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Infectious Diseases Outbreaks: Yellow Fever in Central Africa

Introduction

Since 1980, emerging infectious diseases (EID) have resulted in more frequent outbreaks that are causing higher numbers of human infections. EID are either new diseases or existing ones that have emerged in new areas. In recent decades, *new* EID have included Severe Acute Respiratory Syndrome (SARS) and HIV/AIDS. EID that have spread to *new geographical areas* have included yellow fever and Zika. Zoonotic pathogens (organisms that spread from animals to humans, often through a vector like a mosquito) sicken some 1 billion people annually, roughly 15 million of whom die. Notable EID outbreaks caused by zoonotic pathogens include SARS (2003), Avian Influenza H5N1 (2005), Pandemic Influenza H1N1 (2009), Middle East Respiratory Syndrome coronavirus (MERS-CoV, 2013), West Africa Ebola (2014), Zika (2015), and Central Africa Yellow Fever (2016) and South America Yellow Fever (2016-2017).

On average, Congress has provided about $130 million annually through regular appropriations to the U.S. Agency for International Development (USAID) and the U.S. Centers for Disease Control and Prevention (CDC) for global pandemic preparedness efforts. Emergency responses to EID outbreaks have varied, however, but tend to follow introduction of the disease into the United States. For example, the 114th Congress appropriated roughly $5 billion and $2 billion to help control the West Africa Ebola and Zika outbreaks, respectively, but other Congresses did not provide funds to address SARS or yellow fever outbreaks. Due to the unpredictable nature of EID outbreaks, some question whether Congress will continue to emphasize infectious diseases that reach the U.S. shores or whether the 115th Congress might develop a more proactive approach.

In January 2016, a yellow fever outbreak in Central Africa emerged in an urban area for the first time. It overwhelmed the capacity of the affected countries and subsequently caused an unprecedented number of illnesses and deaths. EID outbreaks are revealing not only the threat that weak health systems in developing countries pose to the world, but also are elucidating gaps in international frameworks for responding to global health crises. The central Africa yellow fever outbreak raises questions about what role the United States might play in addressing infectious disease outbreaks that are occurring at greater frequency and are threatening U.S. health security.

Background on Yellow Fever

Yellow fever is a disease transmitted by mosquitoes endemic in 47 countries across sub-Saharan Africa (SSA) and South America (see **Figure 1**). Roughly 90% of annual yellow fever cases occur in SSA. Many who contract the virus do not exhibit symptoms. Among symptomatic cases, victims often develop fever, nausea, muscle pain, and vomiting. In most instances, related symptoms resolve within four days. According to the CDC, roughly 15% of those who contract yellow fever develop severe symptoms, including organ failure. The "yellow" in the name of the disease refers to the jaundice—yellowing of the skin and whites of the eyes, often indicating liver damage—that typically occurs among severe cases. About half of those who experience severe yellow fever die within 10 days. While specific treatment for the virus does not exist, yellow fever can be prevented through vaccination. Eradication is not considered feasible, as the disease is also found in primates, from which mosquitos can transmit the disease to humans.

Yellow Fever Outbreak in Central Africa

Insufficient laboratory capacity in many of the areas where the disease is endemic and parallel symptoms caused by other common tropical diseases (e.g., malaria, dengue, and other hemorrhagic fevers) have limited the ability to estimate the annual cases and deaths. A modelling study conducted in 2013 estimated that 84,000-170,000 cases occurred in Africa during that year, including 29,000-60,000 deaths.

Angolan health officials reported a yellow fever outbreak to the World Health Organization (WHO) in January 2016. Yellow fever is endemic in Angola, but this was the first large-scale outbreak in 28 years. The last outbreak in the country occurred in 1988, with 37 cases and 14 deaths. Laboratory tests confirmed yellow fever among 884 of 4,347 samples collected between December 5, 2015, and October 20, 2016. Laboratory tests also indicated that 121 of 377 suspected deaths were caused by yellow fever.

The disease has spread from Angola to several countries, including Brazil, China, the Democratic Republic of Congo (DRC), and Kenya. The imported yellow fever cases in China and Kenya (11 and 2 cases, respectively) were quickly detected and did not spread further. In Brazil and the DRC, however, imported cases led to additional infections. Scientists are working to control the yellow fever outbreak in Brazil and have contained it in the DRC. Laboratory tests were conducted on 2,800 samples and indicated that 78 yellow fever cases, including 16 deaths, had occurred in the DRC from January 1 through October 26, 2016. WHO reported that 57 of the cases in the DRC were related to the Angola outbreak.

International Response

The unprecedented size of the central African yellow fever outbreak has raised concern among the international community about the pace at which EID outbreaks are occurring and overrunning global response structures. WHO Director-General Margaret Chan convened an

Emergency Committee meeting in May 2016 to discuss the yellow fever outbreak. She was particularly concerned about the urban spread of the disease (a first for Angola) and the risk of further spread across the region and the world. The committee concluded that the outbreak did not "constitute a Public Health Emergency of International Concern but is a serious public health event which warrants intensified national action with international support."

