



Image credit: Juba, South Sudan, May 2014. Kieran Doherty/Oxfam.

WASH INTERVENTIONS IN DISEASE OUTBREAK RESPONSE

About this evidence brief

This evidence brief provides an overview of *WASH interventions in disease outbreak response* – an evidence synthesis published in February 2017 by the Humanitarian Evidence Programme and carried out by a team from the Civil and Environmental Engineering Department of Tufts University. It summarizes key findings in response to four research questions, indicates the country contexts from which evidence is drawn, outlines the methodology, highlights research gaps and provides references to the original literature.

The brief aims to assist policymakers, practitioners and researchers in assessing the available evidence in this field. It does not provide advice on which interventions or approaches are more or less appropriate in any given context. The varied and varying nature of crisis, vulnerability, goals of humanitarian programming, local conditions and quality of available data make the evidence highly contextual. *The views and opinions expressed herein are those of the authors and do not necessarily represent those of Oxfam, Feinstein or the UK government.*

Objectives of the evidence synthesis

The evidence synthesis identifies, synthesizes and evaluates existing evidence of the impacts of water, sanitation and hygiene (WASH) interventions in disease outbreaks in 51 humanitarian contexts in 19 low and middle-income countries (LMICs). Specifically, it set out to answer four key research questions:

- What are the health impacts of WASH interventions in disease outbreaks?
- What are important WASH programme design and implementation characteristics in disease outbreaks?
- What are the population-related barriers and facilitators that affect WASH interventions in disease outbreaks?
- What are the economic outcomes of WASH interventions in disease outbreaks?

About the evidence synthesis

The protocol, full synthesis and executive summary on which this evidence brief is based are available from [Feinstein International Center](#), [Oxfam Policy & Practice](#) and [UK government](#) websites. Citation:

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About the Humanitarian Evidence Programme

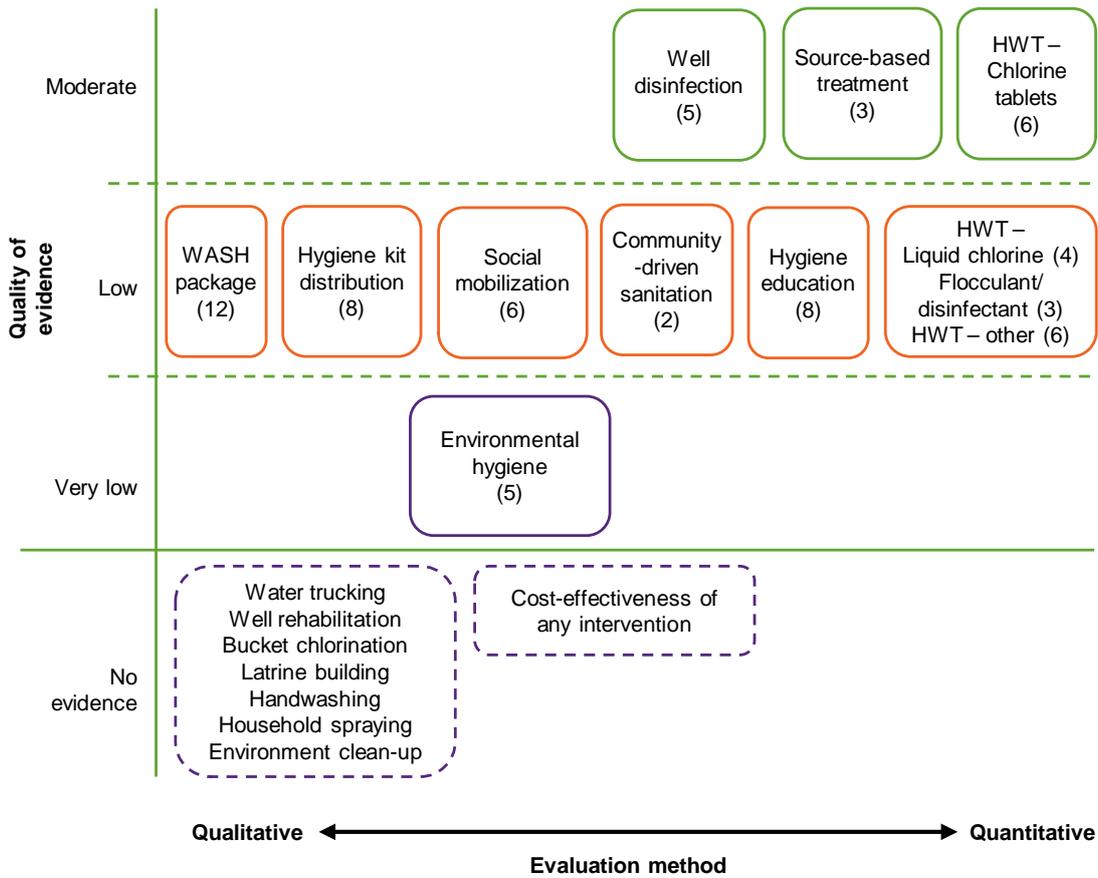
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Figure 1: WASH interventions in disease outbreaks – evidence map. Source: The research team



