33.3% in confirmed cases [Figure 4]. The major presenting symptoms were fever (98.2%) and jaundice (94.5%) [Figure 5]. None of the suspected cases had a history of yellow fever vaccination.

- Figure 2: Age–sex distribution of suspected cases of yellow fever in Kwara State, Nigeria from 18th September to 6th October, 2017.

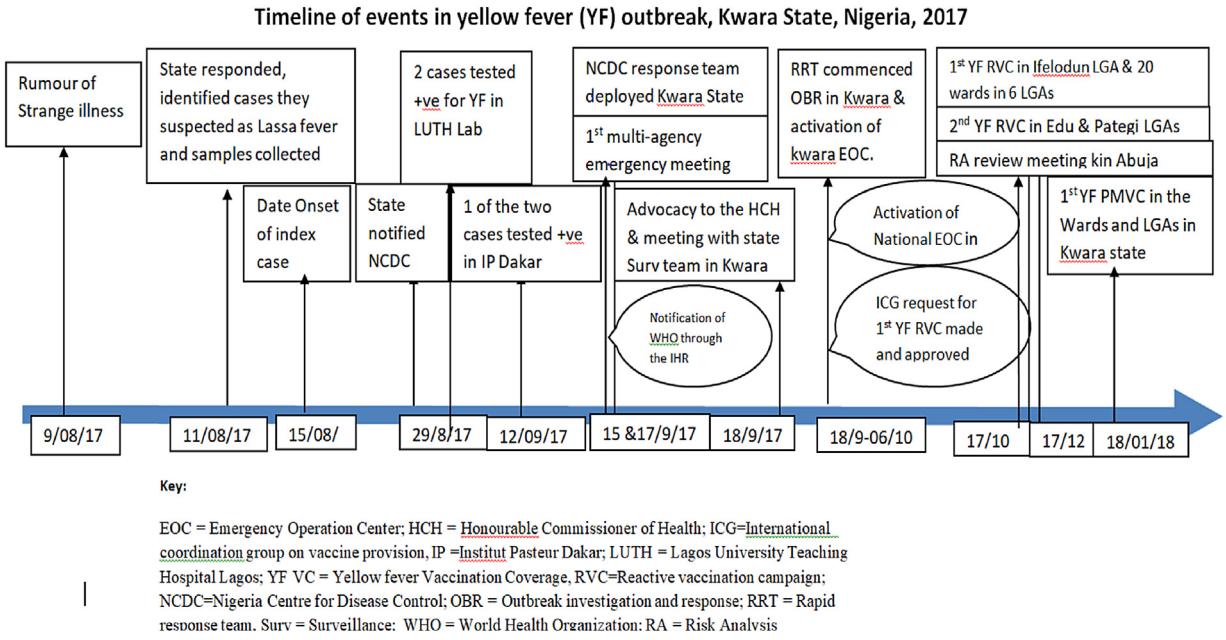

Figure 1. Timeline of events in yellow fever outbreak in Kwara State, 2017.

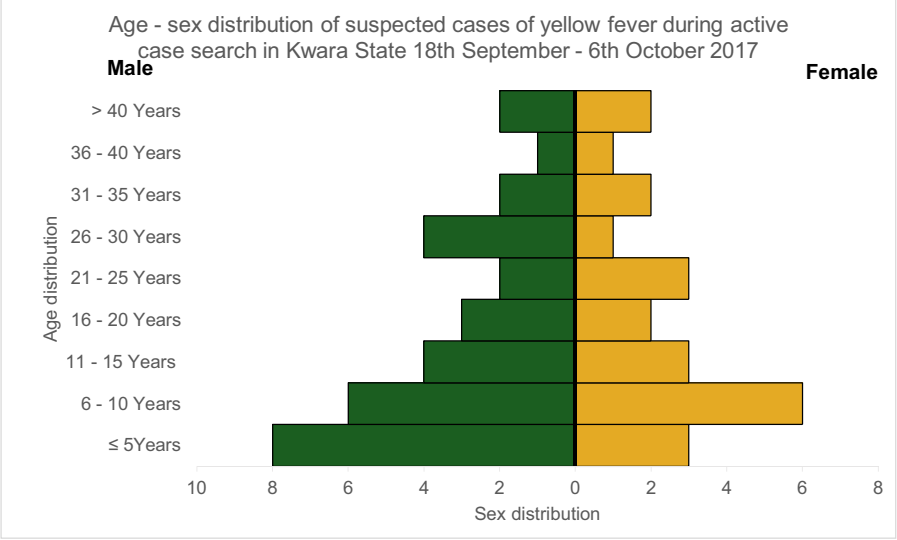

Figure 2. Age-sex distribution of suspected cases of yellow fever during active case search in Kwara State, Nigeria from 18th September to 6th October, 2017.

