Yellow fever vaccination in Nigeria: focus on Oyo State

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Abstract

Background: National vaccination campaigns prevented yellow fever virus epidemics in Nigeria. A build-up of *Aedes aegypti* mosquitoes have been found in parts of the rain forest region that was the hotbed of previous epidemics. This study provides information on the annual vaccination counts in some major vaccination centers, vaccination status of some patients visiting the hospital for malaria and typhoid tests; and the vector density.
Methods: *Aedes aegypti* were caught from two locations in Ibadan between May 2013 and June 2014. Structured questionnaires were administered to patients visiting Adeoyo Hospital Yemetu Ibadan with secondary data collected from three major vaccination centres.
Results: Out of 801 patients visiting Adeoyo specialist hospital Yemetu for malaria parasite examination and widal tests, 799 had no yellow fever vaccination. The childhood YFV vaccination coverage was 40%, 73 %and 63% in 2012, 2013 and 2014 respectively. Two hundred and thirty-six *Aedes aegypti* were caught intermittently, over a period of fourteen months.
Conclusion: A lot of people in Oyo State are unvaccinated. The steady presence of Aedes aegypti underscores the risk of yellow fever hence the need for sustained surveillance. Indiscriminate discarding of hollow containers has immensely increased breeding of the vectors and should be discouraged.

Keywords: Yellow fever, vaccination, Aedes aegypti, Nigeria.

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Introduction

Yellow fever virus is endemic in 44 countries in Africa and Latin America.[1] In Africa, it circulates in both urban and forest cycles. Periodically, during major epidemics, it exits the endemic pattern to infect large number of unimmunized persons. [2] RNA oligonucleotide mapping has shown three genetically distinct geographical variants in Africa which include; Senegal-Gambia, Ivory Coast-Burkina Faso-Nigeria, Central and East Africa variants. [3] In May 2003, an outbreak of fatal hemorrhagic fever occurred in southern Sudan. [4] By 2012, cases of yellow fever were reported in six districts in Northern Cameroon. Later in that year, concerted efforts to curb the spread of the epidemic led to mass vaccination campaign which was collectively embarked on by the Global Alliance for Vaccine Initiative, United Nations Central Emergency Response Fund and the International Coordinating Group on Yellow Fever Vaccine Provision targeting the eight high-risk districts in Northern Cameroon. In the same year, the Ministry of Health in Ghana reported outbreaks of yellow fever in three different districts. [5] An estimated 84,000 – 170,000 severe cases and 29,000 – 60,000 deaths were reported in Africa in 2013.[1] Prior to this time, YFV endemic countries were advised to incorporate yellow fever vaccine into the routine activities of the national immunization programme, and this decision was endorsed by a joint World Health Organization (WHO) and the United Nations Children's Fund Technical Group on Immunization in Africa. [6] Yellow fever vaccine previously suffered from poor thermo-stability but improved stabilizers were added to increase the shelf life for up to two years at a temperature of -20°C or +4°C. [7] Although an effective vaccine now exists, [8] the virus remains a major public health threat in Africa where vaccination is limited by poverty, civil wars, and inaccessibility of rural areas where disease outbreaks occur. [3] In Nigeria, there is lack of surveillance data and no early warning and response network. Between 1986 and 1990, Nigeria reported 16,230 cases of yellow fever during an outbreak in 19 states.[9] Epidemiological investigations suggest the actual number of cases was 4-90 times higher than reported figures, with a case fatality rate of over 80% in children under 10years of age.[9] Although infants are vaccinated routinely as a component of the Expanded Programme on Immunization, most immunized adults are vaccinated in a bid to embark on overseas trips. Others acquire cross-reactive antibodies from other circulating flaviviruses. This study investigated the number of infantile

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vaccinations in dedicated hospitals in Ibadan and the relative abundance of *Aedes aegypti* in Ibadan.

