Scientific Works. Series C. Veterinary Medicine. Vol. LXI (1)
ISSN 2065-1295; ISSN 2343-9394 (CD-ROM); ISSN 2067-3663 (Online); ISSN-L 2065-1295

RISK OF EBOLA VIRUS DISEASE SPREAD OUTSIDE OF AFRICA: REVIEW OF NATURAL RESERVOIR AND TRANSMISSION

Nicoleta Cristina HRISTEA, Stelian BARAITAREANU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, Veterinary Medicine Campus, 105 SplaiulIndependentei, District 5, Bucharest, Romania, Phone: +4021.411.11.22, Fax: + 4021.401.11.22, Email: doruvet@gmail.com

Corresponding author email: doruvet@gmail.com

Abstract

The Ebola virus is one of the most virulent pathogen of humans. Until 2014 there have been reported 35 outbreaks, of which 25 in Africa, three in Asia (Philippines), three in America (USA) and four in Europe (Russia, UK, and Italy). Several outbreaks affected multiple countries. The most non-African human cases were accidentally produced in laboratories (researchers) and hospitals (medical staff). The largest outbreak of Ebola is still ongoing across West Africa (Guinea, Liberia, and Sierra Leone). Sporadic cases of illness and deaths have been reported outside of West Africa, in USA, Spain, UK, Nigeria, Senegal, and Mali. During February, 2014 - January 5, 2015were recorded 20,691cases of human illness and 8,168deaths (data are constantly evolving). The paper aims to present the epidemiologic characteristics of Ebola outbreaks that occurred from 1976 to 2014, in order to identify the source of infection and the route of transmission. The major source of Ebola virus infection identified in outbreaks with human casualties was the close unprotected physical contact with casualties. Another important source of human infection was wildlife. The natural reservoirs of Ebola virus are considered fruit bats (Hypsignathus monstrosus, Epomops franqueti,Myonycte ristorquata, Rousettus aegyptiacus) that spread the virus through urine and saliva. In two major human outbreaks with several casualties, (Zaire virus; Gabon; 1996-1997) the first sources of infection were chimpanzees. In seven outbreaks with asymptomatic human infections (Reston virus; Philippines, USA, Italy, 1989-2008) were involved apes and pigs, but the source of animal infection weren't identified. As a conclusion, the risk of Ebola virus disease spread outside of Africa is mainly associated with the international travel and the trade of live exotic animals. Ebola isn't an airborne disease, but direct exposure (percutaneous or mucous membrane) of people to infected blood or body fluids leads to the rapid transmission of the virus.

Key words*: epidemiologic risk factors, infection, transmission, Ebola virus disease outbreaks.*

INTRODUCTION

The ebolaviruses is one of the most virulent pathogen of humans. It is a rare and deadly disease of humans caused by ebolaviruses (EBVs). EBVs has been included in the family *Filoviridae*, genus *Ebolavirus* (CDC, 2014; WHO, 2015).

Ebolavirus etymology derived from the headstream name of the Mongala River (Democratic Republic of the Congo), where the virus was encountered for the first time (Wildy, 1971).

There are five identified Ebola virus species, named from the region where each was originally identified: *Ebola virus* (EBOV) (formerly *Zaire ebolavirus)*, *Sudan ebolavirus* (SUDV), *Taï Forest ebolavirus* TAFV) (formerly *Côte d'Ivoire ebolavirus*), *Bundibugyo ebolavirus* (BDBV), and *Reston ebolavirus* (RESTV). The last one is not pathogenic for humans (Kuhn et al., 2010; CDC, 2014; WHO, 2015)

EBVs are pathogenic for humans and nonhuman primates (monkeys, gorillas, and chimpanzees) (CDC, 2014). The natural reservoir host remains unknown, but the most likely reservoir are different bat species (e.g. *Hypsignathus monstrosus, Epomps franquet, Myonycte ristorquata, Rousettusa egyptiacus*), most of them native to Africa (Leroy et al., 2005; Pourrut et al., 2009). One exception was reported, RESTV might have the bats from Philippinesas the reservoir host (e.g. *Rousettusamplexicaudatus*) (Taniguchi et al., 2011).

Depending of EBVs susceptibility, the animals can be classified in three epidemiological categories: (1) Accidental

hosts (e.g. humans) - develop serious disease, often fatal, and are the main sources of infection for humans and other animals. (2) Optional hosts – develop silent infections and are not sources of infection for humans or other animals. (3) Natural hosts –maintain the virus on the field (natural reservoir) byintra-species contagious infections (CDC, 2014).

The paper aimes to present the epidemiologic characteristics of Ebola outbreaks that occurred from 1976 to 2014, in order to identify the source of infection and the route of transmission.