- Figure 3: Attack rate of yellow fever cases of by LGA in Kwara State, Nigeria from 18th September to 6th October, 2017.
- Table 1: Showing yellow fever performance indicators for surveillance July–October, 2017.
- Figure 4: Epicurve by week of onset of symptoms of suspected cases of yellow fever in Kwara State, Nigeria from 18th September to 6th October, 2017.
- Figure 5: Presenting symptoms of suspected yellow fever cases in Kwara State Nigeria, 18th September–October, 2017.
- Figure 6: Map of Kwara State showing yellow fever cases by LGA.

Rapid vaccination coverage

For the rapid yellow fever vaccination coverage assessment, a total of 109 children (60 males and 49 females) were sampled from health facility registers. The mean age of children surveyed was 4.4 (3.2) range 1–10 years. Eighty (73.4%) of them were from Ifelodun LGA. Forty six percent of the children had yellow fever vaccination. Only 27.5% could produce their vaccination cards for review. Among the children from Ifelodun LGA, 25% of children had YF vaccination, See Table 2.

- Table 2: Demographic characteristics of children assessed for Rapid YF vaccination coverage survey in Kwara State Nigeria, July to October 2017.

Entomology survey

Entomological survey findings showed that various stages of the *Aedes* mosquito (eggs, larvae, pupae and adult) were found in

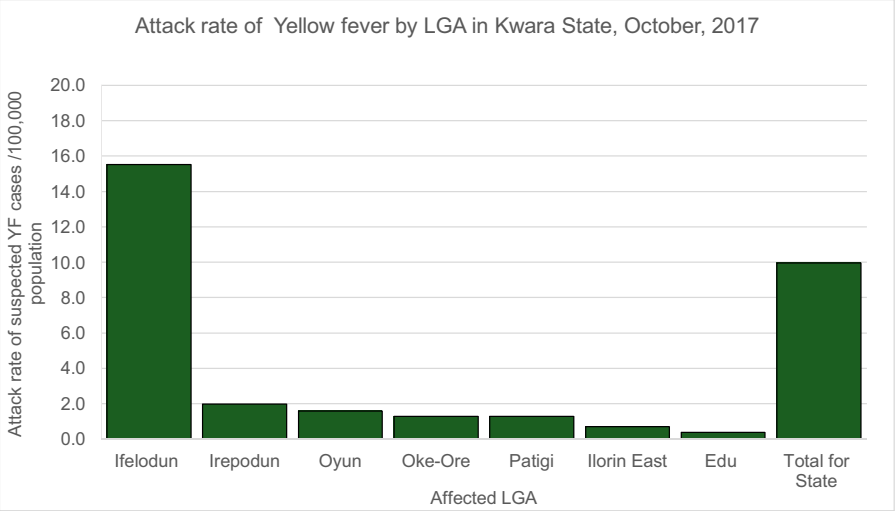

Figure 3. Attack rate of yellow fever cases of by LGA in Kwara State, Nigeria from 18th September to 6th October, 2017.

Table 1
Showing yellow fever performance indicators for surveillance July–October, 2017.

S/Number	Yellow fever performance indicator for surveillance	Frequency	Percent
1	Percentage of LGA reporting (Number of LGAs in Kwara = 16 LGAs)	7	43.8
2	Percentage of LGA that collected blood samples from at least one suspected case of yellow fever per year: target >80% (n = 7)	3	42.9
3	Percentage of all suspect cases for which specimens were collected: target ≥50%. (N = 55)	32	58.2
4	Percentage of cases investigated within 48 h of notification: target ≥80% (n = 32)	28	87.5
5	Percentage of samples sent to the laboratory within three days of investigation: target ≥80% (n = 32)	2	6.3
7	Percentage of samples reaching laboratory in adequate** condition: target ≥80% (n = 32)	29	90.6
8	For IgM test: laboratory results reported < seven days after receipt of blood specimen: target ≥80% (n = 11)	4	36.4

six (out of seven (85.7%)) locations. Aedes vectors collected include *Aedes aegypti*, *Aedes africanus* and *Aedes luteocephalus*. The sylvatic yellow fever vectors/canopy breeders (*Aedes africanus* and *Aedes luteocephalus)* were collected from two (28.8%) locations. Of the ovitraps set in seven locations, 14.3% were positive for *Aedes* eggs on retrieval. Peri-domestic/domestic breeders (*Aedes aegypti*) were collected in all the locations where immature stages were found. Larval indices were found to be high in all locations where *Aedes* species were collected, i.e. with House Index ≥5% and/or Breteau Index ≥20. Tyres and earthen-pots were the most preferred breeding sites.

