



Understanding Ebola: A Visual Guide

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<http://www.goinvo.com/features/ebola/>

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The 2014 Ebola outbreak is the most severe outbreak of **Ebola Virus Disease (EVD)** since the discovery of ebolaviruses in 1976. As of 22 October 2014, the WHO, CDC and local governments together have reported **a worldwide total of 9,964 suspected cases and 4,881 deaths (5,488 cases and 2,945 deaths having been laboratory confirmed)**. Many experts believe that the official numbers substantially understate the magnitude of the outbreak with true figures numbering 2.5 times as many cases as have been reported¹.

EBOLA CASES BY YEAR

EVD, formerly called Ebola hemorrhagic fever, was first identified in 1976 with two simultaneous outbreaks in Zaire (now the Democratic Republic of the Congo) and Sudan (South Sudan).^{2,24}

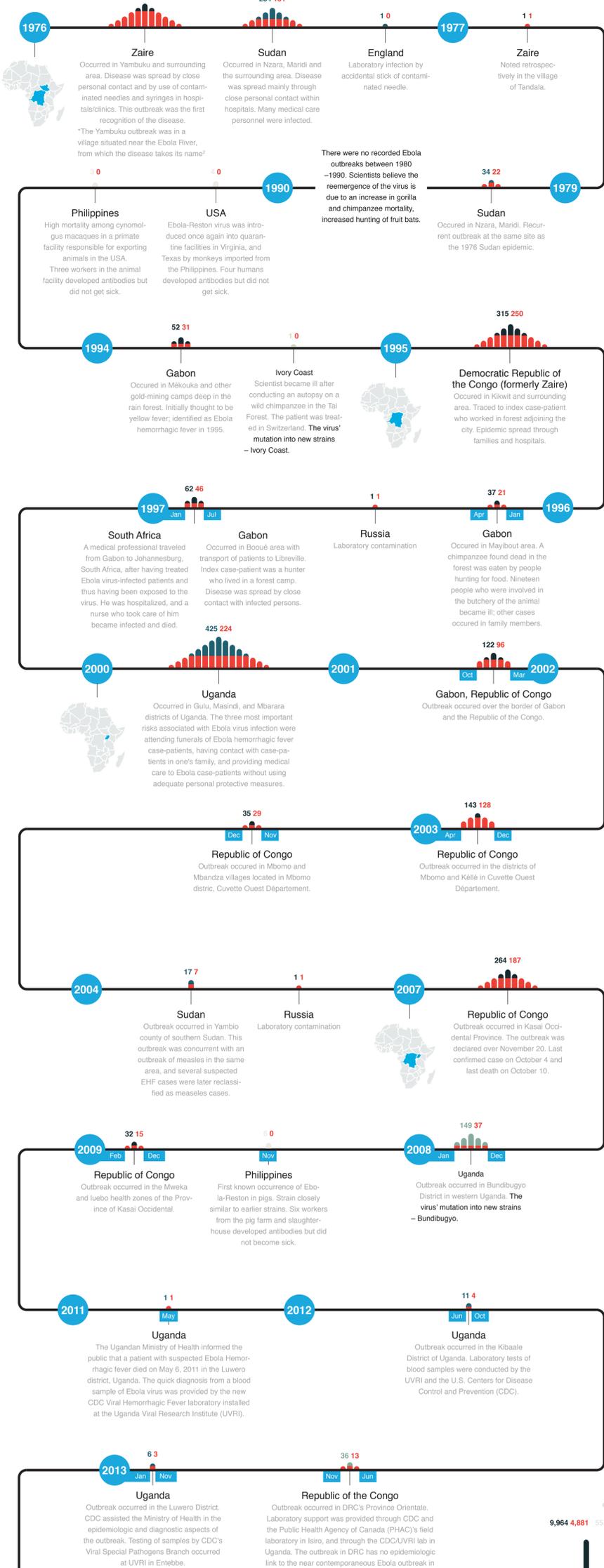
Ebola is caused by infection with a virus of the family Filoviridae, genus Ebolavirus. Five subtypes have been identified: **Zaire, Sudan, Bundibugyo, Ivory Coast (Taï Forest), and Reston.** Reston Ebola virus infects only non-human primates.^{3,24}



Seven countries have confirmed cases of the Ebola virus worldwide (five countries in West Africa).

