

# THE ROLE OF WATER, SANITATION AND HYGIENE (WASH) IN HEALTHCARE SETTINGS TO REDUCE TRANSMISSION OF ANTIMICROBIAL RESISTANCE

ROCHELLE RAINEY (TOP), ENVIRONMENTAL HEALTH ADVISER, AND  
MERRI WEINGER (BOTTOM), ENVIRONMENTAL HEALTH TEAM LEADER, UNITED STATES AGENCY FOR  
INTERNATIONAL DEVELOPMENT (USAID)



The lack of safe water, functional toilets, and handwashing facilities in healthcare settings poses significant health risks to patients, healthcare workers and nearby communities. The ongoing global problem of health facility-acquired infections (HAI) has highlighted the consequences of the lack of water and sanitation facilities and practice of key hygiene behaviours. Antimicrobial resistance (AMR) is a multisectoral problem that requires a comprehensive strategy, including WASH improvements, to prevent emergence and transmission. Hand hygiene has been cited as the single most important practice to reduce HAI, and improved hand hygiene practices have been associated with a sustained decrease in the incidence of antimicrobial-resistant infections in healthcare settings. WASH also plays a role in the cleaning of surfaces and bedding for preventing transmission of HAI. Leadership and commitment is needed from governments, international and local organizations, donors and civil society to implement the global action plan to achieve universal access to WASH in healthcare facilities.

“Do no harm” has been a guiding principle of medicine for over 2,000 years. Two of the most basic interventions to “do no harm” are for healthcare providers to have and use a hygienic sanitation facility, and use running water with soap to wash their hands. Sustainable access to water and sanitation services and the correct and consistent practice of key hygiene behaviours (drinking safe water, use of basic sanitation and handwashing with soap before handling food and after contact with faeces) are important whether in household, public, school, or healthcare settings.

Globally, 91% of the population has access to a protected groundwater source or tap water for their drinking water. However, one in three people still lack access to hygienic sanitation facilities – including 946 million people who defecate in the open, increasing the risk of exposure to faecal pathogens for themselves and members of their communities (1). An estimated 81% of the world’s population does not wash hands with soap after contact with excreta (i.e., use of a sanitation facility or contact with children’s excreta) (2). The proportion of the population with a handwashing facility with soap and water in the household is less than 50% in most sub-Saharan countries (3). Repeated observational studies in

the United States have reported a maximum of 85% of adults washing their hands after using a public toilet (4, 5).

This lack of access to water and sanitation, and poor hygiene behaviour has major health impacts. The World Health Organization (WHO) estimates that 842,000 deaths from diarrhoeal diseases each year could be prevented by improved water, sanitation and hygiene (WASH) (6). Studies on the health impact of handwashing behaviour have also reported reductions in pneumonia (50%) (7), flu (40%) (7) and infective conjunctivitis (67%) (8). Basic hygienic practices by birth attendants and new mothers can reduce the risk of infections, sepsis and death for infants and mothers by over 15% (9, 10).

WASH services in healthcare facilities are fundamental to the provision of quality, people-centred care. Benefits include increased trust in, and uptake of, healthcare; increased efficiency and decreased costs of healthcare services; and improved staff working conditions and morale. All major initiatives to improve global health depend on sustainable provision of basic WASH services in healthcare facilities, yet data from 54 low- and middle-income countries’ healthcare facilities show that 38% do not have a basic water source (defined as tap water or a protected groundwater source), 19% do not have basic sanitation (defined as private and

hygienic toilets/latrines) and 35% do not have water and soap for handwashing. This lack of WASH services undermines the ability to provide safe, quality healthcare, and places both those providing and those seeking care at risk (11).

### Healthcare-associated infections

Healthcare-associated infections (HAIs) are infections acquired while receiving treatment for another condition in a healthcare setting. They are associated with a number of risk factors, including the health status of the patients, the type of medical procedure, the presence of pathogenic microorganisms and the physical environment where the healthcare is provided (12). The risk of acquiring HAIs is universal and affects every healthcare facility and system around the world. Impacts include prolonged hospital stays, financial burdens, long-term disability, excess deaths and increased resistance of microorganisms to antimicrobials.

The source of an HAI may be from the patient's own microbial flora, or it may be from other patients, hospital staff, or surfaces and equipment in the hospital environment; and transmission can take place by direct or indirect contact, or through an airborne route (12). Transmission of HAI through contaminated healthcare workers' hands is the most common pattern of infection in most settings (13).