- Table 3: Entomological findings on larval indices in Kwara State YF outbreak September to October, 2017.

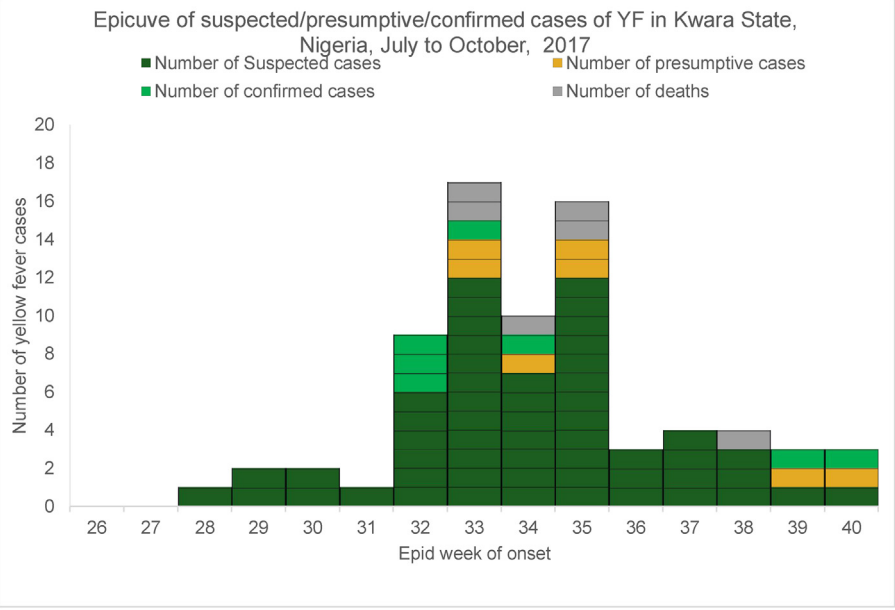

Figure 4. Epicurve by week of onset of symptoms of suspected cases of yellow fever in Kwara State, Nigeria from 18th September to 6th October, 2017.

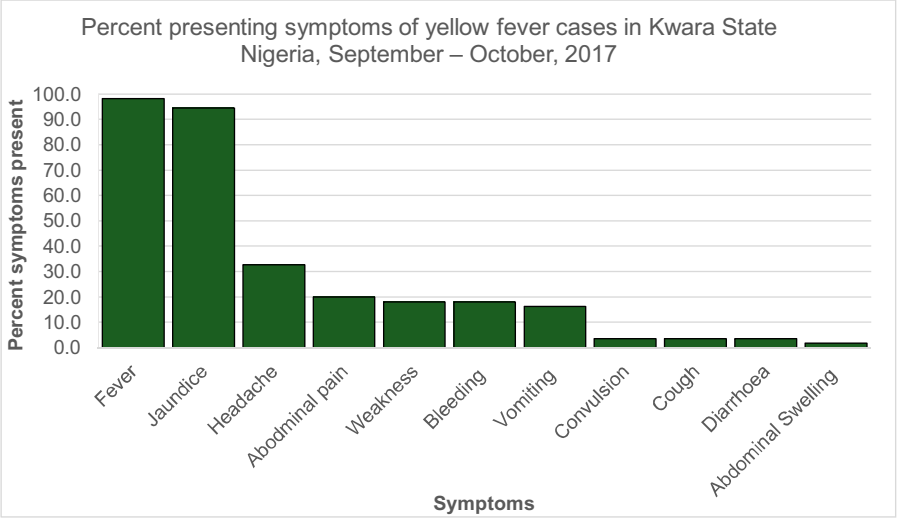

Figure 5. Presenting symptoms of yellow fever cases in Kwara State Nigeria, September–October, 2017.