Fruit bats, a delicacy for some West Africans, are considered to be virus's natural host.⁵

The illustration below describes **Ebola cases between 1976 and 2014**, with the number of infections and deaths:⁶



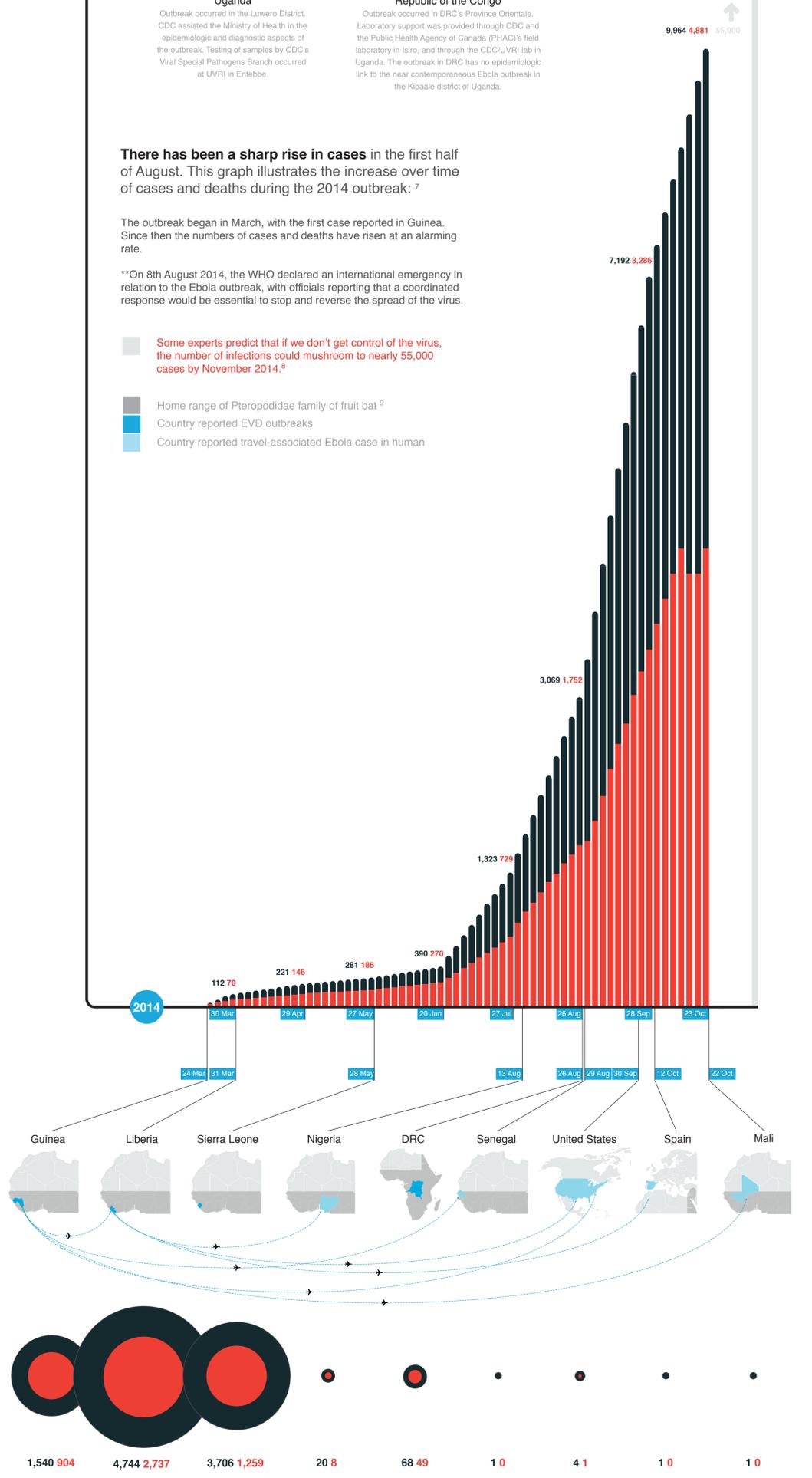
There has been a sharp rise in cases in the first half of August. This graph illustrates the increase over time of cases and deaths during the 2014 outbreak:⁷

The outbreak began in March, with the first case reported in Guinea. Since then the numbers of cases and deaths have risen at an alarming rate.