### Antimicrobial resistance

Antimicrobial resistance (AMR) is resistance of a pathogenic microorganism to an antimicrobial drug that was originally effective for treatment of infections caused by that microorganism. While HAIs are recognized globally as a major patient-safety issue in healthcare and community settings, when the organism causing the infection is a strain that is resistant to the available treatment, the risk to the patient and the cost of treatment increase dramatically. A high percentage of hospital-acquired infections are caused by highly resistant bacteria such as methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococci* (VRE) and multidrug-resistant (MDR) Gram-negative bacteria.

The evolution of antimicrobial resistance is a natural process, but the use (and misuse) of antimicrobial drugs in human health and agricultural settings accelerates the emergence of drug-resistant strains of pathogens. Poor infection prevention and control practices and unsanitary conditions in healthcare facilities contribute to the further emergence and spread of antimicrobial resistance (14).

Antimicrobial resistance is a global health crisis that threatens the effective prevention and treatment of a range of infections. The global burden is unknown, but each year in the United States alone at least 2 million people become infected with bacteria that are resistant to antibiotics, and at least

23,000 people die as a direct result of these infections (15). Without effective treatment options, many standard medical treatments will become very high-risk procedures, with grave consequences if an antimicrobial-resistant infection occurs (14).

### The role of WASH in preventing HAI and antimicrobial resistance

The lack of safe water, functional toilets and handwashing facilities in healthcare settings poses significant health risks to patients, healthcare workers and nearby communities. The ongoing Ebola epidemic in West Africa (16) and periodic outbreaks of cholera on multiple continents have highlighted the devastating consequences of the lack of WASH facilities as a first line of defence for healthcare workers in preventing HAI and for patients in cholera treatment centres (17).

Antimicrobial resistance is a multisectoral problem that requires a comprehensive strategy to prevent emergence and transmission. Within healthcare settings, provision of adequate staff, supplies and services, as well as leadership and education of administrators, health workers, patients and visitors, are critical to create an institutional climate of safety. Information about standard precautions should be incorporated into patient information materials and provided upon admission to the facility.

Standard precautions are a set of evidence-based practices designed to protect both healthcare staff and patients. They represent the minimum infection prevention measures that apply to all patient care in any setting where healthcare is delivered and should be applied to every person every time to assure that transmission of disease does not occur. Standard precautions include:

- ➔ hand hygiene;
- ➔ use of personal protective equipment (e.g., gloves, gowns, facemasks) depending on the anticipated exposure;
- ➔ respiratory hygiene and cough etiquette;
- ➔ safe injection practices; and
- ➔ safe handling of potentially contaminated equipment or surfaces in the patient environment. In addition to consistent use of standard precautions, additional precautions apply to contact with patients with symptoms of an active infection (18).

Hand hygiene (handwashing with either plain or antiseptic-containing soap and water or use of alcohol-based products) has been cited frequently as the single most important practice to reduce HAI (19, 20) and improved hand hygiene practices have been associated with a sustained decrease in the incidence of antimicrobial-resistant infections in healthcare settings (21, 22).

However, the role of WASH in enabling standard precautions for infection prevention and antimicrobial resistance is much larger than just handwashing. Large volumes of water are required for daily cleaning of toilets, environmental surfaces and bedding; while a smaller amount of safe drinking water is required for daily consumption by patients, staff and visitors, and administration of oral medications to patients. Sanitation is also required for every person, multiple times per day, and lack of hygienic sanitation facilities will increase the risk of exposure to pathogens in human faeces.

Documented successes in reducing or eliminating antimicrobial-resistant infections in healthcare facilities have included a variety of combined interventions. Although the major focus of a control programme should be the prevention of hand transfer through hand hygiene, careful cleaning of patient rooms, bathrooms and medical equipment contributes substantially to the overall control of antimicrobial resistance transmission (23). Environmental reservoirs of pathogens during outbreaks are most often related to a failure to follow recommended procedures for amount, dilution and contact time during cleaning and disinfection, rather than due to the specific cleaning and disinfection agent used (18).

Enhanced tolerance to disinfectants has been shown in response to exposure at low concentrations, however, this resistance is unlikely to compromise the effectiveness of disinfectants because the actual concentrations used are much higher (24). Cleaning and disinfection of environmental surfaces is a fundamental step in reducing their potential contribution to the incidence of HAI, and surface disinfection must involve contact with all contaminated surfaces. In all healthcare settings, administrative, staffing and scheduling activities should prioritize the proper cleaning and disinfection of surfaces that could be implicated in transmission (25).

There is no evidence that over-the-counter antibacterial soap products are any more effective at preventing illness than washing with plain soap and water (16). Use of antibacterial soap may carry unnecessary risks of creating antimicrobial-resistant pathogens, given that their benefits are unproven, while antimicrobial resistance is a known and serious problem.