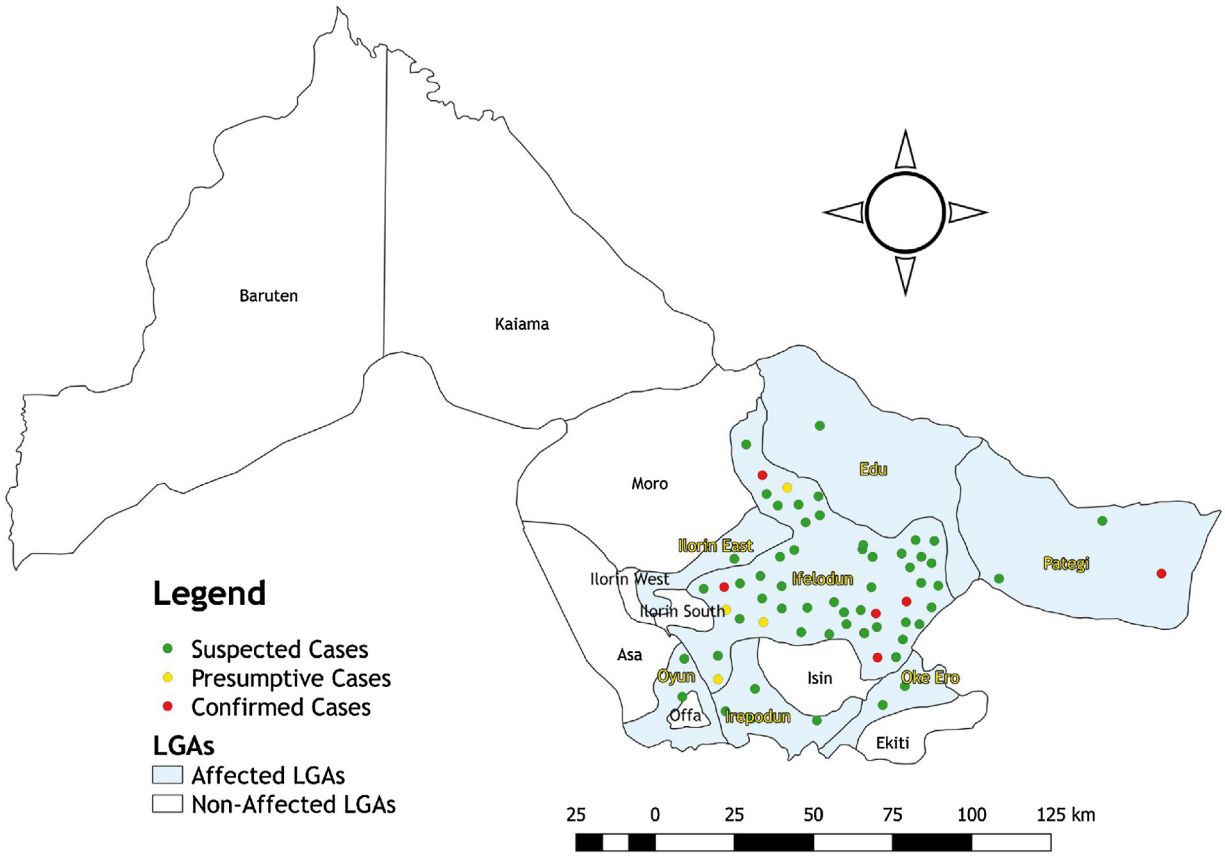

Figure 6. Map showing yellow fever cases by LGA in Kwara state 18th September–6th October, 2017.

Verbal autopsy

The verbal autopsy of deaths among people with similar symptoms revealed 26 deaths, of which 76.9% were males, and this occurred mostly among the age group 6–10 years (42.3%). Of these, 25 deaths (95.6%) were among people with no formal education. Ifelodun LGA had the highest mortality of 21 (80.8%), of which 18 were in nomadic populations. Twelve (65.0%) deaths took place at home while only six died in a hospital. A total of 24 graves were sighted by the teams. All graves sighted were in Ifelodun LGA.

Following the deployment of various channels of communication, the RRT observed improved environmental sanitation activities and active involvement of traditional leaders in the dissemination of key messages. There was an observed increased mobilisation of the community members during the mass vaccination campaigns. At the health facilities, there was improved

Table 2
Demographic characteristics of children assessed for Rapid YF vaccination coverage survey in Kwara State Nigeria, July to October 2017.