MATERIALS AND METHODS

In order to present the epidemiologic characteristics of Ebola outbreaks we've studied official reports of WHO, CDC, ECDC and scientific papers published after 1976.

The Ebola outbreaks included in this study are presented in table 1.

Table 1. Ebola outbreaks used in epidemiological study

Year	Country	Ebolavirus
2014 (Aug-Nov)	Democratic Republic of the Congo*	Zaire
Feb 2014-Present	Multiple countries	Zaire
Nov 2012-Jan 2013	Uganda	Sudan
2012	Democratic Republic of the Congo*	Bundibugyo
2012	Uganda	Sudan
2012	Uganda	Sudan
2011	Uganda	Sudan
2008	Democratic Republic of the Congo*	Zaire
2007	Uganda	Bundibugyo
2007	Democratic Republic of the Congo*	Zaire
2005	Congo	Zaire
2004	Sudan	Sudan
2003 (Nov-Dec)	Congo	Zaire
2003 (Jan-Apr)	Congo	Zaire
2001-2002	Congo	Zaire
2001-2002	Gabon	Zaire
2000	Uganda	Sudan
1996	South Africa	Zaire
1996 (Jul-Dec)	Gabon	Zaire
1996 (Jan-Apr)	Gabon	Zaire
1995	Democratic Republic of the Congo*	Zaire
1994	Cote d'Ivoire	Taï Forest
1994	Gabon	Zaire
1979	Sudan	Sudan
1977	Democratic Republic of the Congo*	Zaire
1976	Sudan	Sudan
1976	Democratic Republic of the Congo*	Zaire

* FormerRepublic of Zaire

RESULTS AND DISCUSSIONS

Until 2014 have been reported 35 outbreaks, of which 25 in Africa, three in Asia (Philippines), three in America (USA) and four in Europe (Russia, UK, and Italy). Some outbreaks were included in different epidemiological studies as parts of the same event (non-African cases were liked with the outbreak that started in West Africa in 2014) (CDC, 2014; ECDC, 2015). The most non-African human cases were accidentally produced in laboratories (researchers) and hospitals (medical staff) (WHO, 2015).

The largest outbreak of Ebola is still ongoing across West Africa (Guinea, Liberia, and Sierra Leone). Sporadic cases of illness and deaths have been reported outside of West

Africa, in USA, Spain, UK, Nigeria, Senegal, and Mali. During February, 2014 - February25, 2015 were recorded 23,729 cases of human illness and 9,604deaths (data are constantly evolving) (CDC, 2015; WHO, 2015).

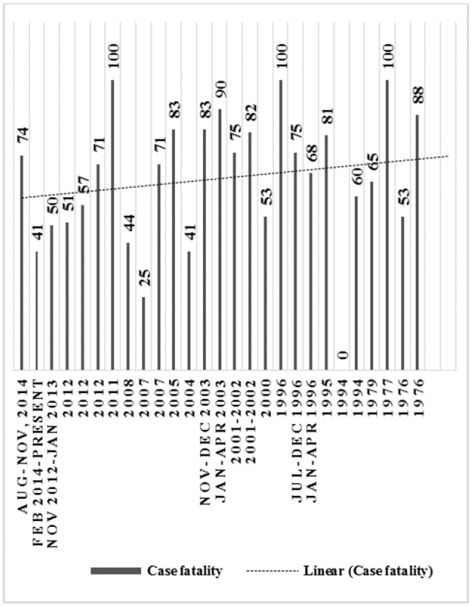

Figure 1. The proportion of Ebola case fatality in 27 outbreaks recorded from 1976 to February 2015. Linear trend line of case fatality has descending trend.

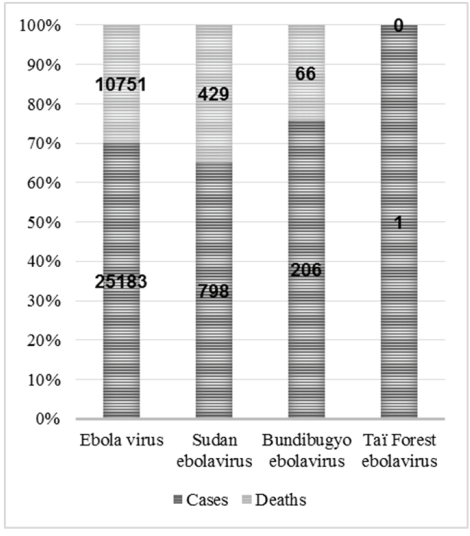

Figure 2. Comparative study of the case fatality in Ebolavirus species. It were compared only species proved to be pathogenic for humans. Datawere recorded from 1976 to February 25, 2015. *Sudan ebolavirus* has the highest proportion of fatality.

