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Infectious Disease Outbreaks: Yellow Fever in South America

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.

The reemergence of yellow fever in several South American countries is the latest event highlighting the global threat of EID outbreaks. The importation of the disease from Angola—where an outbreak of unprecedented proportions occurred in 2016—and the frequency at which EID outbreaks are spreading globally have sparked further concern. For more information on the outbreak in Angola, see CRS In Focus IF10603, *Infectious Diseases Outbreaks: Yellow Fever in Central Africa*, by Tiaji Salaam-Blyther. Moreover, some global health experts have expressed concerns about the vulnerability of the United States to EID (including yellow fever) and about the capacity of the international health system to control future outbreaks.

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 Outbreaks in South America

Yellow fever is reemerging in South America. It is sickening and killing primates and people in numbers not seen for decades. A growing number of cases are being detected in primates in forested areas across Argentina, Bolivia, Colombia, Guyana, Paraguay, Peru, Suriname, Uruguay, and Venezuela. Experts are tracking this phenomenon and working to avoid a scenario in which the disease moves from being transmitted by *Haemogogus* (forest-dwelling) mosquitos to *Aedes* (urban-dwelling) mosquitos. To date, most human cases in South America have been detected among people who either reside in or have traveled to forested or rural areas, including through ecotourism.

The scope of yellow fever outbreaks vary across the region:

- In Bolivia, Colombia, Ecuador, and Suriname, the disease was detected in ecotourists. These cases were rapidly detected and did not cause further transmission.
- A yellow fever outbreak that began in Peru in 2016 sickened 78 people and killed 26 of them. That outbreak was the largest seen in Peru since 2006. No new cases have been reported since February 2017.
- Brazil is working to contain an outbreak that began in 2016. Health experts are concerned about the continued spread of the disease across Brazil, particularly as outbreaks approach densely populated urban areas with populations who frequently travel throughout the region, including to the United States. As of April 20, 2017, the disease has infected 681 people in Brazil, 234 of whom have died. Health officials are investigating an additional 768 suspected cases and 35 deaths.

Yellow Fever Vaccination

In Brazil, most human yellow fever cases are occurring in parts of the country that had not been considered at risk of yellow fever transmission. The largest clusters of cases are in the states of Minas Gerais (471 confirmed cases and 252

cases under investigation) and Espirito Santo (185 confirmed cases and 289 cases under investigation). Most people in these areas were not vaccinated against the disease, and now local health officials are implementing mass vaccination campaigns in these areas.

Some health experts assert that Brazil and Peru experienced larger outbreaks than other South American countries because of their relatively low vaccination rates. The World Health Organization (WHO) recommends that at least 80% of a population receive yellow fever vaccinations to prevent outbreaks. By the end of 2015, roughly 46% of Brazilians and 67% of Peruvians were vaccinated. Meanwhile, its neighboring countries, which reported only isolated imported cases, exceeded WHO's vaccination guidelines (Bolivia, 91%; Colombia, 92%; Ecuador, 78%; and Suriname, 86%).

WHO and several international organizations created the International Coordination Group on the Provision of Vaccines (ICG) 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 2016, the global vaccine stockpile was depleted several times and was unable to meet the global need.

Yellow fever vaccine shortages forced WHO to employ a "fractional" dosing campaign during the 2016 central African yellow fever outbreak. Fractional doses use one-fifth of the standard dosage and provides protection against the disease for one year. Standard doses provide lifetime protection in most cases. Brazil, typically a yellow fever vaccine donor country, is reportedly considering using this strategy to contain the outbreak and has received 3.5 million doses from WHO.

Outlook

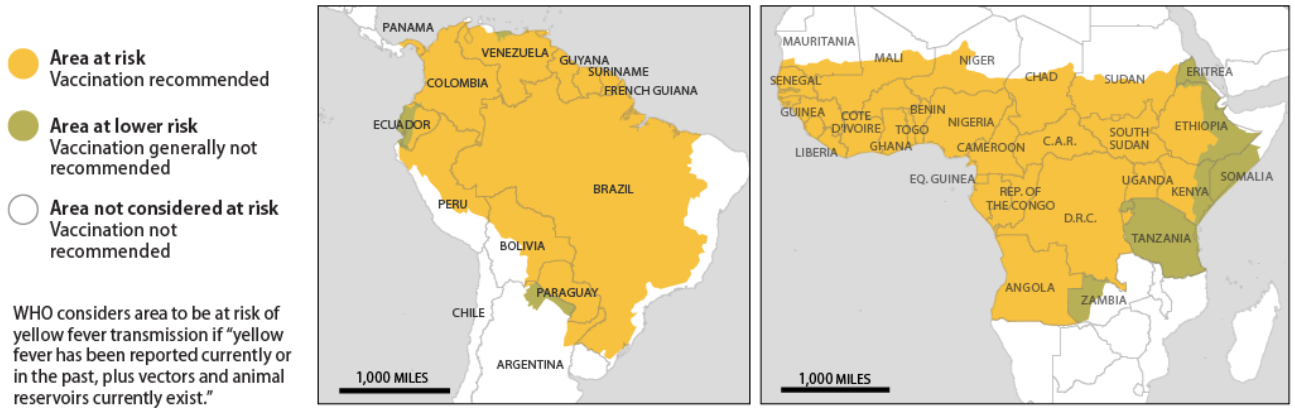
Recent EID outbreaks in South America are raising questions about how the United States and other countries can address this challenge. The mass vaccination campaign to stop the central African yellow fever outbreak was the largest such effort in recent history, and trends indicate that other EID might require similar responses. Questions abound, however, about whether sufficient resources exist globally to handle simultaneous outbreaks of a similar magnitude. Other issues raised by the outbreak include:

Global Risks—WHO has warned that the global risk of future yellow fever outbreaks is heightened by climate change, increased international trade and travel, and the resurgence of the urban-dwelling *Aedes* mosquito (which can spread other tropical diseases). Brazilian officials detected yellow fever, for example, in a person traveling from Angola. Almost 80% of South Americans live in urban areas, elevating the region's vulnerability to urban epidemics. Populations in the United States are also vulnerable to yellow fever, as many are not vaccinated against the disease.

International Preparedness—Many low- and middle-income countries (LMIC) lack the ability to detect, prevent, and contain EID outbreaks. Some observers worry that yellow fever transmission may be occurring in Venezuela, but that deteriorating conditions in the country limit detection and surveillance capacity. Health experts are also wary about the growing proportion of urbanization in LMIC that is driven by population growths in slum areas that lack adequate access to clean water and sanitation. Yellow fever cases in the states of Rio de Janeiro and San Paolo are troubling to health experts who fear a spread of the disease to major cities in the states where tens of millions of people live, many in informal settlements.

Congressional Response—Some groups advocate for more funding to strengthen health systems worldwide and improve pandemic preparedness efforts like the Global Health Security Agenda. They argue that emergency responses are more costly than preventive measures and assert that ignoring poor health conditions worldwide imperils health security. Others question how broad-based health systems support could be adequately measured and monitored, and argue for stronger political will in many LMIC to address the issue.

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 South America were developed in July 2015 and March 2014, respectively.

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