**On 8th August 2014, the WHO declared an international emergency in relation to the Ebola outbreak, with officials reporting that a coordinated response would be essential to stop and reverse the spread of the virus.

Some experts predict that if we don't get control of the virus, the number of infections could mushroom to nearly 55,000 cases by November 2014.⁸

Home range of Pteropodidae family of fruit bat⁹
Country reported EVD outbreaks
Country reported travel-associated Ebola case in human



The illustrations above describe **known cases and outbreaks of EVD, in chronological order** as of 22 October 2014, with the number of infections and deaths.

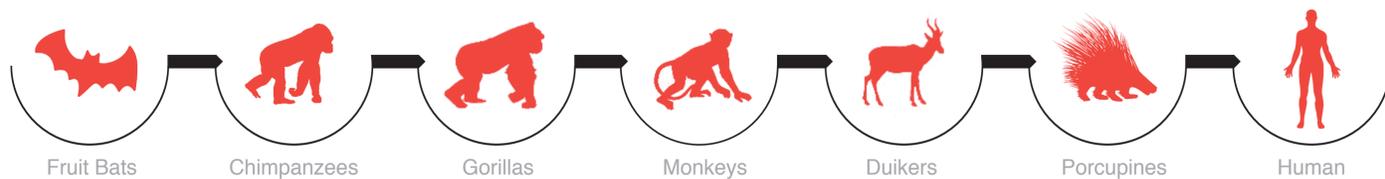
It began in Guinea in December 2013 and then spread to Liberia and Sierra Leone. A small outbreak of twenty cases occurred in Nigeria, and one case occurred in Senegal. Following a 42-day waiting period, both countries were declared disease-free as of 20 October 2014. Cases of secondary infections of medical workers in the United States and Spain have occurred, neither of which has yet spread to the general population. A single case has been identified in Mali as of 22 October 2014¹.

¹The outbreak in Democratic Republic of the Congo is unrelated to the current outbreak of Ebola in West Africa.

