



## Editorial

## Why is the yellow fever outbreak in Angola a ‘threat to the entire world’?



The short answer to the World Health Organization (WHO) declaration is because yellow fever has spread throughout the country, causing probably thousands of cases and hundreds of deaths, and the world has run out of vaccine. This is very bad because cases so far have been imported into the Democratic Republic of the Congo (DRC), Mauritania, Kenya, and even China, the first time in history that cases have been confirmed in Asia. In fact, more travelers infected with yellow fever have now been seen than in the last 50 years, each one with the potential to spread it on arrival, and still further to more countries worldwide via international airlines. This will require more vaccine; but supplies cannot be rapidly boosted.

Angola discovered its first urban cases in December 2015, and is struggling to complete vaccination of the capital, Luanda. More than 10 million more doses are needed to cover the rest of the country completely. The longer the delay in getting them to Angola, the more people will become infected and many will die.

The more immediate problem is the DRC. First cases in Angolan visitors to the capital, Kinshasa, were reported on April 11, by which time it had spread to at least one Congolese resident, signifying the tip of the iceberg. Without mass vaccination there is no way to stop it spreading the way it has in Luanda. Kinshasa has 196 weekly international flights, most via Johannesburg, South Africa. The potential for export is enormous.

## 1. Historical epidemics

In schools, they no longer teach the history of the huge yellow fever epidemics that went around the world with the sailing ships, when port cities with much smaller populations than now were devastated. The disease was carried by *Aedes aegypti* mosquitoes breeding in freshwater kegs on board and cycled among the slaves below deck, and both humans and mosquitoes disembarked on arrival to spread havoc.

For example, in the Americas, yellow fever broke out in New York (1668), Boston (1691), and Charleston (1699), and yellow fever epidemics claimed thousands of victims in major cities of 13 eastern and southern states: Philadelphia (1793,  $n = 4044$  fatal; and again in 1798,  $n = 3506$  fatal), Baltimore (1794,  $n = 360$  fatal; and again in 1800,  $n = 1197$  fatal), New York City again (1798 and 1803), Galveston (1839, when 5% of the population died), Memphis and New Orleans (1878–79,  $n = 4046$  fatal), where the last US

outbreak was recorded (1905,  $n = 8399$  cases). These outbreaks brought terrible social and economic disruption. Between 1897 and 1906, 4000 European immigrants died in Rio de Janeiro, Brazil from yellow fever. Extrapolating these death rates to the current size of those cities gives some idea of the threat.

In Europe, Spanish ports in 1800 recorded 60 000 fatal cases, and in 1821, Barcelona reported 20 000 deaths (one-sixth of the inhabitants) and more in 1870 related to a ship arriving from Cuba. Other outbreaks occurred in France (1802 and 1861), Italy (1804 Livorno,  $n = 650$  fatal), Portugal (1857 Oporto and Lisbon), the UK (1852 and 1865 Swansea), and Gibraltar (1828,  $n = 1183$  fatal). The last outbreak in Europe occurred just over 100 years ago in Gibraltar in 1905, but it could now come back.

In Africa, more recently, an urban yellow fever outbreak in 1986–87 in Nigeria caused an estimated 120 000 cases and 24 000 deaths, more than the Ebola epidemic in three other West African countries. In an unvaccinated population, the case fatality rate of yellow fever can be as high as 75%. Uganda is reporting a rural outbreak currently, which it is hoped will not spread to the capital. Nowadays, epidemics go around the world in air traffic, which carries even more bodies than the slave trade ever did – each day a number of passengers as great as the entire population of Austria are in transit by air.

Of course, not all the cities mentioned above are infested with *A. aegypti*, but some are, and it is not just coastal cities that are at risk today; airports have replaced ocean ports as major hubs. *A. aegypti* also transmits dengue, so wherever there is endemic dengue, yellow fever can spread, including most of India and much of Southeast Asia, Latin America, and the Caribbean. Peru Bolivia and Brazil are currently reporting rural outbreaks that hopefully will not spread to their capitals.

## 2. Mosquito control

Mosquito control is not the answer. If it worked, dengue would not be such a problem in the tropics. Because *A. aegypti* is day-biting, bed-nets are only useful for preventing the spread to those who are caring for bedridden patients. However, any action to reduce the numbers of the vector would of course help. When buses and heavy goods traffic are crossing borders from an infected region, it would be good practice to spray them inside to kill any mosquitoes. While travelers are waiting for vaccination (see below), indoor spraying should be done in the buildings or camps where they stay and places where they eat.

### 3. Border controls

There is currently an outbreak in Uganda originating in the DRC/Rwanda forest, with no health controls on entry to Uganda, but the two major crossing points on the Uganda/Kenya border have been blocked by both countries demanding yellow fever vaccination certificates. However, there are many uncontrolled border crossings, and according to the Kenya *Daily Nation*, border officials were using brokers to collect money from every bus passenger without a vaccination certificate and let them travel on unvaccinated, totally defeating the intended control measures.

The longer people are stuck at the border, the greater the risk that a yellow fever-infected person will get there from the DRC or Rwanda, and mosquitoes will spread it to the Kenya side. Then when they are released, travelers will spread it all over both countries, to Kampala and Nairobi first, and then Dar-es-Salaam and from those international airports to the world. It is essential to vaccinate at those crossing points and then let the people go. If they are held there for another 10 days – which would be desirable from a public health point of view to let the vaccine take its full effect – it would only increase the risk of their getting infected.

### 4. Vaccination

In the final analysis, the vaccine is the only recourse. There could be a solution. Studies have shown that the vaccine is so potent that one-fifth of a dose immunizes just as well – so an existing five-dose vial could protect 25 people. The WHO has the authority to declare temporary use of the lower dose, which would usefully stretch the supply. Next, priority should be given to vaccinating health and essential services personnel, to keep hospitals and clinics, power, water, transport, and communications functioning.

However, vaccination cannot be done without cold boxes and transport for distribution, syringes to apply it, staff to administer it, and aircraft and logistics to deliver it to countries where

commercial airlines interrupt service. All these were provided by the United Nations agencies to combat the Ebola epidemic. The WHO is still suffering from serious, chronic understaffing and underfunding, whereas the United Nations has money and a number of relevant relief agencies to call on. Perhaps that is the way to go, with WHO expertise for guidance rather than execution.

The USA is even today spending far more on precautions against the importation of Ebola than it has spent in West Africa previously. New York City just announced a 3-year, \$21 million plan to protect New Yorkers from the Zika virus. Imagine how much of that could have been saved by putting just one-tenth of the money into the prevention of Ebola and Zika at the source. Recalling that pennies spent on prevention at source save thousands of dollars in treatment at home, we call on international donors to respond rapidly to this developing emergency before it becomes a global crisis.

ProMED-mail (<http://www.promedmail.org>) is providing timely coverage as the outbreak grows and spreads, citing local press reports and WHO situation updates. It would be far better for ProMED-mail to be able to report vigorous international response and more available vaccine. Without those, the problem will only get worse.

Every day that goes by now, people are dying from yellow fever. The clock is ticking.

J.P. Woodall<sup>a,\*</sup>

T.M. Yuill<sup>b</sup>

<sup>a</sup>*ProMED, International Society for Infectious Diseases, Brookline, Massachusetts, USA*

<sup>b</sup>*Department of Pathobiological Sciences and of Forest and Wildlife Ecology, University of Wisconsin-Madison, Madison, Wisconsin, USA*

*E-mail address: [jackwoodall13@gmail.com](mailto:jackwoodall13@gmail.com) (J.P. Woodall).*

Accepted 3 May 2016