HWT: household water treatment.

Findings

What are the health impacts of WASH interventions in disease outbreaks?

WASH interventions consistently reduce both the risk of disease and the risk of transmission in outbreak contexts.

- **Reduced disease risk** – evaluations of the health impacts of WASH interventions in disease outbreaks using measured change in disease rates were rarely conducted. Only six such evaluations were identified. Five of these involve less common household water treatment (HWT) interventions (PUR, simple filters, SODIS and safe storage) and in all cases showed reduced disease rates. The sixth evaluation – a long-running Community-Led Total Sanitation (CLTS) intervention implemented before and during an Ebola virus disease ('Ebola') outbreak – recorded a large and significant reduction in disease risk.
- **Reduced transmission risk** – evaluations of the impact on risk of transmission of WASH interventions were more common than disease risk evaluations and included: well disinfection, chlorine dispensers and HWT (liquid chlorine, chlorine tablets and flocculant/disinfectants). Some evaluations also demonstrated reduced short-term transmission risk with environmental hygiene interventions.

Programme design and beneficiary preferences are important factors in ensuring WASH interventions reach their potential.

What are important WASH programme design and implementation characteristics in disease outbreaks?

The following four design and implementation characteristics are identified as important for effective programming:

- **simplicity** – some of the most basic interventions had a clear positive impact; interventions requiring little to no promotion led to incremental improvements that reduced the risk of disease and disease transmission
- **timing** – prepositioned stock, quick release of funds and early triggers for rapid scale-up were important facets of a positive response, particularly with hygiene kit and HWT interventions
- **engagement in the community** – community-driven interventions can increase awareness, trigger behaviour change and lead to local solutions
- **linking relief, rehabilitation and development** – linking with pre-existing programming reduces the need for rapid beneficiary behaviour change, and is an opportunity for responding agencies to increase local cultural understanding for future emergency response programmes.

Definitions

This synthesis focuses on WASH interventions targeted at populations affected by cholera, Ebola, hepatitis E, hepatitis A, typhoid, acute watery diarrhoea and bacillary shigellosis (dysentery).

The 10 WASH interventions covered are: well disinfection, source-based water treatment, HWT – chlorine-based products, HWT – other products, community-driven sanitation, hygiene promotion, social mobilization, hygiene kit distribution, environmental hygiene and WASH package.

'Outbreaks' are defined in accordance with World Health Organization (WHO) guidelines (WHO, 2016b):

- the occurrence of disease in excess of the normal baseline (two times the baseline) or a sudden spike in cases (two times the incidence of new cases)
- a single case of a communicable disease long absent from a population, or caused by a pathogen not previously recognized in that community or area
- emergence of a previously unknown disease
- a single case of particular diseases of interest (cholera, Ebola and hepatitis E).

