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washplus Weekly
Supportive Environments for Healthy Communities

Issue 180| Feb 27, 2015 | Water Quality

Thanks to Ryan Rowe of the UNC Water Institute for suggesting this Weekly topic and for sharing recent studies on the issue of water quality. The studies and reports in this issue include a World Health Organization (WHO) technical brief on boiling water; a review of household water treatment to prevent diarrheal diseases; Tufts University reports on chlorine and turbidity and chlorine solution for Ebola emergencies; and studies on water quality in water bags and bottled water.

2015 STUDIES AND REPORTS

Technical Brief: Boil Water, 2015. WHO. Link
The process of heating water to a rolling boil, as recommended in the WHO Guidelines for Drinking-Water Quality (WHO 2011), is sufficient to inactivate pathogenic bacteria, viruses, and protozoa. After the water has reached a rolling boil, it should be removed from the heat, allowed to cool naturally, without the addition of ice, and protected from post-treatment recontamination during storage. If turbid water needs to be clarified for aesthetic reasons, this should be done before boiling.

Household Water Treatment and Safe Storage to Prevent Diarrheal Disease in Developing Countries. *Current Environmental Health Reports*, Jan 2015. T Clasen. Link
Household water treatment and safe storage (HWTS) methods, such as boiling, filtering, or chlorinating water at home, have been shown to be effective in improving the microbiological quality of drinking water. However, estimates of their protective effect against diarrhea, a major killer, have varied widely. Evidence suggests that the effectiveness of HWTS can be optimized by: ensuring that the method is microbiologically effective; making it accessible to an exposed population; and securing its consistent and long-term use.

Microbial Contamination of Drinking Water and Human Health from Community Water Systems. *Current Environmental Health Reports*, Jan 2015. N Ashbolt. Link
This review is relevant to most regions with functional drinking water treatment provided through a community system. A key realization is the need for ongoing systemwide vigilance, coupled with a preventative rather than just responsive management approach. Even with well-operated drinking-water treatment systems, there is growing concern that aging drinking water distribution systems are vulnerable to higher rates of mains breaks/repairs and related pressure losses that may lead to pathogen intrusion scenarios. In addition traditional monitoring practices may fall short of identifying poor treatment performance resulting from

rain-induced dirty-water events that appear to be associated with increased rates of waterborne gastrointestinal disease.

Preventing Diarrhoea through Better Water, Sanitation and Hygiene: Exposures and Impacts in Low- and Middle-Income Countries, 2015. WHO. Link
This report confirms that lack of safe water, sanitation, and hygiene remains one of the world's most urgent health issues, while acknowledging the impressive reductions in deaths from diarrhea that have been seen in recent years. In bringing together current evidence on exposure to unsafe drinking water, inadequate sanitation and hygiene, alongside the most up-to-date analysis on the health impacts of interventions, this document contributes to informed policy making and targeting of resources. It underscores how further progress can be achieved in this unfinished global water, sanitation, and health agenda.

Seasonal Variation of Fecal Contamination in Drinking Water Sources in Developing Countries: A Systematic Review. *Science of the Total Environment*, May 2015. C Kostyla, The Water Institute, University of North Carolina. Abstract/order info
Regular monitoring of the seasonal variability of fecal contamination of drinking water sources is an important step in improving continued access to safe drinking water. In Science of the Total Environment, the authors systematically reviewed 22 studies and show improved drinking water sources tend to be more contaminated during the wet season, regardless of bacteria type, source, climate zone, or population setting. Monitoring guidelines set by the World Health Organization and national water quality agencies should include guidance on seasonally representative water quality monitoring.

2014 STUDIES AND REPORTS

Circuit Rider Post-construction Support: Improvements in Domestic Water Quality and System Sustainability in El Salvador. *Jnl Water San Hyg for Develop, 4(3) 2014. G Kayser,* The Water Institute, University of North Carolina. Link
Small, rural, piped water supply systems are often unable to provide reliable, safe, and sustainable services. Circuit Rider (CR) post-construction support (PCS) addresses these challenges through technical, financial, and operational assistance. This article by The Water Institute at UNC is the first rigorous study of the CRPCS model. In a case-control study in El Salvador, CRPCS communities had better water quality and sustainability outcomes. CRPCS offers practitioners a low-cost approach (< $1 / household / year) for improving water services.

Fecal Contamination of Drinking-Water in Low- and Middle-Income Countries: A Systematic Review and Meta-Analysis. *PLoS Med*, May 2014. R Bain, The Water Institute, University of North Carolina. Link
Access to an "improved source" provides a measure of sanitary protection but does not ensure water is free of fecal contamination nor is it consistent between source types or settings. International estimates therefore greatly overstate use of safe drinking water and do not fully reflect disparities in access. An enhanced monitoring strategy would combine indicators of sanitary protection with measures of water quality.