VIRUS TRANSMISSION

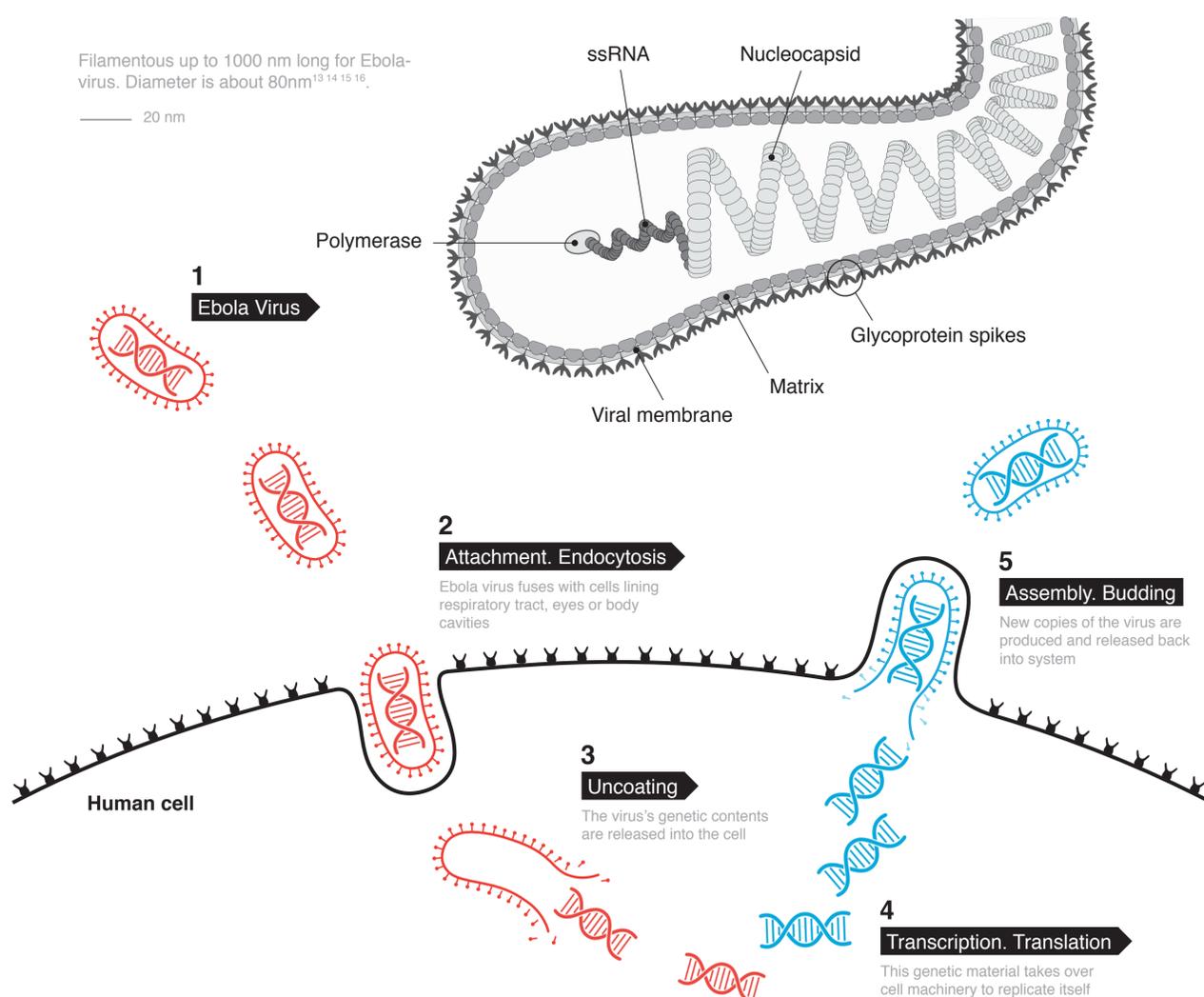
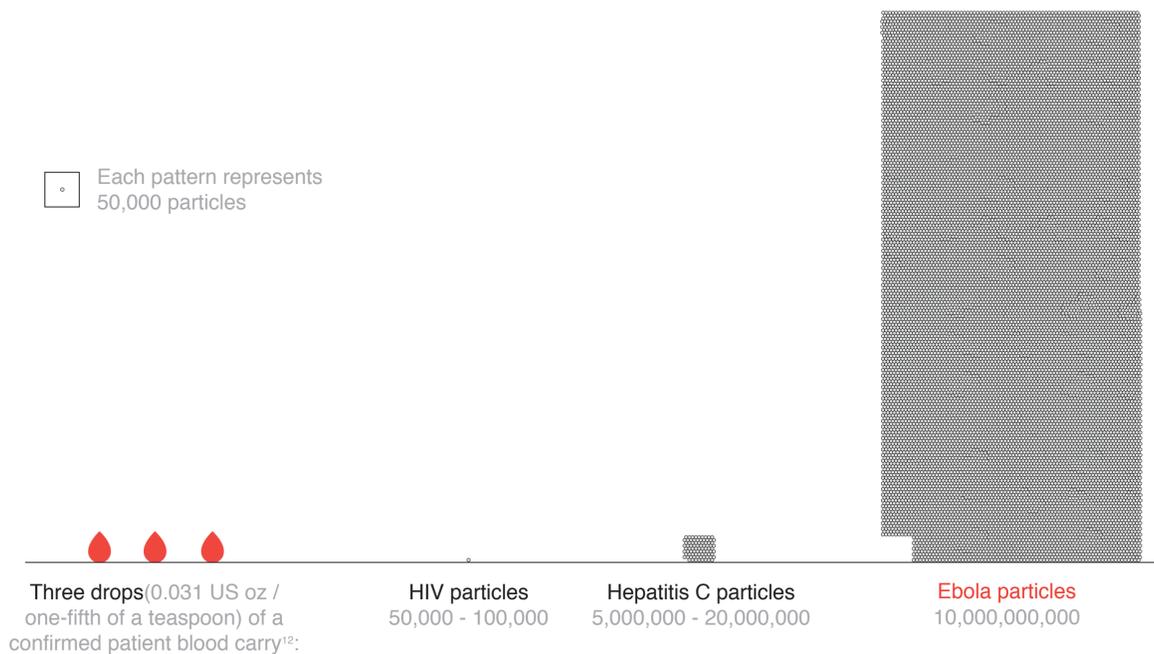
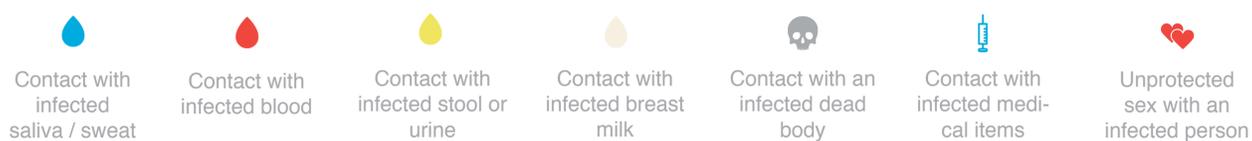
Ebola is introduced into the human population through contact with an infected animal. Ebola is spread through close and direct physical contact with infected bodily fluids, the most infectious being blood, faeces and vomit. The Ebola virus has also been detected in breast milk, urine and semen.

