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Comment on "Ebola Virus Persistence in the Environment: State of the Knowledge and Research Needs"

In the letter "Ebola Virus Persistence in the Environment: State of the Knowledge and Research Needs", the authors' review existing evidence on Ebola virus persistence in the environment and recommend research to understand potential transmission risks associated with liquid wastes from Ebola-infected patients.[1] We agree the research described is necessary. However, the letter is limited by: 1) selective reporting of Ebola persistence data on surfaces and Ebola surrogate survival; and, 2) lack of information on the potential role of environmental transmission in the larger epidemiological picture of Ebola transmission. Additionally, the authors' recommendation to use "a more conservative estimate than current WHO and CDC recommendations"[1] for handling liquid wastes from Ebola patients is unfounded based on current evidence and could contribute to the culture of fear around Ebola.

SELECTIVE REPORTING

The Piercy paper on filovirus environmental survival provides the best available evidence on Ebola environmental survivability.[2] The authors' correctly report Piercy's results that greater than 10% and greater than 3% of Ebola virus survived on glass and plastic surfaces, respectively, after 14 days at 4 °C and that Ebola virus persisted in sera for greater than 40 days. However, what the authors' fail to mention is that in the same Piercy paper the following results were also reported: (1) No virus was viable on these surfaces at first sampling (2 days) when incubated at room temperature. (2) No virus was viable on metal surfaces at first sample (2 days) after incubation (at 4 °C and room temperature). (3) Pig sera is likely a better Ebola virus host than water or wastewater.[2] Considering this excluded data leads to a more nuanced understanding of potential Ebola survivability in real-world environments.

Additionally, the authors' suggest using "enteric virus transport and survival as a model to understand and assess Ebola virus in the environment".[1] In support of this suggestion, they reference a Casanova manuscript on the long-term survival of two SARS surrogate coronaviruses—transmissible gastroenteritis virus and mouse hepatitis virus—in feces.[3] However, (1) both of these SARS surrogate viruses are transmitted via the fecal−oral route and are thus likely to be adapted for survival in feces. Also, (2) filoviruses are enveloped viruses (unlike enteroviruses) and are likely to be much less robust in the environment. The authors do not mention a Lai manuscript that reports an actual SARS coronavirus (not transmitted via the fecal−oral route and thus likely to be a nonfeces-adapted virus) was rapidly inactivated (within 6−24 h for a normal adult) in stool.[4]

LARGER EPIDEMIOLOGICAL PICTURE OF EBOLA TRANSMISSION

Although Ebola is severe, it is not easily transmitted person-to-person; the basic reproduction number for the 24 completed Ebola outbreaks is estimated as less than 1.0.[5] The primary transmission risks for Ebola are in direct contact, particularly in caring for a patient in the late-stage of the disease and in unsafe burials.[6] Indirect contact with fomites (objects) or a bodily fluid-contaminated surface also carries some risk.[6] Spread though more distant contact such as water and wastewater, although theoretically possible, has not been described *in humans* in the literature.

Thus, the traditional pillars of treatment—isolation of infected persons, contact tracing, safe burials, outreach, health promotion, and psycho−social support—are the basis of the Ebola response.[7] The application of these pillars has successfully prevented ongoing transmission in the current outbreak in Nigeria, the United States, Senegal, Spain, and Mali.

The authors question the current WHO recommendation for liquid waste disposal—which have been adopted by the CDC and EPA in the United States—of direct disposal in the sewer without disinfection. They references the Nebraska Biocontainment Unit's decision to "place liquid waste along with hospital grade disinfectant [unnamed] at the appropriate manufacturer recommended ratio and held for 2.5 times the recommended contact time before flushing", which "surpassed the CDC's guideline" and "was positively received by numerous stakeholders within the surrounding community and alleviated concerns of local plumbing and public works organizations."[8]