What are the population-related barriers and facilitators that affect WASH interventions in disease outbreaks?

Four community perceptions and preferences affecting the success of WASH outbreak interventions are identified:

- **taste and smell** – taste and smell of HWT may hinder use (e.g. chlorine treatments can have an off-putting smell or taste) or facilitate use (e.g. filters and flocculant/disinfectants improve taste)
- **preferred communication** – radio and face-to-face communication were consistently reported as 'most trusted' or 'most valued' for hygiene communication
- **perception of risk** – community understanding of some interventions overestimate effectiveness and risk reduction potential (i.e. household spraying and well disinfection)
- **trust/fear** – social mobilization and open communication between the community and responders builds trust and greater community cohesion.

What are the economic outcomes of WASH interventions in disease outbreaks?

It was not possible to assess the economic outcomes of WASH interventions as no economic evaluations were found and only minimal cost information is reported.

Methodology

The initial database and website searches took place between September 2015 and March 2016. Of the 15,026 studies identified in the systematic review process, 47 were deemed suitable following title, abstract and full screening.

The search criteria included studies published or written between 1995 and 2016. Those included in the review span the period 1998 to 2015.

The review encompassed:

- 19 low and middle-income countries and 51 contexts – the most frequently represented countries in the studies were Zimbabwe and Haiti
- cholera, Ebola, hepatitis E, hepatitis A, typhoid fever, acute watery diarrhoea and shigellosis
- 10 eligible interventions (see Definitions on previous page).

In terms of research design, 49 percent (25) of the studies were quantitative, 18 percent (9) qualitative and 33 percent (17) field commentary.

A roughly equal number of evaluations were identified from the peer-reviewed (26, 51 percent) and grey literature (25, 49 percent). Although the overall number of evaluations is roughly equal between published and grey literature, differences were seen by intervention, with water having more published evaluations and hygiene and WASH package having more grey literature evaluations.

Research gaps

Overall, the amount and quality of evidence of the health impacts of WASH interventions in outbreaks is found to be lacking and low. As illustrated in the evidence map (Figure 1), the review found better and more quantitative evidence relating to water interventions, source-based treatment and HWT than to hygiene, sanitation and WASH package interventions, which tend to be assessed with lower quality and in more qualitative studies.

While the 47 studies analysed provided solid information to generate comments, there were some limitations of the evidence, including:

- none include high quality evidence relating specifically to health impacts
- while they show consistent findings, most are low quality cross-sectional study designs, only two randomized controlled trials are included in the review
- those that are quantitative studies (mainly published and relating to water interventions) have less risk of bias
- those that evaluate WASH package interventions tend to be field commentary, unpublished and with a high risk of bias
- none provide evidence of the impacts of well rehabilitation, bucket chlorination, latrine building, handwashing, household spraying, water trucking, environmental drainage/clean-up or cost-effectiveness of any intervention
- none provide formal economic analysis of WASH interventions in disease outbreaks.

The weak evidence base is attributed to two factors:

- the prioritization of rapid response activities over research in emergency contexts
- the difficulty of conducting research in the rapidly changing and unstable settings where disease outbreaks often occur.

What were the most frequently represented diseases and interventions in the studies reviewed?

Cholera was the most researched and discussed disease, present in 44 of 51 contexts (86%), followed by acute diarrhoea (6%, 3), Ebola (4%, 2), shigellosis (2%, 1) and typhoid fever (2%, 1).

Water interventions were the most evaluated (22/51 contexts), followed by hygiene and WASH package, which made up 29 percent (15) and 24 percent (12) of included interventions, respectively; sanitation is least evaluated, making up only 4 percent (2/51) of the included studies.