It is not entirely clear how an Ebola outbreak starts. **The initial infection is believed to occur after an Ebola virus is transmitted to a human by contact with an infected animal's body fluids.** Evidence strongly implicates bats as the reservoir hosts for ebolaviruses. Bats drop partially eaten fruits and pulp, then land mammals such as gorillas and duikers feed on these fallen fruits. This chain of events forms a possible indirect means of transmission from the natural host to animal populations¹.



Ebola then spreads in the community through human-to-human transmission, with infection resulting from direct contact (through broken skin or mucous membrane) with the blood, secretions, or other bodily fluids, or with the organs of infected people, and indirect contact with environments contaminated with such fluids. The virus can survive in liquid or dried material for a number of days.^{10 11}

The following are the most common methods of EVD transmission between people²⁴:



The virus spreads to cell types throughout the body by binding glycoprotein to receptors on cell surfaces. Infected cells detach from blood vessels, causing massive hemorrhage. Loss of blood leads to kidney and liver failure.

Ebola diagnosis requires ruling out other diseases, which may include malaria, typhoid fever, shigellosis, cholera, leptospirosis, plague, rickettsiosis, relapsing fever, meningitis, hepatitis, and other viral hemorrhagic fevers²⁴.

Once these have been ruled out, Ebola virus infections can be diagnosed definitively in a laboratory through several types of tests:²⁰



- Antibody-capture enzyme-linked immunosorbent assay (ELISA)
- Antigen-capture detection tests
- Serum neutralisation test
- Reverse transcriptase polymerase chain reaction (RT-PCR) assay
- Electron microscopy
- Virus isolation by cell culture

To confirm the diagnosis, blood test samples are tested for viral antibodies, viral RNA, or the virus itself²⁴.

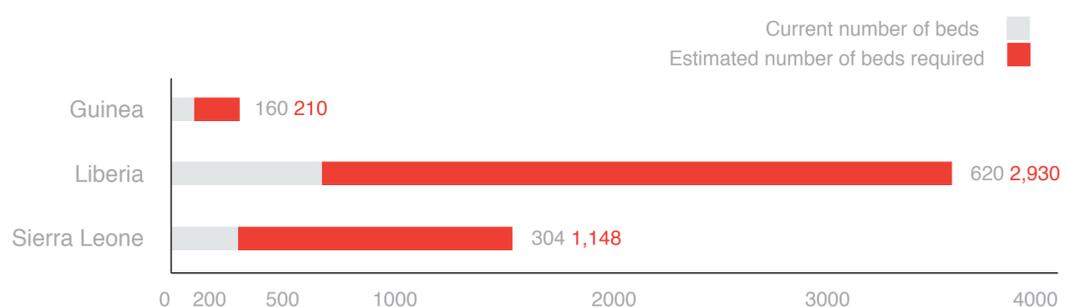
There is no licensed vaccine or specific treatment available for Ebola. The goal of an Ebola vaccine is to induce an effective immune response to the Ebola virus which would lead to protection from subsequent infection. A number of potential Ebola vaccines have been tested in animals but none have been adequately tested in humans. **Tests of new Ebola drugs could take place as early as November 2014.**²¹

The course of treatment for infected patients involves **supportive therapy**: providing relief of symptoms while the body fights the infection. Intravenous fluids, antibiotics, and oxygen are usually employed. Treatment may also include the use of medications to control fever, help the blood clot, and maintain blood pressure. Even with such supportive care, death occurs in 70.8% of cases.