Infectious disease outbreaks in urban areas are a growing problem that is overwhelming long-standing international stopgap measures. For example, the WHO and several international organizations created the International Coordination Group on the Provision of Vaccines in 1997 to manage the production and distribution of vaccine stockpiles for cholera, meningitis, and yellow fever. The stockpile was created to avert the spread of deadly infectious disease outbreaks from countries without sufficient capacity to control them. In recent years, however, mosquito-borne outbreaks, including yellow fever, have taxed the global vaccine stockpile, even depleting it twice in 2016. A Brazilian manufacturer (Bio-Manguinhos) sent additional yellow fever vaccine doses to supplement the depleted stockpiles.

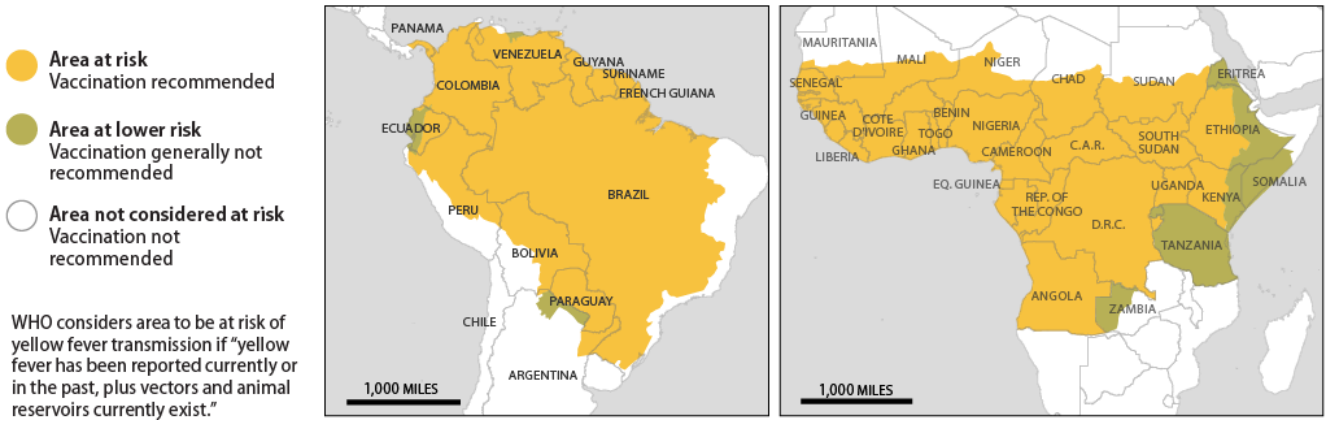
Yellow fever vaccine shortages forced WHO to employ a fractional dosing campaign, which used one-fifth of the standard yellow fever vaccine dose. Experts hoped that fractional dosing would provide sufficient protection to stop the spread of the diseases and last for at least one year. The strategy effectively controlled the outbreak, with Angola and the DRC having declared the outbreak over in December 2016 and February 2017, respectively. Experts caution, however, that the region remains vulnerable to future outbreaks because the disease is endemic to the area. WHO warns that detection of future outbreaks may be delayed by persistent deficiencies in disease surveillance and laboratory capacities in both countries.

Outlook

The accelerated pace at which EID outbreaks are occurring has overwhelmed international health networks and is raising questions about how the United States and other countries can address this challenge. The mass vaccination campaign to stop the central African yellow fever outbreak became the largest such effort in recent history, and trends indicate that other EID might require similar unprecedented responses. Issues raised by the outbreak include the following:

- **Global Risks**—Is the global risk of future yellow fever outbreaks increasing? WHO warns that the global risk of future yellow fever outbreaks is heightened by climate change, increased international trade and travel, and the resurgence of the *Aedes aegypti* mosquito (which can spread other tropical diseases, including chikungunya, dengue, and Zika).
- **International Preparedness**—Is the international community prepared to control additional EID outbreaks? Many poor countries lack the ability to detect, prevent, and contain infectious disease outbreaks, potentially exacerbating the reach of such outbreaks. Escalating urbanization further complicates efforts to control infectious disease threats, as curbing disease outbreaks in dense, urban areas is time- and resource-intensive. For example, more than 41,000 volunteers and 8,000 vaccination teams were enrolled to vaccinate some 30 million people against yellow fever in Angola, the DRC, and Uganda.
- **Congressional Response**—What approach might the 115th Congress consider going forward? Some groups advocate for deepening investments in global health system strengthening efforts worldwide, arguing that emergency responses require considerably more resources than preventive measures and that ignoring poor health conditions worldwide imperils global and domestic security. Others express concern about how broad-based health systems support could be adequately measured and monitored.

Figure 1. Areas at Risk of Yellow Fever Transmission: Sub-Saharan Africa and South America



Source: Adapted by CRS from CDC webpage on Yellow Fever at https://www.cdc.gov/yellowfever/, accessed on January 27, 2017.
Notes: Data for sub-Saharan Africa and Latin America were developed in July 2015 and March 2014, respectively.

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