



Ebola Virus Disease (EVD): Important aspects for the food science and technology community

Background

Ebola virus disease (EVD), formerly known as Ebola haemorrhagic fever, is a severe, often fatal illness in humans. It is a zoonosis affecting both humans and non-human primates (NHPs), namely monkeys, gorillas and chimpanzees. The virus is transmitted to humans from wild animals, with the natural reservoir, thought to be species of fruit bats residing in Africa. In the human population, transmission is through human-to-human contact or through contact with infected blood or bodily fluids as well as contaminated items (clothing, bedding and medical equipment). The current EVD case fatality rate is around 50%, but case fatality rates have varied from 25% to 90% in past outbreaks. The first EVD outbreaks occurred practically simultaneously in 1976 in remote villages of the Democratic Republic of Congo (DRC), near the Ebola River, and Sudan, near tropical rain forests. Fatality rates of 88% and 53% respectively were recorded. The sources of transmission of the two species of Ebola virus involved i.e. Zaire ebolavirus in the DRC outbreak and Sudan ebolavirus in the Sudan outbreak, remain unknown. Many years passed before the next outbreak occurred in 1994, this time in Côte d'Ivoire. Subsequent localized outbreaks have occurred in other countries, but the most recent outbreak in West Africa has involved a number of countries in the region, with major urban and rural areas affected. The current outbreak seems to have started in a village near Guéckédou, Guinea, where bat hunting is common, according to Médecins Sans Frontiers (Doctors Without Borders). The outbreak has spread to Liberia and Sierra Leone. Imported cases in Nigeria and Senegal were contained demonstrating the effectiveness of rapid response and traditional quarantine measures. An imported case was recently reported in Mali and cases have also been imported into a number of countries in the developed world. This is the most serious Ebola outbreak so far and as of 25 October 2014, 10,141 confirmed, probable and suspected cases have been reported with 4,922 deaths. The World Health Organization (WHO, 2014a) has declared this Ebola outbreak to be a Public Health Emergency of International Concern. The purpose of this Scientific Information Bulletin (SIB) is to review what is currently known about Ebola and to clarify whether it is indeed foodborne. Because events are evolving very rapidly and new information is becoming available daily, this SIB will be updated periodically hereafter.

Ebola virus disease

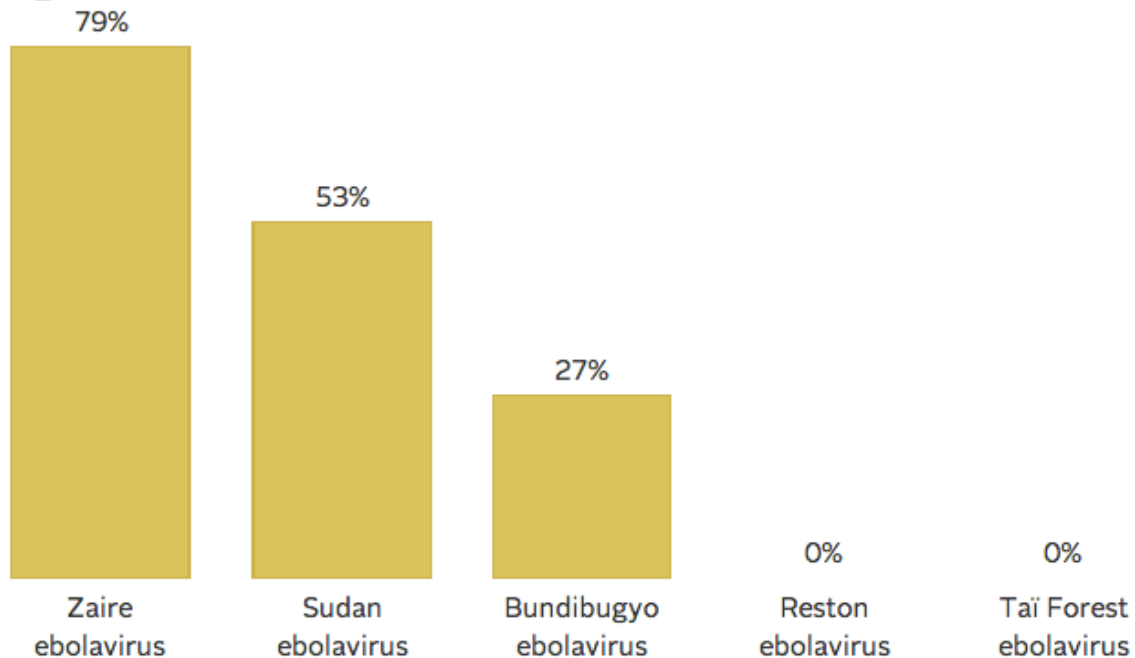
Ebola virus causes a disease, which is severe and often fatal in humans as well as NHPs such as monkeys, gorillas and chimpanzees. Since its identification in 1976, the disease has appeared sporadically in sub-Saharan Africa. The natural reservoir was originally thought to be gorillas because human outbreaks began after people ate gorilla meat. Scientists now believe that African fruit bats are the natural