Global Assessment of Exposure to Faecal Contamination Through Drinking Water Based on a Systematic Review. *Trop Med and Intl Health*, May 2014**.** R Bain, The Water Institute, University of North Carolina. **Link**

Global and regional estimates were derived from a *PLOS Medicine* systematic review of over 300 studies of fecal indicator bacteria. This study estimated that 1.1 billion people drink water from sources that are of at least "moderate" risk. Earlier global burden of disease estimates may have substantially understated the disease burden associated with inadequate water services. The results are reported in a series on the global burden of diarrhoeal disease due to water, sanitation, and hygiene.

Comparison and Cost Analysis of Drinking Water Quality Monitoring Requirements Versus Practice in Seven Developing Countries. *Int J Environ Res Public Health*, July 2014. J Crocker, The Water Institute, University of North Carolina. Link
Drinking water quality monitoring programs aim to support the provision of safe drinking water by informing water quality management. Little evidence or guidance exists on best monitoring practices for low-resource settings. Across seven study countries, few distinct approaches to monitoring were observed, and in all but one country all monitoring relied on fixed laboratories for sample analysis. There is potential for substantive optimization of monitoring programs by considering field-based testing and by fundamentally reconsidering monitoring approaches for non-piped supplies. This is the first study to look quantitatively at water quality monitoring practices in multiple developing countries.

Assessing the Microbial Quality of Improved Drinking Water Sources: Results from the Dominican Republic. *Am Jnl Trop Med Hyg*, Jan 2014. R Baum, The Water Institute, University of North Carolina. Link
This study by The Water Institute at UNC examined the relationship between microbial drinking water quality and drinking water source in the Puerto Plata region of the Dominican Republic, showing that 47% of improved drinking water sources were of high to very-high risk water quality, and therefore unsafe for drinking. This study provides evidence that microbial water quality data are needed to reliably assess the safety of drinking water.

Biochar for Control of Trace Contaminants in Water, 2014. J Kearns. Video
Research demonstrates the potential of char made from surplus biomass (biochar) as an effective sorbent for chemical toxins. Studies have shown that highly adsorbing biochar can be produced from surplus biomass using low-tech, efficient and environmentally friendly gasifier drum ovens.

India – Safe Drinking Water in Slums from Water Coverage to Water Quality. *Econ & Polit Weekly*, June 2014. B Satapathy. Link
This article analyzes the water, sanitation, and hygiene situation in slum households and compares it with the non-slum urban households using data from the 2011 census. It argues for a shift from mere water supply coverage to an emphasis on quality water distribution. Intermittent water supply coupled with poor sanitation contributes to higher health risks. Promoting point-of-use water treatment and basic hygiene practices on safe handling and storage of water are important preventive health interventions. This article advocates for a shift from availability of infrastructure to delivery of service-level outcomes.

Chlorine Demand and Microbiological Disinfection in Turbid Water, 2014. A Kaufmann, Tufts University. Link
Chlorinating water is one form of household water treatment that has been proven to be effective at disinfecting water; however, the ability of chlorine to effectively disinfect turbid waters is uncertain. Turbid waters tend to have a larger chlorine demand, and particulate

matter in turbid waters can shield microorganisms from disinfection. Therefore, a double dose (3.75 mg/L) of chlorine is recommended in turbid waters.

Methods to Test Chlorine Solution Concentrations in Ebola Emergencies, 2014. D Lantagne, Tufts University. **Link**
Chlorine solution is widely used for disinfection in emergency response activities. In Ebola response, 0.5 percent chlorine solution is recommended for cleaning nonliving things and surfaces and 0.05 percent chlorine solution is recommended for cleaning living things. The recommended chlorine solutions concentrations in Ebola response are too high to test with commonly used free chlorine residual (FCR) and total chlorine residual (TCR) test kits, which have a maximum reading of about 4 mg/L. Thus, alternate test methods are needed. Three alternate methods are described in this fact sheet: portable iodimetric titration kits; dilution followed by testing with FCR/TCR test kits; and calculation based on manufacturing.

Methods to Make Chlorine Solution in Ebola Emergencies, 2014. D Lantagne, Tufts University. Link
The recommended chlorine solutions concentrations in Ebola response are 5,000 ppm (for cleaning nonliving things/surfaces) and 500 ppm (for cleaning living things). Chlorine solutions in these concentrations can be purchased or manufactured on site. This fact sheet describes methods for onsite manufacturing, which include: dilution of HTH or NaDCC powder in water, dilution of concentrated liquid solution in water, and generating sodium hypochlorite using salt, water, and electricity.