The authors', however, do not state the reasons WHO does not recommend disinfection of liquid Ebola wastes before disposal, which include the following: (1) The chlorine demand of liquid wastes will rapidly inactivate the chlorine, leaving the chlorine unavailable for disinfection and potentially a false sense of security among handlers.[9] (2) Existing evidence on direct chlorination of even pretreated feces notes "rapid initial mixing [within 3 seconds] of the chlorine solution and wastewater is essential for efficient disinfection",[9] which creates an exposure risk to staff who are mixing. (3) Facilities in resource-poor environments do not treat small volumes of waste in a toilet; they store large volumes of liquid waste in containers.[10] Disinfecting waste directly (especially in resource-poor settings) can thus actually increase the risk of onward transmission. Organizations that do directly disinfect waste require personnel to wear full PPE.[10]

Thus, a necessary research question the authors' fail to identify is to assess the potential of disinfectants at efficaciously removing Ebola from liquid wastes, in order to develop evidence-based recommendations. At this point, the WHO recommendations are based on the best available scientific evidence. While "surpassing" them in the United States may have alleviated community concern, there is scant evidence doing so effectively reduced risk of ongoing transmission.

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The public is fearful of this current Ebola outbreak: 85% of Americans incorrectly believe Ebola can be transmitted in a cough or sneeze; 52% are concerned there will be a large Ebola outbreak in the next 12 months in the United States; and 38% say they or someone in their immediate family may get sick with Ebola in the next 12 months.[11] As scientific professionals, it is our responsibility give a balanced presentation of scientific knowledge to the public. The authors' letter does not do this. While environmental research as outlined by the authors is necessary and should be completed (especially as the current Ebola outbreak is larger and with more sustained transmission than any previous outbreak), this research should be conducted within an accurate understanding of the larger epidemiological picture of Ebola. In particular, it is imperative that existing data be presented objectively, as readers of their letter could be left—incorrectly—with the impression that liquid wastes from Ebola patients presently pose a substantial risk to the wider community.

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Notes

The authors declare no competing financial interest.

REFERENCES

(1) Bibby, K.; Casson, L.; Stachler, E.; Haas, C. Ebola virus persistence in the environment: State of the knowledge and research needs. *Environ. Sci. Technol. Lett.* **2014**, *2* (1), 2−6.

(2) Piercy, T. J.; Smither, S. J.; Steward, J. A.; Eastaugh, L.; Lever, M. S. The survival of filoviruses in liquids, on solid substrates and in a dynamic aerosol. *J. Appl. Microbiol.* **2010**, *109* (5), 1531−9.

(3) Casanova, L.; Rutala, W. A.; Weber, D. J.; Sobsey, M. D. Survival of surrogate coronaviruses in water. *Water Res.* **2009**, *43* (7), 1893−1898.

(4) Lai, M.; Cheng, P.; Lim, W. Survival of severe acute respiratory syndrome coronavirus. *Clin Infect Dis* **2005**, *41* (7), 67−71.

(5) House, T. Epidemiological dynamics of Ebola outbreaks. *Elife* **2014**, DOI: 10.7554/eLife.03908.

(6) Feldmann, H.; Geisbert, T. W. Ebola haemorrhagic fever. *Lancet* **2011**, *377* (9768), 849−862.

(7) Doctors without Borders. http://www.doctorswithoutborders.org (accessed January 2015).

(8) Lowe, J. J.; Gibbs, S. G.; Schwedhelm, S.; Nguyen, J.; Smith, P. W. Nebraska Biocontainment Unit perspective on disposal of Ebola medical waste. *Am. J. Infect. Control* **2014**, *42*, 1256−1257.

(9) *Manual for Wastewater Chlorination and Dechlorination Practices*; California State Water Resources Control Board: Sacramento, CA, 1981.

(10) Personal communication with Daniele Lantagne, 2014.

(11) Poll: Most believe Ebola likely spread by multiple routes, including sneezing, coughing, October 15, 2014. Harvard School of Public Health. http://www.hsph.harvard.edu/news/press-releases/poll-finds-most-believe-ebola-spread-by-multiple-routes/ (acccessed January 2015).

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