Variable	Frequency (N = 109)	Percentage (100.0%)
Age (Years)		
1	16	14.6
2	22	20.2
3	15	13.8
4	10	9.2
5	16	14.6
>5	30	27.6
Gender		
Male	60	55
Female	49	45
Location		
Rural	100	91.7
Semi-urban	3	2.8
Urban	6	5.5
LGA		
Ifelodun	74	67.9
Irepodun	10	9.2
Isin	8	7.3
Ilorin East	7	6.4
Oyun	5	4.6
Edu	3	2.8
Oke-Ore	2	1.8

Table 3
Entomological findings on larval indices in Kwara State YF outbreak September to October, 2017.

S/Number	Location	House index (%)	Container index (%)	Breteau index
1	Gaa Ibrahim	13.33	3.77	13.33
2	Gaa Alasoro	9.09	8.11	13.64
3	Gaa Labaka	0	0	0
4	Health facilities Oke-ode	30	19.05	40
5	Oro-Ago Town	18.6	11.11	27.91
6	Gidan Alhaji M. Dogo	5.26	2.56	5.26
7	Ajegunle	11.5	7.4	23.07

High Larval Index = House Index ≥5% and/or Breteau index ≥20; Low Larval Index = House Index <5% and/or Breteau Index <20.

reception of patients by care givers, and hospital beds were fitted with insecticide treated nets.

Discussion

A yellow fever outbreak occurred in Ifelodun LGA Kwara State, Nigeria, between July and October, 2017, the first confirmed cases of yellow fever in Nigeria for 21 years. The outbreak investigation led to the identification of 55 suspected cases. Out of this, eleven were in-country presumptive and inconclusive cases, and seven were confirmed in the WHO regional reference laboratory. Evidence from the results of the verbal autopsy above showed that the burden of the disease was probably higher than initially reported and may have been due to delay in diagnosis. The outbreak was first described as a “strange illness” with various diagnoses including Lassa fever made before the diagnosis of yellow fever was finally confirmed. Other challenges faced during this outbreak include a low index of suspicion of yellow fever, poor reporting of cases and fear of treatment of cases among healthcare workers. This underscores the need for training and improving the knowledge of yellow fever in health workers.

In addition to the 55 suspected cases above, there were rumours of other cases rejected at the healthcare facilities, with no documentation to support these cases. Some other cases were managed by traditional healers, the number of which could not be substantiated. Also, the long period of 21 years following the last confirmed case of YF in Nigeria could be attributed to the low index of suspicion observed among health care givers and invariably non testing of samples for yellow fever. In Kwara State, the average administrative yellow fever vaccination coverage for Ifelodun LGA from 2012 to 2016 was 87.6% peaking at 127% in 2016. However, the rapid community yellow fever vaccination coverage survey conducted by the outbreak response team requiring that vaccination cards be produced, gave a figure of 46% in all LGAs and 25% in Ifelodun LGA. The difference in the administrative and survey figures brings into question the validity of the administrative vaccination coverage data in Kwara State. The most affected community was a nomadic population with a low routine immunisation uptake, living in hard-to-reach areas, displaying poor health-seeking behavour, with associated poor geographical access to health care.

A yellow fever outbreak was last confirmed in Nigeria in the year 1996, this outbreak affected many parts of the country (Lucey and Gostin, 2016). There was no preventive mass vaccination campaign (PMVC) until 2013, when 8.1% of the 37 Nigerian States (including the Federal Capital Territory (FCT)) carried out yellow fever preventive mass vaccination campaigns. Yellow fever vaccine was introduced into the Nigerian routine immunisation schedule in 2003 but its use was initially limited to high-risk populations. Full introduction took place in 2004 and since then, three series of yellow fever national routine immunisation coverage surveys have been conducted, in 2006, 2010 and 2016. The results of these surveys showed coverage of 27.2%, 60.1% and 39% respectively. These low coverage levels have probably resulted in the accumulation of a susceptible population — a known trigger for outbreaks (Obi, 2016). This is similar to the situation in Angola, which experienced a large outbreak of yellow fever in 2016 (WHO, 2016).

The entomological survey showed the presence of yellow fever vectors, the Aedes species. The sylvatic (*Aedes africanus* and *Aedes luteocephalus*) and urban (*Aedes aegypti*) yellow fever vectors were established in Ifelodun LGA. Hence, with the presence of the vectors, unimmunised individuals are at risk.