Further considerations

While WASH interventions in disease outbreaks are under-researched, it is likely that population-related barriers and facilitators will remain critical to the success of WASH interventions and remain context specific. As such, for the sake of more effective interventions in the future, the following activities should be considered:

- well-designed non-experimental and qualitative studies to increase the evidence base, particularly on well rehabilitation, bucket chlorination, latrine building, household spraying, handwashing, water trucking, environmental drainage/clean-up and cost-effectiveness
- developing templates and protocols for consistent and robust evaluations
- evaluating interventions at the beneficiary level
- identifying intervention factors that lead to more scalable and more timely responses
- increasing responders' understanding of community preferences and cultural differences.

Overall, we found low quality but consistent evidence that some WASH interventions are successful at reducing the risk of disease transmission, although programme design, implementation characteristics and community aspects are critical to programme success.

References

Articles included in evidence synthesis

- Action Contre La Faim (ACF). (2007). *UNOCHA Emergency Funding Water and Sanitation Program in Kebri Dehar District, Somali Region*. Action Contre La Faim – France.
- ACF. (2009). *Household NFI monitoring Report (Post Distribution Monitoring (PDM))* May 2009. Action Contre La Faim – Zimbabwe.
- ACF. (2014a). *Hygiene Kits Post Distribution Monitoring Report*. Action Contre La Faim – South Sudan.
- ACF. (2014b). *Projet pilote de l'approche de marché pour la promotion du chlore liquide*. Action Contre La Faim.
- ACF. (2015). *Community Led Ebola Management and Eradication (CLEME) Trigger Behavioral Change to strengthen community's resilience to Ebola Outbreaks*. Action Contre La Faim.
- Cavallaro, E.C., Harris J.R., et al. (2011). *Evaluation of pot-chlorination of wells during a cholera outbreak, Bissau, Guinea-Bissau, 2008*. *Journal of Water and Health* 9(2):394–402. doi: 10.2166/wh.2011.122.
- Colwell, R.R., Huq, A. et al. (2003). *Reduction of cholera in Bangladeshi villages by simple filtration*. *Proc Natl Acad Sci USA* 100 (3), 1051–5. doi: 10.1073/pnas.0237386100.
- Condor, J. and Rana, R. (2011). *Evaluation of the International Organization for Migration's Ongoing Activities on Support to the Flash Appeal for the Haiti Earthquake and Cholera Outbreak*. IOM International Organization for Migration.
- Conroy, R.M., Meegan, M.E. et al. (2001). *Solar disinfection of drinking water protects against cholera in children under 6 years of age*. *Archives of disease in childhood* 85(4):293–95.
- Contzen, N. and Mosler, H-J. (2013). *Impact of different promotional channels on handwashing behaviour in an emergency context: Haiti post-earthquake public health promotions and cholera response*. *Journal of Public Health* 21(6), 559–73.
- Date, K., Person, B., et al. (2013). *Evaluation of a Rapid Cholera Response Activity-Nyanza Province, Kenya, 2008*. *Journal of Infectious Diseases* 208, S62–S68. doi: 10.1093/infdis/jit198.
- DeGabriele, J. and Musa, A.. (2009). *An emergency response to humanitarian WASH-related emergencies in Zimbabwe*. Action Contre la Faim and Welthungerhilfe Zimbabwe.
- Dinku, S., (2011). *Emergency Water, Sanitation, and Hygiene Interventions for AWD and Drough Affected Pastoral Communities in Borana Zone, Ethiopia*. Action Contre La Faim – International.
- Doocy, S. and Burnham G. (2006). *Point-of-use water treatment and diarrhoea reduction in the emergency context: an effectiveness trial in Liberia*. *Tropical Medicine & International Health* 11(10), 1542–52.
- Dunston, C., McAfee, D. et al. (2001). *Collaboration, cholera, and cyclones: A project to improve point-of-use water quality in Madagascar*. *American Journal of Public Health* 91 (10):1574–76. doi: 10.2105/ajph.91.10.1574.
- Einarsdóttir, J., Passa, A. and Gunnlaugsson, G. (2001). *Health Education and Cholera in Rural Guinea-Bissau*. *International Journal of Infectious Diseases* 5(3), 133–38.
- El-Mahmid, I. and Roussy, S. (2009). *Zimbabwe Emergency Response*. Action Contre la Faim.
- Garandeau, R., Trevett, A. and Bastable, A. (2006). *Chlorination of hand-dug wells in Monrovia*. *Waterlines* 24(3), 19–21.
- Gartley, M., Valeh, P. et al. (2013). *Uptake of household disinfection kits as an additional measure in response to a cholera outbreak in urban areas of Haiti*. *Journal of Water and Health* 11(4), 623–28. doi: 10.2166/wh.2013.050.
- Gauthier, J., 2014. *A real-time evaluation of ACF's response to cholera emergency in Juba, South Sudan*. Action Contre la Faim – International.
- Grayel, Y. (2011). *Evaluation Externe Réponse d'Urgence à L'Epidémie de Choléra en Haïti*. Action Contre la Faim – International (ACF – IN).
- Grayel, Y. (2014). *Programme D'Intervention Pour Limiter et Prevenir la Propagation de l'Epidemie du Cholera*. Action Contre la Faim – International.
- Guevart, E., Van Hecke, C. et al. (2008). *Handmade devices for continuous delivery of hypochlorite for well disinfection during the cholera outbreak in Douala, Cameroon* (2004). *Medecine tropicale: revue du Corps de sante colonial* 68 (5):507–13.
- Huq, A., Yunus, M. et al. (2010). *Simple sari cloth filtration of water is sustainable and continues to protect villagers from cholera in Matlab, Bangladesh*. *MBio* 1(1), doi: 10.1128/mBio.00034-10.
- Imanishi, M., Patience F. et al. (2014). *Household Water Treatment Uptake during a Public Health Response to a Large Typhoid Fever Outbreak in Harare, Zimbabwe*. *American Journal of Tropical Medicine and Hygiene* 90(5), 945–54. doi: 10.4269/ajtmh.13-0497.
- Lantagne, D.S. and Clasen, T.F. (2012). *Use of Household Water Treatment and Safe Storage Methods in Acute Emergency Response: Case Study Results from Nepal, Indonesia, Kenya, and Haiti*. *Environmental Science & Technology*. 46(20), 11352–60. doi: 10.1021/es301842u.
- Libessart, Y., and Youcef, H. (2000). *Integrated chlorination campaign in Mogadeshu*. *WEDC* 26.
- Matemo, C. (2014). *Use of H2S Tests to Monitor Water Quality in Insecure Environment*. Action Contre la Faim – Kenya.