from infected animals (bats or monkeys), fruit that has been covered with bat saliva or feces, or by coming in contact with surfaces covered in infected bat droppings and then touching their eyes, nose or mouths.

Ebola viruses consist of five genetically distinct members of the Filoviridae family: Zaire ebola virus, Sudan ebolavirus, Bundibugyo ebolavirus, Reston ebolavirus and Tai Forest (Côte d'Ivoire) ebolavirus. Reston ebolavirus was isolated from monkeys from the Philippines after having caused disease in NHPs only but was found later in swine suffering from porcine reproductive and respiratory disease syndrome. Zaire, Sudan and Bundibugyo Ebola viruses are responsible for most EVD outbreaks. However, Zaire ebolavirus constitutes the most serious threat to both human and NHPs in Sub-Saharan Africa because of its high case fatality (see Figure 1 below). It has also caused the largest number of outbreaks, including the present one. As of September 2014, the average risk of death among those infected is 50%.

Figure 1

Death rates of the 5 Ebola virus species



Source: CDC
CDC (2014)

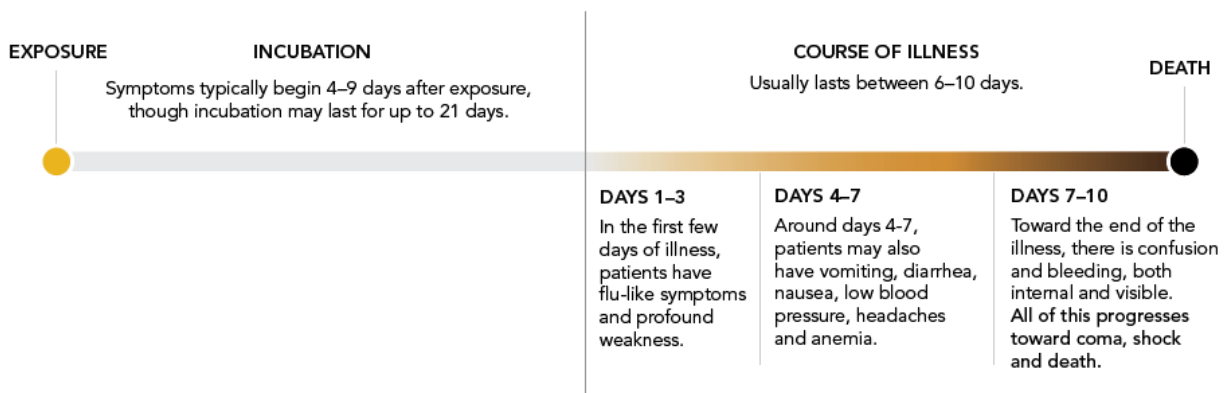


The incubation period, that is, the time interval from infection with the virus to onset of symptoms is 2 to 21 days, with an average of 8-10 days. Importantly, humans are not infectious and therefore cannot transmit the virus, until they develop symptoms. Initial symptoms are the sudden onset of fever, fatigue, muscle pain, headache and sore throat. This is followed by vomiting, diarrhea, abdominal (stomach) pain, rash, symptoms of impaired kidney and liver function, and in some cases, both internal and external bleeding (e.g. oozing from the gums, blood in stools). Laboratory findings include low white blood cell and platelet counts and elevated liver enzymes. In cases that become fatal, death usually occurs 9-10 days after the onset of symptoms. If the patient survives past the second week of infection, there is a significantly increased likelihood of survival. See Figure 2 for an infographic on how Ebola symptoms progress.