Materials and Methods

Study Design: Approval was obtained from UI/UCH ethics board, Oyo State Ministry of Health Ethics Board and the National Parks Service. One mosquito scout caught day-time-biting mosquitoes thrice in Agodi and University of Ibadan environs by employing human bait method or stationary direct landing catches. Only adult *Aedes aegypti* were caught throughout the sampling period from 2012 to 2014 (Fig. 1). *Aedes aegypti* were sorted morphologically in the Department of Virology, University of Ibadan. Vaccination records were reviewed from the University Health Services and Institute of Child Health (both belonging to the University of Ibadan but situated about 10km apart) and Adeoyo Hospital Yemetu - Ibadan. Structured questionnaires were administered to 801 patients visiting Adeoyo Hospital for malaria parasite examination and widal test from April to November 2014. With a projected 185million people from the 2006 population census, a routine annual immunization target of 4% was made (which is 7.4million children). The monthly target population of Ibadan North Local Government Areas for YFV vaccination is 414,508. The 2015 target population figures was used, where annual target population for the three centres studied was 4,460. Monthly target populations were 58, 35 and 279 for ICH, University Health Services (Jaja Clinic) and Adeoyo Hospital respectively.

Results

Diurnal mosquito activity was evident within 15km radius from the University of Ibadan environs to Agodi in Ibadan North LGA and in areas with bamboo located off the course of the drainage in the mechanic workshop beside Agodi.

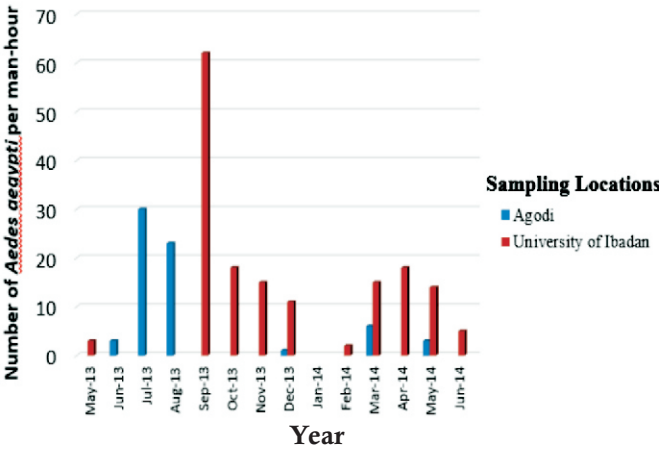

Figure 1. Density of *Aedes aegypti* caught in Ibadan from May 2013 to June 2014

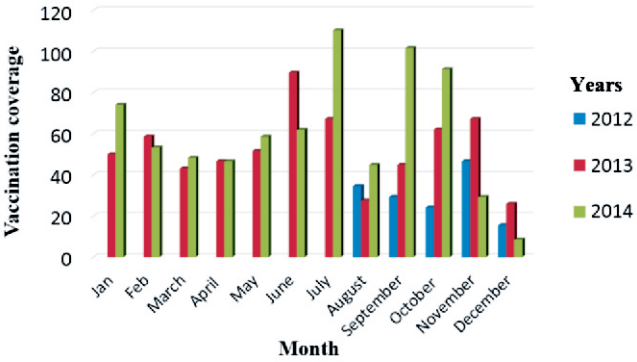

Fig. 2. YFV Vaccination coverage of children visiting the Institute of Child Health from 2012 to 2014

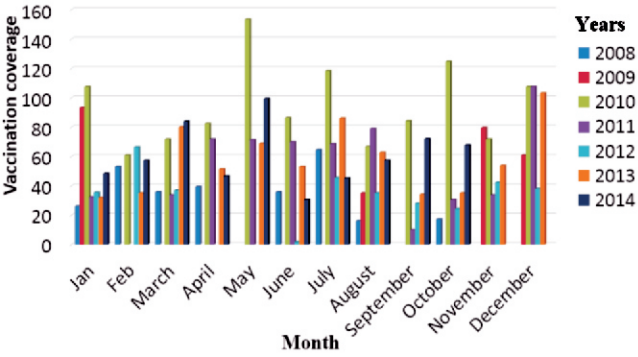

Fig. 3. YFV Vaccination coverage of children visiting Adeoyo Maternity Hospital Yemetu, Ibadan from 2008 to 2014

