

## Insights into Ebola and Other Emerging and Re-emerging Infectious Disease Risks

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**KEYWORDS:** Ebola, (re)emerging, infectious, disease

**CITATION:** Kelley. Insights into Ebola and Other Emerging and Re-emerging Infectious Disease Risks. *Environmental Health Insights* 2014;8 39–41 doi: 10.4137/EHI.S20757.

**TYPE:** Editorial

**FUNDING:** Author discloses no funding sources.

**COMPETING INTERESTS:** Author discloses no potential conflicts of interest.

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During the 20th and early 21st centuries, the discipline of environmental health has contributed to tremendous improvements in air, water, and food quality; occupational health; waste management practices; and disease vector control. As a result of these and other improvements, prevention and treatment of infectious disease (eg, those caused by biological agents) and non-infectious disease (eg, those caused by chemical or physical agents) has improved significantly around the world. However, substantial challenges remain, particularly in developing countries with limited health resources relative to more developed countries. Examples include recent (summer, fall, 2014) concerns for the Ebola virus and non-polio enterovirus D68 (EV-D68). There are also previous and ongoing concerns for diseases such as sudden acute respiratory syndrome (SARS); H1N1 influenza; other swine and avian influenza (swine, bird flu); and a variety of other viral, bacterial, and protozoal diseases.

Are the risks of transmission of infectious diseases such as Ebola actually increasing, or is the public just more aware of the problem because of the efficiency of the global media in identifying infectious disease outbreaks?

As an example, Ebola hemorrhagic fever has been in the news during summer and fall 2014 because of the outbreaks and related infections of health-care providers in Africa. Ebola transmission is accomplished via direct or indirect exposure to blood or other bodily fluids, and is therefore relatively easily

controlled by the use of personal protective equipment such as gloves, masks, safety glasses, and Tyvek™ suits (Centers for Disease Control and Prevention [CDC]).<sup>1</sup> Therefore, the risks of an Ebola pandemic would appear to be low. However, there are concerns that Ebola could become an epidemic and/or endemic disease in Africa. A September, 2014 CDC Morbidity and Mortality Weekly Report Supplement predicted that there could be as many as 1.4 million cases in Liberia and Sierra Leone by January, 2015 ([http://www.cdc.gov/mmwr/preview/mmwrhtml/su6303a1.htm?s\\_cid=su6303a1\\_w](http://www.cdc.gov/mmwr/preview/mmwrhtml/su6303a1.htm?s_cid=su6303a1_w)).<sup>2</sup> It should be noted, however, that the authors outlined significant limitations to this prediction. There has also been public concern expressed about bringing infected health-care workers to the US because of the perceived potential for an outbreak of Ebola. Identification and treatment of specific Ebola symptoms and use of an experimental monoclonal antibody treatment (ZMapp™, developed by Mapp Biopharmaceutical Inc.) to manage the disease process appear promising. There is also an Ebola vaccine that began US National Institutes of Health (NIH) human testing in October, 2014.<sup>3</sup>

Other diseases in the news during the past decade may be more easily transmitted than Ebola, particularly those that are airborne. SARS, transmitted by an airborne coronavirus, was a major concern in 2003, but fortunately, no cases have been reported worldwide since 2004.<sup>4</sup> The US Public Health Emergency of 2009 for H1N1 influenza strain expired in June,



2010, and the World Health Organization (WHO) announced in 2010 that H1N1 had moved into the post-pandemic period.<sup>5</sup> Although influenza may initially cycle in animals such as pigs and birds (zoonoses), “variant” forms of viruses may contribute to sporadic, unpredictable human infection outbreaks. These infections are usually the result of direct or indirect contact with animals such as swine and poultry, but may also be transmitted among humans under the right conditions. EV-D68 has also been of recent concern in summer and fall, 2014, for individuals with pre-existing respiratory conditions such as asthma or respiratory diseases.<sup>6,7</sup> Influenza vaccines target those viruses predicted to be most common for that season. For example, the US 2014–15 flu vaccine will include influenza A H1N1, H3N2, and one or two influenza B viruses, depending on the version of the vaccine used.<sup>8</sup>

An *emerging* disease is identified by the WHO as “one that has appeared in a population for the first time, or that may have existed previously, but is rapidly increasing in incidence or geographic range.”<sup>9</sup> The term *re-emerging* indicates that the disease is emerging once again in the same or perhaps a different geographic area. The emergence or re-emergence of an infectious disease may be complicated by reservoirs of the disease (such as domesticated or wild animals) resulting in sporadic outbreaks among humans. A variety of environmental factors may contribute to re/emergence of a particular disease, including temperature, moisture, human food or animal feed sources, etc. Disease re/emergence may be caused by the coincidence of several of these environmental and/or social factors to allow optimal conditions for transmission of the disease. For example, Ebola virus is transmitted to humans from wild animals and then spreads via human-to-human transmission. It is believed that fruit bats are natural Ebola virus hosts and that the virus is introduced to humans via infected animals such as chimpanzees, gorillas, fruit bats, etc. found dead or ill in the rainforest.<sup>10</sup>

It seems likely that a wide variety of infectious diseases have affected human populations for thousands of years emerging when the environmental, host, and agent conditions were favorable. Expanding human populations have increased the potential for transmission of infectious disease as a result of close human proximity and increased likelihood for humans to be in “the wrong place at the right time” for disease to occur (eg, natural disasters or political conflicts). Global travel increases the potential for a carrier of disease to transmit infection thousands of miles away in just a few hours, as evidenced by WHO precautions concerning international travel and health.<sup>11</sup>

So what can environmental health professionals do to help to limit transmission of infectious disease and accurately educate the public on the associated risks? Firstly, quality research is the foundation of a better understanding of how, when, and where disease agents are transmitted through the environment so that appropriate controls can be implemented to reduce the

potential for disease transmission. Secondly, enforcement of proper environmental health regulations (eg, air, water, food, occupational health, waste management, vector control, etc.) by environmental health practitioners at the local, regional, national, and international level serves a vital role in limiting disease transmission. Finally, sharing and reinforcement of accurate information with the public concerning the potential for transmission of infectious disease and how it may be prevented or controlled is an important role that environmental health professionals can play. For example, it has been speculated that infectious disease transmission could be reduced by up to 80% by something as simple as appropriate, regular hand washing techniques.

We live in a global society where media shares information almost instantaneously worldwide, so it is not surprising that knowledge of a disease outbreak thousands of miles away may create local concern. This concern may even be legitimate given the ability of humans to travel around the world within just a few hours. Movies and television showing the potential consequences of a pandemic (global) infection have also raised public awareness. However, human diversity and adaptability has thus far limited the spread of infectious disease. It is also important to note that of the top 10 leading causes of death worldwide as identified by the WHO, only three – lower respiratory infections, HIV/AIDS, and diarrheal disease (#4, #6, and #7, respectively) – have a clear infectious disease component.<sup>12</sup> The rest of the causes are chronic diseases or accidents, which may be limited by personal habits such as an active lifestyle, lower fat diet, smoking cessation, and safer driving. While some media “sensationalism” of international infectious disease outbreaks is unavoidable, environmental health professionals can help to provide a more balanced view of the risks and share ways in which individuals can empower themselves to prevent or control both infectious and non-infectious diseases.

### Author Contributions

Conceived the concepts: TK. Wrote the first draft of the manuscript: TK. Made critical revisions: TK. The author reviewed and approved of the final manuscript.

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