- Meyer Capps, J., and Njiru, H. (2015). *Open Defecation Status, Community-Led Total Sanitation and Ebola Virus Disease (EVD) in Voinjama and Kolahun Health Districts, Lofa County, Liberia* (2014). Global Communities.
- Mong, Y., Kaiser, R. et al. (2001). *Impact of the safe water system on water quality in cyclone-affected communities in Madagascar*. *American Journal of Public Health* 91(10), 1577–9. doi: 10.2105/ajph.91.10.1577.
- Neseni, N. and Guzha, E. (2009). *Evaluation of the WASH Response to the 2008–2009 Zimbabwe Cholera Epidemic and Preparedness Planning for Future Outbreaks*. Institute of Water and Sanitation Development.
- Ngegba, S. (2002). *Water and Sanitation Programme*. Tearfund UK.
- Pennacchia, V., Poidatz, J. and Hearne, N.. (2011). *Bridging the Gap: Providing Water and Sanitation and Non-Food Item Assistance to Returnees, IDPs and Host Communities in North Kivu*.
- Rees-Gildea, P. (2013). *Sierra Leone Cholera ERU Operation Review*. International Federation of Red Cross and Red Crescent Societies (IFRC).
- Roberts, L., Chartier, Y. et al. (2001). *Keeping clean water clean in a Malawi refugee camp: a randomized intervention trial*. *Bulletin of the World Health Organization* 79(4), 280–87.
- Rowe, A.K. (1998). *Chlorinating well water with liquid bleach was not an effective water disinfection strategy in Guinea-Bissau*. *International Journal of Environmental Health Research* 8(4):339–40. doi: 10.1080/09603129873444.
- Ruiz-Roman, E. (2009). *Evaluation of the Blanket Distribution of Nonfood Items as Part of the Cholera Response in Zimbabwe*. UNICEF Zimbabwe.
- Simpson, R., Legesse, N.B. and Mubayiwa, R. (2009). *Real Time Evaluation of the Cholera Response in Zimbabwe*. Oxfam International.
- Steele, A., Clarke, B. and Watkins, O. (2008). *Impact of jerry can disinfection in a camp environment-experiences in an IDP camp in Northern Uganda*. *Journal of water and health* 6(4), 559–64.
- Tokplo, H. (2015). *Project de Reprise Communautaire de la Lutte Contre le Cholera et les Maladies Hydriques dans les Zones de Sante de Minova (Sud Kivu) et de Kirotshe (Nord Kivu), R.D. Congo*. Action Contre la Faim – R.D. Congo.
- Walden, V.M., Lamond, E.A. and Field, S.A. (2005). *Container contamination as a possible source of a diarrhoea outbreak in Abou Shouk camp, Darfur province, Sudan*. *Disasters* 29(3), 213–21.
- Wall, I. and Chéry, Y.G. (2011). *Ann Kite Yo Pale: Let Them Speak*.
- Waterkeyn, J., Okot, P. and Kwame, V. (2005). *Rapid sanitation uptake in the internally displaced people camps of northern Uganda through community health clubs*. *WEDC* 31.
- World Health Organization (WHO). (no date). *Guidance on communication with respect to safe drinking water and household hygiene: Literature review, interviews and case studies*.
- Williams, H.A., Gaines, J. et al. (2015). *Perceptions of Health Communication, Water Treatment and Sanitation in Artibonite Department, Haiti*, March–April 2012. *PLoS ONE* 10(10), 1–17. doi: 10.1371/journal.pone.0142778.
- Yates, T.M., Armitage, E. et al. (2015). *Effectiveness of chlorine dispensers in emergencies: case study results from Haiti, Sierra Leone, Democratic Republic of Congo and Senegal*. *Environ Sci Technol.* 49(8), 5115–22. doi: 10.1021/acs.est.5b00309.