- Intravenous (IV) fluids to maintain fluids and electrolytes (sodium, potassium, and chloride)
 - Oxygen and devices that help with breathing
 - Medications to control fever, help the blood clot, and maintain blood pressure
 - Antibiotics to prevent secondary infections from bacteria
 - Good nursing care.
- * In August, it was reported that healthcare workers represented nearly 10 percent of the cases and fatalities, significantly impairing the ability to respond to the outbreak in an area which already faces a severe shortage of doctors. According to the WHO, the high proportion of infected medical staff can be explained by lack of the number of medical staff needed to manage such a large outbreak, shortages of protective equipment, or improperly using what is available, and “the compassion that causes medical staff to work in isolation wards far beyond the number of hours recommended as safe.”. By 29 September, the WHO reported 377 workers had been infected and 216 had died.

Current bed capacity for patients in countries with active cases as of 8 Oct 2014 ²²



- **ZMapp**, a monoclonal antibody vaccine. The limited supply of the drug has been used to treat a small number of individuals infected with the Ebola virus. Although some of these have recovered the outcome is not considered statistically significant. ZMapp has proved highly effective in a trial involving rhesus macaque monkeys.
- The NIH along with the Wellcome Trust and Britain's Medical Research Council and Department for International Development have begun human trials of a **monovalent vaccine** at the University of Oxford. The first healthy patient received a monovalent vaccine containing antigenic material from just the Zaire strain on 17 September. In parallel studies, human trials began on this same monovalent vaccine on healthcare workers in Mali in early October, and are due to start in Maryland, USA in October and potentially in Gambia.
- The NIH in collaboration with the U.S. Department of Defense, have begun human safety trials of a **recombinant vesicular stomatitis virus Ebola vaccine (VSV-EBOV)** in Maryland in October. There are also plans to expand safety trials to sites in Europe and sub-Saharan Africa. This vaccine has been developed by the Public Health Agency of Canada (PHAC) and NewLink Genetics. Initial results about safety and dose ranges are expected by the end of 2014.

PREVENTION AND CONTROL

Good outbreak control relies on a coordinated set of interventions including case management, surveillance and contact tracing, reliable laboratory services, safe burials, and social mobilization. **Community engagement** is key to successfully controlling outbreaks. Raising awareness of risk factors for Ebola infection and protective measures that individuals can take is an effective way to reduce human transmission. Risk reduction messaging should focus on several factors:



Avoid physical contact with people showing symptoms of the Ebola virus.



Wash your hands regularly with clean water and soap.



Keep away from fruit bats, monkeys, dead animals, and bush meat.



Thoroughly cook all animal products before consumption.



Inform health authorities immediately in case of contact with expected or confirmed Ebola case.



Travel to areas where there is an Ebola outbreak only in case of urgent need.