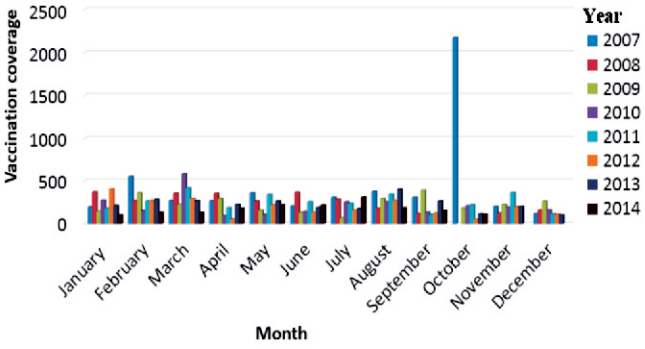

Fig. 4. YFV Vaccination coverage of children visiting University of Ibadan Health Services (Jaja Clinic) between 2007 and 2014

Out of 801 patients with visiting the hospital for malaria parasite examination and widal tests in Ibadan, 799 had no yellow fever vaccination while 751 had been bitten by day-time-biting mosquitoes. The vaccination coverage in Ibadan LGA was 445%, 54.5%, 50.9%, 121%, 83.5%, 39.9%, 72.8% and 63.7% in 2007, 2008, 2009, 2010, 2011, 2012, 2013 and 2014 respectively. Figures 2-4 show the coverage in major hospitals in Ibadan. Two hundred and thirty-six *Aedes aegypti* were caught among other *Aedes species.* Mosquitoes were spasmodically collected between the hours of 3:00pm and 7:00pm.

Discussion

The steady presence of *Ae. aegypti* found in this study (Fig. 1) is worrisome. It has been shown that in the presence of high population density, an incompetent mosquito vector can initiate and maintain YFV transmission resulting in an epidemic. [10] This is coming when international concern has risen following an increase in the number of infections in Africa [11] especially because of the large number of Africans travelling across the globe. Although man is a dead-end host, the virus is able to replicate in the mosquito vector - *Aedes aegypti* after ingesting an infected blood meal and this cycle of replication continues until it gets into the salivary glands from where further transmission to new susceptible host is made possible. Primary transmission cycle (sylvatic) involves nonhuman primates and tree hole–breeding mosquitoes while the urban cycle requires human exposure to infected mosquitoes. [12] In most parts of southwest Nigeria (which falls within the rainforest region), there are several hollow trees which are scattered everywhere that breed the vectors. Cut bamboos stems collect water, thereby increasing breeding sites and facilitating the process. Taking a cue from a successful 20 year national campaign of *Ae. aegypti* eradication in Brazil. [13] It is possible to put in place environmental health strategies that will reduce the number of this vectors in Ibadan. When the program was jettisoned for some reasons it led to re-emergence of YFV in the Central and Southeast Regions of Brazil, causing 51 cases and 21 deaths from 2008-2009. [14] This situation is an indication of the likelihood of epidemics, if the vectors are able to get infected and maintain the YFV hence the need for sustained surveillance in *Ae. aegypti* and humans.

In 1994, Nigeria had the highest number of yellow fever cases with 20,337 reports which made the WHO to place her on the top list of thirty-four high priority countries that needed YF vaccination to be included into the EPI. The YF immunization coverage of 1993 was 1% although no vaccination record was available for 1994 and 1995.[2] In this current study, vaccination count before 2012 could not be retrieved from ICH. On the other hand, the National Primary Health Care Development Agency provided registers for proper documentation which enhanced vaccination-record keeping in Adeoyo Maternity Hospital and University of Ibadan Health Service. The number of patient enrollment in these two hospitals was very high because of the close proximity to the urban population hence the higher vaccination count. In the ICH, the major factor responsible for the abysmal count is her location within the University College Hospital which is acclaimed to be an elitist facility. However, with the high birth rate in Ibadan like in many parts of Nigeria, YF immunization count is not enough to provide herd immunity. Also, there are so many ill-equipped primary health centres that do not routinely vaccinate against YFV which would have increased the vaccination count. In rural areas of Oyo State, the far distance from the central vaccine store leads to irregular or non-existent vaccine supply. In addition, steady power supply is required to maintain cold chain of the vaccine. This is not guaranteed and inadvertently jeopardizes vaccination efforts. Gambia had a successful immunization progamme with combined strategy which included mass immunization coverage of 95% of the population in 1978-1979 followed by preventive vaccination in the EPI which reached 87% of infants. [15]