Other studies cited in the synthesis

- Aggarwal, R., and Sita, N. (2009). *Epidemiology of hepatitis E: Current status*. *Journal of Gastroenterology & Hepatology* 24 (9), 1484–93. doi: 10.1111/j.1440-1746.2009.05933.x.
- Ali, M., A.L. Lopez. et al. (2012). *The Global Burden of Cholera*. *Bull World Health Organ* 90 (3):209–218A. doi: 10.2471/BLT.11.093427.
- Ali, S.I., and Kadir, K. (2016). *WASH in Emergencies Problem Exploration Report: Water Treatment*. Humanitarian Innovation Fund.
- Baird, S., Ferreira, F., et al. (2013). *Relative effectiveness of conditional and unconditional cash transfers for schooling outcomes in developing countries: a systematic review*. *Campbell systematic reviews* 9 (8).
- Blanchet, K, Sistenich, V. et al. (2013). *An evidence review of research on health interventions in humanitarian crises*. London: London School of Hygiene & Tropical Medicine, Harvard School of Public Health, Overseas Development Institute.
- Boccia, D., Guthmann, J-P. et al. (2006). *High mortality associated with an outbreak of hepatitis E among displaced persons in Darfur, Sudan*. *Clinical infectious diseases: an official publication of the Infectious Diseases Society of America*. 42(12), 1679–84. doi: 10.1086/504322.
- Brown, J., Jeandron, A., et al. (2012). *Evidence review and research priorities: Water, sanitation, and hygiene for emergency response*. London: SHARE at London School of Hygiene & Tropical Medicine.
- Cairncross, S., Cumming, O., et al. (2013). *Water, Sanitation and Hygiene Evidence Paper*. In *Evidence Paper*. Department for International Development.
- Darcy, J., Stobaugh, H., et al. (2013). *The Use of Evidence in Humanitarian Decision Making ACAPS Operational Learning Paper*. Feinstein International Centre.
- de Vries, D.H., Rwemisisi, J.T. et al. (2016). *The first mile: community experience of outbreak control during an Ebola outbreak in Luwero District, Uganda*. *BMC Public Health* 16:161. doi: 10.1186/s12889-016-2852-0.