Figure 2

How Ebola Symptoms Progress

Infection with the Ebola virus can lead to flu-like symptoms, bleeding (both visible and internal) and, in many cases, death. The current outbreak has a mortality rate of around 60 percent.



Source: Dr. Nahid Bhadelia M.D., M.A., Associate Hospital Epidemiologist, Boston Medical Center
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THE HUFFINGTON POST
 Huffington Post (2014a)

Ebola virus spreads from person-to-person through direct contact with tissue, organs, blood or bodily fluids (including vomit, urine, sweat, saliva, semen and breast milk) from an infected person and through surfaces and materials contaminated with these fluids, including clothing, bedding, medical equipment, used needles and syringes. The virus enters the body through broken skin or mucous membranes (such as eyes, nose or mouth) and is not airborne; however, a cough from a sick person could infect someone who has been sprayed with infected saliva. The virus is also present on a patient's skin after symptoms develop.

Controlling the Ebola outbreak

WHO has stated that community engagement is key to successfully controlling outbreaks and relies on applying a suite of interventions, namely case management, surveillance and contact tracing, good

laboratory services, safe burials and social mobilization. Early supportive care with rehydration and treatment of symptoms improves rates of survival. There is as yet no licensed treatment proven to neutralize the virus but a range of blood, immunological and drug therapies are under development. There are currently no licensed Ebola vaccines but 2 potential candidates are undergoing evaluation. WHO projects that hundreds of thousands of doses of vaccine will be available in the first half of 2015 with millions more by the end of 2015 (WHO, 2014a).

Is Ebola virus foodborne?

Antibodies to Ebola virus are found in some hunted game animals in Africa, including forest antelopes and rodents. Pigs, guinea pigs, horses and goats have been infected experimentally and either had no symptoms or mild ones. Ebola virus has not been found in any African felines, such as lions, so cats may be immune. Studies of hammer-headed bats in the Democratic Republic of Congo have found that 10 percent of the bats carry antibodies to the virus. Similar studies of fruit bats in Ghana have found a prevalence of 36% with Ebola virus antibodies (Hayman *et al.*, 2012). Of 24 plant species and 19 vertebrate species experimentally inoculated with Ebola virus, only bats became infected. Furthermore, the bats displayed no clinical signs and this suggests that bats are a reservoir species of the virus (Swanepoel *et al.*, 1996). Non-human primates are particularly susceptible to EVD. While the case fatality rate in NHPs is unknown, some ecological data suggest that EVD has contributed to declines of up to 98% of local great ape populations in Gabon and the Republic of Congo. Since NHP groups are geographically separated, the source of the infection is likely to be contact with the reservoir species. Bats are notoriously adept at hosting parasites and pathogens and spreading diseases to other animals. Such viruses like SARS, Marburg and Ebola can be passed to NHPs and ultimately to humans (Muyembe-Tamfum *et al.*, 2012).

As a consequence, WHO (2014a) recommends that:

“Reducing the risk of wildlife-to-human transmission from contact with infected fruit bats or monkeys/apes and the consumption of their raw meat. Animals should be handled with gloves and other appropriate protective clothing. Animal products (blood and meat) should be thoroughly cooked before consumption.”

The US Centers for Disease Control and Prevention (CDC) has flatly stated that Ebola is not foodborne. This viewpoint results most likely because neither bats nor NHPs are eaten or handled in the USA food supply chain. In fact, importing bush meat is not permitted and is subject to a fine of US\$250,000 (CDC, 2014). However, from an international perspective as pointed out by WHO, food handlers and consumers of raw meat from bats or monkeys/apes are at risk of EVD and therefore, Ebola is a foodborne disease in those countries with bush meat traditions.