According to WHO, there are four categories of prioritisation based on the vector abundance demonstrated by the level of larval indices. Priority 1: localities where an outbreak has occurred; priority 2: localities with high larval indices (House Index ≥5% and/or Breteau Index ≥20); priority 3: localities with relatively low larval indices (House Index <5% and/or Breteau Index <20); priority 4: localities with no report of the disease and low *Aedes* densities.

Areas that fall under priorities 1 and 2 are considered high risk areas, while those that fall under priorities 3 and 4 are considered low risk areas. Based on these entomological findings from the survey, Ifelodun and its environs are located in high risk areas with high yellow fever vector density. This can serve as a guide for good planning and rational management of vaccination campaigns.

Upon notification of a confirmed case of yellow fever in Nigeria by the NCDC, the International Health Regulations (IHR) focal point in line with the IHR (2005) sent official notification to the World Health Organization of a confirmed case of yellow fever in Ifelodun LGA of Kwara State on the 15 September 2017. Following the country’s official notification of the re-occurrence of yellow fever outbreaks in Kwara State, the National multi-agency yellow fever incident management system (IMS) was activated to coordinate the response activities. The IMS support to the outbreak response was critical in facilitating the quick success of the response. Through this emergency operation centre (EOC) activation, all other State Epidemiologists in Nigeria were informed of the re-occurrence of yellow fever and surveillance was intensified in all the states of the country. This was likely to have led to the reporting

of cases from other states like Kogi and Zamfara and effective coordination of the outbreak in all the affected states.

Following the deployment of the national RRT to support the Kwara State, the state EOC was also activated to coordinate the response activities at the state level. State advocacy visits and training of clinicians in case management were intensified. The initial International Coordination Group (ICG) on vaccine provision for yellow fever reactive vaccination request was made on the 26th September 2017. Subsequent to the approval of the ICG request, the first series of yellow fever reactive mass vaccination campaigns in the affected LGA and its contiguous LGAs were implemented from 11th to 20th October 2017. The second yellow fever reactive mass vaccination campaign was implemented in two LGAs (Pategi and Edu) on the 7th–18th December, 2017.

Subsequent to this, a national risk analysis for yellow fever was reviewed. The states reporting confirmed yellow fever cases were prioritised and scheduled for preventive mass vaccination campaigns which were implemented in all the remaining wards and LGAs of Kwara State on the 18th–27th January 2018

Limitations to the study

The Team observed a very low index of suspicion of yellow fever among healthcare providers that led to late confirmation of the disease as well as rejection of cases at the health facilities and lack of data from cases managed by the traditional healers. The long period (21 years) of no confirmed case of yellow fever in Nigeria accounted for the low index of suspicion and also affected the performance indicators. Diagnostic challenges include time lag in the sample collection and transportation to the in-country laboratory, testing and confirmation. The use of PCR in samples collected beyond 10 days after the date of onset of the illness might have given false negative results on some PCR tests. There were no tools to measure the risk communication activities.

Conclusion

This article describes the re-emergence of yellow fever in Kwara State in Nigeria following confirmed case of yellow fever in Ifelodun LGA in Kwara, 21 years after the last outbreak in Nigeria. The young adult–aged group and males were mostly affected. There was low routine yellow fever vaccine coverage over several years in the area and a long delay from the last vaccination campaigns.

We recommend training of healthcare workers to ensure a high index of suspicion for yellow fever for early detection and reporting of cases, use of universal care precautions while treating patients, and acceptance of yellow fever patients in health facilities. It is also important for the relevant government health institutions to strengthen YF surveillance and improve YF vaccination (routine immunisation, preventive mass campaigns and yellow fever vaccination to travellers). It is recommended that states carry out sensitisation and social mobilisation to increase awareness on the prevention, signs and symptoms as well as treatment options for yellow fever. YF risk communication activities should be sustained to prevent large urban outbreaks of yellow fever in Nigeria.

Conflict of interest

There are is no relationships/conditions/circumstances that present a potential conflict of interest for this manuscript.

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Ethical consideration

The manuscript was reviewed and approved by both the Kwara State Ministry of Health through the Director of Public of Health and the Chief Executive Officer of the Nigeria Centre for Disease Control and these institutions have been acknowledged. Although the study was part of response activities to an outbreak, participation was voluntary, Patients’ confidentiality was maintained as this was stated in the study instrument. The process was fully explained to the respondents, and proper interpretation made to those respondents who do not understand the English language. All respondents gave their consent before administration of data tools.

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