- Dunoyer, J. and Sudre, B. (2012). *Le choléra au Tchad en 2011 et les stratégies d'intervention associées*. Action Contre la Faim – France.
- Flachenberg, F., Davis, R., Duffy, M. and Tamming, R. (2015). *Hygiene promotion in Ebola: embedding best practices for safe and dignified burials, the case of Freetown, Sierra Leone*. Water, Engineering and Development Centre (WEDC) Loughborough University of Technology 38.
- Gaffga, N.H., Tauxe, R.V. and Mintz, E.D. (2007). *Cholera: A New Homeland in Africa?* *American Journal of Tropical Medicine and Hygiene* 77(4), 705–13.
- George, C.M., Shirajum, M., et al. (2016). *Randomized controlled trial of hospital-based hygiene and water treatment intervention (CHoBI7) to reduce cholera*. *Emerging Infectious Diseases* 22, 233+.
- GIDEON. (2016). Global Infectious Disease and Epidemiology Online Network. <http://www.gideononline.com/>
- Godfrey, S., McCaffery, L. et al. (2003). *The Effectiveness of Point-Source Chlorination in Improving Water Quality in Internally Displaced Communities in Angola*. *Water and Environment Journal* 17(3), 149–51.
- Grange, C. (2016). *WASH in Emergencies Problem Exploration Report: Faecal Sludge Management*. Humanitarian Innovation Fund.
- Hakim, M.S., Wang, W. et al. (2016). *The global burden of hepatitis E outbreaks: a systematic review*. *Liver Int.* doi: 10.1111/liv.13237.
- Higgins, J.P.T. and Green, S. (2008). *Cochrane handbook for systematic reviews of interventions*. Vol. 5: Wiley Online Library.
- Joint Monitoring Program (JMP). (2014). *Progress on Drinking Water and Sanitation 2014 Update*. Geneva, Switzerland.
- Kaur, M. (2016). *Cholera Case Control Studies: A Systematic Review and Analysis*. Master of Science, Civil and Environmental Engineering Tufts University.
- Legrand, J., Grais, R.F. et al. (2007). *Understanding the dynamics of Ebola epidemics*. *Epidemiology and Infection* 135(4), 610–21. doi: 10.1017/S0950268806007217.
- Loo, S., Fane, A.G., Krantz, W.B. and Lim, T-T. (2012). *Emergency water supply: a review of potential technologies and selection criteria*. *Water research* 46(10), 3125–51. doi: 10.1016/j.watres.2012.03.030.
- Murray, J., McFarland, D.A. and Waldman, R.J. (1998). *Cost-effectiveness of oral cholera vaccine in a stable refugee population at risk for epidemic cholera and in a population with endemic cholera*. *Bulletin of the World Health Organization* 76(4), 343–52.
- Nielsen, C.F., Kidd, S. et al. (2015). *Improving Burial Practices and Cemetery Management During an Ebola Virus Disease Epidemic – Sierra Leone, 2014*. *Morbidity and Mortality Weekly Report* 64 (1), 20–7.
- Oxfam. (2014). *Turning the tide on Ebola: Scaling up public health campaigns before it's too late*. Oxfam.
- Oxman, A.D. and GRADE Working Group. (2004). *Grading quality of evidence and strength of recommendations*. *BMJ*. 328(19), 1490–4.
- Parkinson, J. (2009). *A Review of the Evidence Base for WASH interventions in Emergency Responses*.