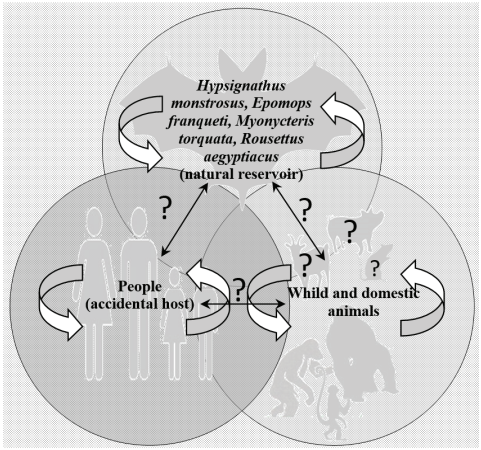

Figure 3. Sources and routes of infections in ebolaviruses infections

The major source of Ebola virus infection identified in outbreaks with human casualties has been the close unprotected physical contact with casualties (WHO, 2015).

Another important source of human infection is wildlife. The natural reservoirs of ebolaviruses are considered fruit bats (*Hypsignathus monstrosus, Epomops franqueti, Myonycteris torquata, Rousettusa egyptiacus*) that spread the virus through urine and saliva. In two major human outbreaks with several casualties, (Zaire virus; Gabon; 1996-1997) the first sources of infection were chimpanzees. In seven outbreaks with asymptomatic human infections (Reston virus; Philippines, USA, Italy, 1989-2008) were involved apes and pigs, but the source of animal infection weren't identified. (Leroy et al., 2005; Pourrut et al., 2009; Taniguchi et al., 2011; CDC, 2014, WHO, 2015, ECDC, 2015).

CONCLUSIONS

The risk of Ebola virus disease spread outside of Africa is mainly associated with the international travel and the trade of live exotic animals.

The virus is not transmitted through dogs or cats but it's not recommended that they get into contact with casualties. Insects (e.g. mosquitos, flies) have no implications in spreading the virus.

Ebola is not an airborne disease, but direct exposure (percutaneous or mucous membrane) of people to infected blood or body fluids leads to the rapid transmission of the virus.

REFERENCES

Centers for Disease Control and Prevention (CDC), 2014. Ebola (Ebola Virus Disease). National Center for Emerging and Zoonotic Infectious Diseases (NCEZID). Division of High-Consequence Pathogens and Pathology (DHCPP), Viral Special Pathogens Branch (VSPB), http://www.cdc.gov/vhf/ebola/ about.html [last updated December 8, 2014] [accesed February 26, 2015].

Centers for Disease Control and Prevention (CDC), 2015. Outbreaks Chronology: Ebola Virus Disease. National Center for Emerging and Zoonotic Infectious Diseases (NCEZID). Division of High-Consequence Pathogens and Pathology (DHCPP). Viral Special Pathogens Branch (VSPB). http://www.cdc.gov/vhf/ebola/ about.html [last updated February 25, 2015] [accesed February 26, 2015].

European Centre for Disease Prevention and Control (ECDC), 2015. Ebola and Marburg fevers.http://www.ecdc.europa.eu/en/healthtopics/ebola_marburg_fevers/pages/index.aspx [accesed February 26, 2015].

Kuhn J.H., Becker S., Geisbert T.W., Johnson K.M., Lipkin W.I., Negredo A.I., Netesov S.V., Nichol S.T., Palacios G., Peters C.J., Tenorio A., Volchkov V.E., Peter B. Jahrling P.B., 2010. Proposal for a revised taxonomy of the family *Filoviridae*:

classification, names of taxa and viruses, and virus abbreviations. Arch Virol. 155(12): 2083–2103.

Leroy E.M., Kumulungui B., Pourrut X., Rouquet P., Hassanin A., Yaba P., 2005. Fruit bats as reservoirs of Ebola virus, Nature, 438:575–576.

Pourrut X., Souris M., Towner J.S., Rollin P.E., Nichol S.T., Gonzalez J.P., 2009. Large serological survey showing cocirculation of Ebola and Marburg viruses in Gabonese bat populations, and a high seroprevalence of both viruses in *Rousettus aegyptiacus*. BMC Infect Dis, 9:159.

Taniguchi S., Watanabe S., Masangkay J.S., Omatsu T., Ikegami T., Alviola P., 2011. Reston Ebolavirus antibodies in bats, the Philippines, Emerg Infect Dis., 17:1559–1560.

Wildy P., 1971. Classification and nomenclature of viruses—first report of the International Committee on Nomenclature of Viruses. Monograph in Virology. S. Karger Ed. Basel, Switzerland.

World Health Organisation (WHO), 2015. Ebola virus disease. http://www.who.int/csr/disease/ebola/en/ [accesed February 26, 2015].