The Bacteriological Quality of Different Brands of Bottled Water Available to Consumers in Ile-Ife, South-western Nigeria. *BMC Research Notes*, (7) 2014. O Igbeneghu. Link
Bottled water samples produced by the large scale multinational producers were of acceptable bacteriological quality unlike those produced by most small companies. The study concluded there is a need for greater control of water bottling processes carried out by commercial bottled water producers in Nigeria.

Water Bags as a Potential Vehicle for Transmitting Disease in a West African Capital, Bissau. *International Health*, Apr 2014. A Bordalo. Link
Street vendors of chilled packaged water play an increasing role in meeting the drinking water demand of people on the move in developing nations. Hygienic conditions can be questionable, and water quality screening scarce or nonexistent. This study tested water in hand-filled, hand-tied bags that originated from communal tap water and melted ice in Guinea-Bissau. Findings show that all packaged water samples were unfit for human consumption and during the 2012 cholera outbreak represented a potential vehicle for the spread of the disease. The design of measures to decrease the risk associated with the consumption of highly contaminated chilled water is clearly required.

Why Does Household Water Quality and Household Water Treatment (HWT) Matter? London School of Hygiene & Tropical Medicine (LSHTM). Link
LSHTM research focuses on identifying the extent and conditions in which HWT can actually prevent disease. This includes laboratory assessments of microbiological performance of filters and disinfection methods, field studies to assess the consistency and effectiveness of treatment practices, behavior trials to pilot and evaluate adoption of interventions, and rigorous randomized controlled trials to assess health impact in low-income settings as well as in emergency settings and among HIV-positive populations.

Water Distribution System Deficiencies and Gastrointestinal Illness: A Systematic Review and Meta-Analysis. *Env Hlth Perspec*, July 2014. A Ercumen. Link
Water distribution systems are vulnerable to performance deficiencies that can cause recontamination of treated water and plausibly lead to increased risk of gastrointestinal illness (GII) in consumers. The authors reviewed published studies that compared direct tap water consumption to consumption of tap water retreated at the point of use and studies of specific system deficiencies such as breach of physical or hydraulic pipe integrity and lack of disinfectant residual. Tap water consumption is associated with GII in malfunctioning distribution networks. System deficiencies such as water outages also are associated with increased GII, suggesting a potential health risk for consumers served by piped water networks.

Impact of the Provision of Safe Drinking Water on School Absence Rates in Cambodia: A Quasi-Experimental Study. *PLoS ONE*, Mar 2014. P Hunter. Link
There appears to be a strong association between providing free safe drinking water and reduced absenteeism, though only in the dry season. The mechanism for this association is not clear but may in part be due to improved hydration leading to improved school experience for the children.

Water Quality Laboratories in Colombia: A GIS-Based Study of Urban and Rural Accessibility. *Science of the Total Environment*, July 2014. J Wright. Abstract/order info
The objective of this study was to quantify sample transportation times associated with mandated microbiological monitoring of drinking water in Colombia. The analysis demonstrates the difficulty of undertaking microbiological monitoring in rural areas and small towns from a fixed laboratory network. Our GIS-based approach could be adapted to optimize monitoring strategies and support planning of testing and transportation infrastructure development. It could also be used to estimate sample transport and holding times in other countries.

Assessing the Consistency and Microbiological Effectiveness of Household Water Treatment Practices by Urban and Rural Populations Claiming to Treat their Water at Home: A Case Study in Peru. *PLoS One*, Dec 2014. G Rosa. **Link**
HWT can improve drinking water quality and prevent disease if used correctly and consistently by vulnerable populations. The objective of this study was to examine how HWT practices are actually performed by households identified as HWT users, according to international monitoring standards. The results raise questions about the usefulness of current international monitoring of HWT practices and their usefulness as a proxy indicator for drinking water quality. The lack of consistency and suboptimal microbiological effectiveness also raise questions about the potential of HWT to prevent waterborne diseases.

WASHplus Weeklies highlight topics such as Urban WASH, Household Air Pollution, Innovation, Household Water Treatment and Storage, Hand Washing, Integration, and more. If you would like to feature your organization's materials in upcoming issues, please send them to Dan Campbell, WASHplus Knowledge Resources Specialist, at dacampbell@fhi360.org.

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About WASHplus - WASHplus, a five-year project funded through USAID's Bureau for Global Health, supports healthy households and communities by creating and delivering interventions that lead to improvements in access, practice and health outcomes related to water, sanitation, hygiene (WASH) and household air pollution (HAP). WASHplus uses at-scale, targeted as well as integrated approaches to reduce diarrheal diseases and acute respiratory infections, the two top killers of children under five years of age globally. For information, visit www.washplus.org or email: contact@washplus.org.