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REVIEW

Ebola virus disease: Effects of respiratory protection on healthcare workers



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KEYWORDS

Ebola virus diseases;
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Abstract Ebola virus disease outbreak in West Africa sends an alarming message to all countries in the world, to increase the level of coordination and application of preventive measures globally to avoid a disastrous epidemic in the World, as the current situation in West Africa is critical especially after the World Health Organization increased the alarming level to an emergency in public health all over the world. Viral hemorrhagic fevers are important because they can readily spread within a hospital or mortuary setting, there is no effective cure or vaccine, they have a high mortality rate and they are difficult to recognize and diagnose rapidly. WHO has recommended respiratory protection for HCWs performing certain tasks such as aerosol-generating procedures, laboratory procedures, and autopsies. Particulate respirators are designed to help reduce the wearer's exposure to certain airborne particles. The most effective way to block aerosolized particles is to use either a half-face or a full-face respirator. HCWs still need shoe covers, a full face respirator and latex or nitrile gloves to decrease the risk of Ebola virus contamination.

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Abbreviations: VHF, Viral hemorrhagic fever; EVD, Ebola virus disease; WHO, World Health Organization; PPE, Personal protective equipment; HCWs, Health care workers

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Overview

Ebola virus disease outbreak in West Africa sends an alarming message to all countries in the world, to increase the level of coordination and application of preventive measures globally to avoid a disastrous epidemic in the World, as the current situation in West Africa is critical especially after the World Health Organization increased the alarming level to an emergency in public health all over the world [1]. Ebola virus disease is a severe, often fatal disease in humans and nonhuman primates such as monkeys, gorillas, and chimpanzees [2].

Ebola virus is one of the causes of viral hemorrhagic fever (VHF) [3]. Viral hemorrhagic fever describes a severe, multi-organ disease in which the vascular system is damaged and the body's ability to regulate itself is impaired. VHFs are often accompanied by hemorrhages which can be life threatening. Viral hemorrhagic fevers are important because they can readily spread within a hospital or mortuary setting, there is no effective cure or vaccine, they have a high mortality rate and they are difficult to recognize and diagnose rapidly [4].

The first cases of Ebola virus disease (EVD) were reported in 1976 in the Democratic Republic of Congo and since then sporadic cases and small scale outbreaks have occurred in central African countries [5]. There are five strains of EV but the Zaire strain is the most severe, with a case-fatality rate up to 90% [6]. The unprecedented scale of the current outbreak of EVD in Sierra Leone, Guinea, Liberia and Nigeria, led to the World Health Organization [7,8,5] declaring an international public health emergency. The outbreak has since spread to Senegal, and a reportedly unrelated outbreak has since occurred in the Democratic Republic of Congo (World Health Organization) [9]. As of 22nd August 2014, the West African outbreak has resulted in 2615 cases and 1427 deaths and is unprecedented because it has continued for more than double the length of time of the largest previous outbreak in Uganda in 2000 (3 months vs. 8 months), has resulted in more than six times as many cases (425 cases vs. 2615 cases), and has for first time occurred in more than one country simultaneously and in capital cities [10,5]. Among the total cases, 1251 have been laboratory confirmed, and genetic sequencing has showed that the similarity of the virus to the Zaire EV is 97% [11]. Unlike past outbreaks, the current outbreak of EVD has not been contained and has resulted in social unrest, breakdown in law and order, shortages of personal protective equipment (PPE) and depletion of the healthcare workforce, with over 240 health care workers (HCWs) becoming infected and 120 HCW deaths (WHO) [5,12]. The inability to contain this outbreak has been blamed variously on lapses in infection control, shortages of PPE and other supplies, myths and misconceptions about EVD, and the fact that it is occurring in large cities rather than small villages. HCWs, many of whom are nurses, are on the frontline of the response, and their occupational health and safety is critical to control of the outbreak and maintenance of the health workforce during a crisis. The Centers for Disease Control and Prevention (CDC) [13,14]

and World Health Organization (WHO) [7–9] have recommended the use of respirators.

Ebola virus disease (EVD)

Ebola virus disease is a severe acute viral illness often characterized by the sudden onset of fever, intense weakness, muscle pain, headache and sore throat. This is followed by vomiting, diarrhea, rash, impaired kidney and liver function, and in some cases, both internal and external bleeding [14,15]. Outbreaks of Ebola have occurred sporadically in parts of Africa, South America, the Middle East and Eastern Europe, with fatality rates ranging up to 90% [1].

Modes of transmission of Ebola

Ebola is spread through direct contact with blood or body fluids (including, but not limited to urine, saliva, sweat, feces, vomit, breast milk and semen) of an infected person or animal, or through contact with objects that have been contaminated with the blood or other body fluids of an infected person, dead or alive [14,16]. Transmission is believed to occur via contact with mucous membranes and non-intact skin (i.e., rashes, cuts, etc.). Risk of infection by inhalation of contaminated aerosols by healthcare workers has not been documented but is thought to be low at this time based on case history evidence [15,17]. Ebola virus is readily killed by soap, bleach, direct sunlight, or drying. Machine washing clothes that have been contaminated with fluids will destroy Ebola virus. Ebola virus survives only a short time on surfaces that are in the sun or have dried [18].

Factors to be considered in making recommendations for respiratory protection of HCWs

When determining recommendations for the protection of HCWs, a risk analysis approach is required that takes into account all relevant factors which could impact on the occupational health and safety of HCWs (Fig. 1). The severity of the outcome (case-fatality rate and disease severity) must be considered [19]. Any level of uncertainty around modes of transmission must also be evaluated, particularly if the disease has a high case-fatality rate. In addition, the availability of pre- and post-exposure prophylaxis or treatment must be considered. The immune status and co-morbidities in HCWs should also be considered, as some HCWs may be innately more vulnerable to infection [20].

As the aging of the nursing workforce occurs in developed countries, there is likely to be a high proportion of HCWs with chronic conditions. In this case, facemasks have been recommended for HCWs by CDC and WHO because of the assumption that EV is not transmitted via the airborne route [13,8]. However, there is uncertainty about transmission, the consequences of EVD infection are severe and there is no proven treatment, vaccine or post-exposure prophylaxis. Recommend-

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