- Ramesh, A., Blanchet, K., et al. (2015). *Evidence on the Effectiveness of Water, Sanitation, and Hygiene (WASH) Interventions on Health Outcomes in Humanitarian Crises: A Systematic Review*. *PLoS ONE* 10(9), 1–20. doi: 10.1371/journal.pone.0124688.
- Ramos, M., Benelli, P., Irvine, E. and Watson, J. (2016). *WASH in Emergencies Problem Exploration Report: Handwashing*. Humanitarian Innovation Fund.
- Reed, B. and Mena-Moreno, R. (2016). *WASH in Emergencies Problem Exploration Report: Solid Waste Management*. Humanitarian Innovation Fund.
- Rowe, A.K. (1998). *Chlorinating well water with liquid bleach was not an effective water disinfection strategy in Guinea-Bissau*. *International Journal of Environmental Health Research* 8(4):339–40. doi: 10.1080/09603129873444.
- Smith, K.F., Goldberg, M. et al. (2014). *Global rise in human infectious disease outbreaks*. *Journal of The Royal Society Interface*. 11(101), 20140950. doi: 10.1098/rsif.2014.0950.
- Spencer, L., Ritchie, J., Lewis, J. and Dillon, L. (2003). *Quality in qualitative evaluation: a framework for assessing research evidence*.
- Sphere Project. (2011). *Sphere Handbook: Humanitarian Charter and Minimum Standards in Disaster Response*. 3rd ed. Sphere Project.
- Steele, A. and Clarke, B. (2008). *Problems of treatment process selection for relief agency water supplies in an emergency*. *Journal of Water and Health* 6(4), 483–9.
- Taylor, D.L., Kahawita, T.M., Cairncross, S. and Ensink J. (2015). *The Impact of Water, Sanitation and Hygiene Interventions to Control Cholera: A Systematic Review*. *PLoS ONE*. 10(8), 1–19. doi: 10.1371/journal.pone.0135676.
- Tota-Maharaj, K. (2016). *WASH in Emergencies Problem Exploration Report: Surface Water Drainage*. Humanitarian Innovation Fund.
- UNICEF. (2013). *Cholera Toolkit*. edited by Programme Division. New York.
- Water 1st International. (2015). *Paths of Disease Transmission*. Retrieved 14 May 2016. <http://water1st.org/problem/f-diagram/>
- Watson, J.T., Gayer, M. and Connolly, M.A. (2007). *Epidemics after Natural Disasters*. *Emerging Infectious Diseases*. 13(1):1–5.

WHO (2014). Health Facility Information Systems Resource Kit. Geneva, Switzerland: World Health Organization, US Agency for International Development (USAID), University of Oslo.

WHO. (2016a). *Cholera case fatality rate: Situation and trends*. WHO Retrieved 14 July 2016.
http://www.who.int/gho/epidemic_diseases/cholera/case_fatality_rate_text/en/

WHO. (2016b). *Disease Outbreaks*. WHO. Retrieved 14 July 2016.
http://www.who.int/topics/disease_outbreaks/en/

WHO. (2016c). *Ebola Situation Reports*. WHO Retrieved 15 May 2016. <http://apps.who.int/ebola/ebola-situation-reports>

WHO. (2016d). *Global Health Observatory (GHO) Data: Number of reported cholera cases*. Retrieved 25 June 2016.
http://www.who.int/gho/epidemic_diseases/cholera/cases_text/en/

Yates, T., Vijcic, J. et al. (2015). *Impact of WASH interventions during disease outbreaks in humanitarian emergencies: A systematic review protocol*. Oxfam.