Bush meat is traditionally eaten in many parts of Sub-Saharan Africa. In some countries, bush meat is an important source of protein where other sources of animal protein are scarce or too expensive. If the Ebola epidemic continues, farmers may abandon their fields and food markets may be disrupted, which may increase demand for bush meat as a necessary alternative food source. Therefore, WHO (2014a) has provided food safety advice concerning Ebola and has emphasized that if food products are properly

prepared and cooked, humans cannot become infected by consuming them as the Ebola virus is inactivated through cooking. More specifically, the Ebola virus is inactivated by heating for 60 minutes at 60 °C or boiling for 5 minutes (HPSC, 2014). WHO (2014a) also emphasizes that basic hygiene measures can prevent infection in people in direct contact with infected animals or with raw meat and by-products. Such measures include regular hand washing, handling potentially infected meat with gloves, and changing of clothes, boots and other protective clothing before and after touching these animals and their products. In addition, sick, diseased or dead animals should never be consumed.

Take away for the food science and technology community

For most of the world, the chances of contracting EVD through food are negligible. Basic food hygiene messages that have been promoted for many years should continue to be invoked as these have a history of successfully preventing the transmission of biological hazards in general and this would certainly be applicable to the Ebola virus as well. These messages are best embodied in the WHO Five keys to safer food (WHO, 2014b), namely:

1. Keep clean
2. Separate raw and cooked
3. Cook thoroughly
4. Keep food at safe temperatures
5. Use safe water and raw materials

In particular, hand-washing by food handlers is important when food will be consumed with no further processing to destroy any possible contamination.

Some other important facts on the Ebola virus that may be of use to the food industry:

- It can survive in liquid or dried material for a number of days;
- It is an envelope virus – one with a lipid and protein membrane – which makes it vulnerable to attack by chemical disinfectants and is inactivated by soap, household bleach, chlorine dioxide, hydrogen peroxide and most other disinfectants
- It is not inactivated by freezing or refrigeration (HPSC, 2014).

Finally, the current Ebola outbreak has become complex because of its size and scope. Disruption of economic activity, including farming, is a potential threat to the entire food supply, especially for urban consumers. In addition, individuals, families and even communities may be subject to a 21 day quarantine if they were exposed to a symptomatic EVD patient. The inadequate provision of food during this period has already resulted in violation of the cordon sanitaire (Huffington Post, 2014b). In the worst case scenario, the distribution of food may become as important as the delivery of health care.

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<http://www.who.int/csr/disease/ebola/en/>

WHO (2014b). WHO Five keys to safer food. http://www.who.int/foodsafety/areas_work/food-hygiene/5keys/en/

Further Reading

European Commission Public Health (All EU languages) http://ec.europa.eu/health/ebola/index_en.htm

Mayo Clinic (English) <http://www.mayoclinic.org/diseases-conditions/ebola-virus/basics/definition/con-20031241>

Wikipedia (over 100 languages) http://en.wikipedia.org/wiki/Ebola_virus_disease

European Food Safety Authority <http://www.efsa.europa.eu/en/efsajournal/pub/3884.htm>

This SIB was prepared by Academy Fellows Lucia Anelich and Gerald G. Moy on behalf of, and approved by, the IUFoST Scientific Council. Lucia Anelich has a PhD in Microbiology and over 30 years of experience in the food industry, academia and international organizations. Dr. Anelich established and grew the Food Safety Initiative (FSI) for the food industry through the Consumer Goods Council of South Africa, a first for South Africa. She consults for Food and Agriculture Organization of the United Nations, the

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The International Union of Food Science and Technology (IUFOST) is the global scientific organisation representing more than 300,000 food scientists and technologists from over 75 countries. IUFOST is a full scientific member of ICSU (International Council for Science) and it represents food science and technology to international organizations such as WHO, FAO, UNDP and others.

IUFOST organises world food congresses, among many other activities, to stimulate the ongoing exchange of knowledge and to develop strategies in those scientific disciplines and technologies relating to the expansion, improvement, distribution and conservation of the world's food supply.

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