Ibadan is one of the largest cities in Nigeria and like other States has one designated port health centre where adult yellow fever vaccinations are carried out. This is in line with the Revised 2005 international health regulations of the WHO. The 55th National Council on Health resolved in 2012 that administration of vaccines and issuance of yellow cards should be done by the Port Health Services Division of the Federal Ministry of Health offices nationwide. [16] This decision was as a result of persistent procurement of fake cards by unvaccinated Nigerians which led to a diplomatic row between the South African and Nigeria governments. Considering the large population of Nigeria, there is the need to increase yellow fever vaccination points for adults to include facilities in Tertiary institutions and State-owned hospitals. The increased vector activity in this current study reinforces the need for more vaccination points especially as the last vaccination campaign was over two decades ago. It does not preclude the Port Health Authority from certifying vaccinated individuals who wish to travel overseas. Many rural and urban areas are at risk of yellow fever with the extensive geographical coverage of the tropical rain forest and savannah areas that are known to breed the vectors (Fig. 1.). Concerns of the possible yellow fever epidemics have been predicted because of increased activity of *Ae. aegypti* in southeast Nigeria. [17] This is pertinent because within two decades of cessation of vaccination campaigns, Cameroon started experiencing serious yellow fever epidemics, [18, 19] most of which remained unknown. [20] Genetic data further suggests that yellow fever virus is endemic in East and Central Africa, with outbreaks occurring as a result of favorable environmental conditions. [21] The fact that the isolates from Sudan were closely related to an isolate obtained 10 years ago in Kenya supports the contention that yellow fever is endemic in East Africa and has the potential to cause large outbreaks when conditions favor transmission to humans. [4] In this present study, we observed that many city dwellers in Ibadan were exposed to bites of *Ae. aegypti,* a known vector of urban cycles of yellow fever infection. Poor environmental hygiene,

indiscriminate discarding of tyres and hollow plastic containers with accumulation of stagnant water are common and serve as mosquito breeding sites. *Ae. aegypti* readily enters human habitations and takes multiple blood meals during each gonotrophic cycle for both egg production and general nutrition, these behaviors increase vector competence and transmission to multiple human hosts. [22, 23] In rural areas of Ibadan, people encroach into bushes to fetch firewood for cooking while hunters go into the forest to hunt game where sylvatic vectors abound. Also, increasing developmental projects cause lumber-jack activities to increase there and all these activate the sylvatic cycles of yellow fever infection which later may result in urban transmission.

Conclusion

Taken together, the steady presence of *Ae. aegypti* in this study shows a long period of vector activity in Ibadan and by extension the rain forest region of west Africa. The number of childhood vaccination in Ibadan is very low, despite the high birth rate which is the situation in many states in Nigeria. The port health vaccination centres alone cannot support the large population of adult Nigerians in need of YF vaccination. Cases of yellow fever in neighboring countries such as Cameroun, Sudan, Ghana highlight the need to embark on another national vaccination campaign to avert impending national disaster. Vaccination is strongly recommended for travelers who visit Nigeria. This study serves as an early warning of the likelihood of future YF infections and/or epidemics and it is important to inform all the policy makers and international vaccination centres about the impending danger.

Limitation of the study

Presence Aedes aegypti does not necessarily mean they transmit YFV, as molecular investigation was not done.

Conflict of Interest

We declare that there is no conflict of interest.

Acknowledgment

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