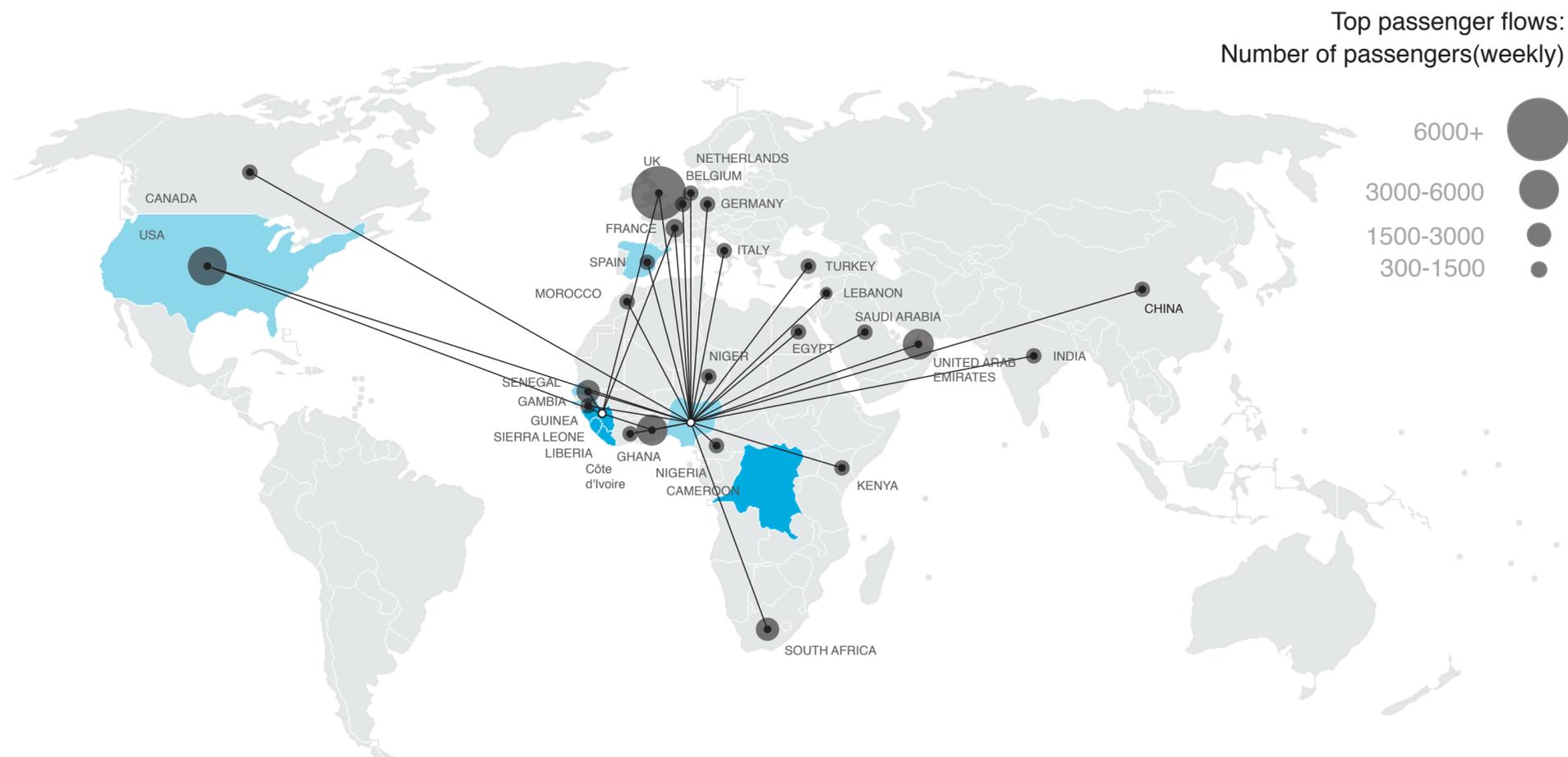


Contact tracing involves finding everyone who comes in direct contact with a sick Ebola patient. Contacts are watched for signs of illness for 21 days from the last day they came in contact with the Ebola patient. If the contact develops a fever or other Ebola symptoms, he or she is immediately isolated, tested, treated, and the cycle starts again—all of the new patient's contacts are found and watched for 21 days, and so on.

POTENTIAL OF SPREADING INTERNATIONALLY

There are major concerns that the EVD outbreak could spread, particularly to Europe and the United States. The main concern centres around **air travel, which is thought to be the primary potential route for the virus to spread across international and continental borders.**

Air traffic connections from West African countries to the rest of the world. Guinea, Liberia, and Sierra Leone are not well connected outside the region. Nigeria, in contrast, being the most populous country in West Africa with more than 166 million people, is well connected to the rest of world. For historical reasons, all these countries have the strongest ties with European countries.²³



The figure shows that travel from Sierra Leone, Guinea, and Liberia within the continent of Africa is much more prevalent than travel elsewhere.

Severe travel restrictions to and from the affected areas (80% airline traffic reduction) generates only a **3-4 weeks delay** in the international spreading.

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