### Challenges and opportunities for WASH in healthcare settings

To address the challenge of reducing diarrhoeal disease, USAID, UNICEF and other partners created a strategic approach to WASH programming with three mutually supporting elements for achieving sustainable water and sanitation services (27):

- ➔ Access to WASH infrastructure and products (e.g. water supply and storage, latrine slabs/toilets, soap and drinking water treatment products).
- ➔ Support for adoption of behaviour change in operating and

maintaining WASH infrastructure and for adoption of key hygiene behaviours (e.g. training, mentoring, collecting and managing tariffs, social marketing, counselling, community demonstrations, school and community programmes).

- ➔ An effective enabling environment (e.g. supportive policies, technical and governance capacity, financing mechanisms and community mobilization).

These interconnected components are all necessary to implement effective hygiene improvement strategies and programmes that achieve public health impact and are even more important to ensure functioning WASH services to prevent HAI and transmission of antimicrobial resistance.

Many healthcare facilities do not have functioning WASH services, but even in settings where these do exist, adherence to handwashing remains low in all healthcare settings and among all types of staff (28). The overall average adherence from both developed and developing countries is 39% (29). Self-reported factors for poor adherence to hand hygiene include personal comfort; real or perceived lack of access to infrastructure and products; lack of knowledge or scepticism about the value of handwashing; forgets and/or is too busy; and lack of institutional guidelines for how and when to wash hands (30).

Given the broad range of factors affecting handwashing, improvement requires an institutional commitment and a strategic approach to integrate infection control practices into the organization's safety culture. Methods include educational and motivational programmes; role modeling; providing feedback on performance to individuals and groups; modifying and improving equipment; and administrative policies and sanctions (28).

### Improving healthcare through WASH

Hygiene, sanitation and water supply continue to have health implications in both developed and developing world settings. The active involvement of health professionals in hygiene, sanitation, and water supply is crucial to accelerating and consolidating progress for health. Meanwhile, modern medical practice is at risk from the complex and serious issue of antimicrobial resistance, which requires action across all sectors of government and society.

Combating antimicrobial resistance requires a three-fold approach: first, improving infection prevention and control; second, conserving the effectiveness of existing and future antimicrobials; and third, engaging in research to optimize such approaches and to develop new antimicrobials, vaccines, treatment alternatives and rapid diagnostic tools (31).

WASH in healthcare facilities provides the basis for “do no harm” and plays a critical role in infection control. Leadership

and commitment is needed from governments, international and local organizations, donors and civil society to implement the global action plan to achieve universal access to WASH in healthcare facilities (32) in order to improve quality of care, reduce HAIs and decrease development and transmission of antimicrobial resistance. ■

*Dr Rochelle Rainey has served as a Senior Environmental Health Adviser at USAID since 2005. She designs programmes to increase access to sustainable water and sanitation services and to increase correct and consistent adoption of improved hygiene behaviours in household, school and health facility settings. She is currently working with colleagues at the US Centers for Disease Control and Prevention, WaterAid Mali, WHO and other partners to assess the*

*health impacts of functioning water and sanitation infrastructure and improved hygiene behaviours by staff in healthcare facilities using post-surgical infections as the outcome variable.*

*Merri Weinger serves as the Environmental Health Team Leader in United States Agency for International Development's (USAID) Bureau for Global Health. She has over 25 years of experience in environmental health with a special focus on WASH and the design of behaviour change programmes. Ms Weinger participated in the 2014 Global Meeting on Improving WASH in Health Care Facilities where an action plan was drafted, and was also active in the successful efforts to include WASH in Health Care Facilities as part of the new Sustainable Development Goal 6: Ensure access to water and sanitation for all.*

## References

- WHO/UNICEF (2015). Progress on sanitation and drinking water: 2015 update and MDG assessment. [http://www.unicef.org/publications/index\\_82419.html](http://www.unicef.org/publications/index_82419.html) Accessed January 7, 2016
- Freeman MC, Stocks ME, Cumming O, Jeandron A, Higgins JP, Wolf J, Prüss-Ustün A, Bonjour S, Hunter PR, Fewtrell L, Curtis V. 2014. Hygiene and health: systematic review of handwashing practices worldwide and update of health effects. *Trop Med Int Health*. 2014 Aug; 19(8):906-16. <http://www.ncbi.nlm.nih.gov/pubmed/24889816> Accessed January 7, 2016
- WHO/UNICEF. 2015. Key facts from JMP 2015 report. [http://www.who.int/water\\_sanitation\\_health/monitoring/jmp-2015-key-facts/en/](http://www.who.int/water_sanitation_health/monitoring/jmp-2015-key-facts/en/) Accessed January 7, 2016
- 2010 ACI ASM Handwashing Study. [http://www.cleaninginstitute.org/clean\\_living/2010\\_aci\\_asm\\_handwashing\\_study.aspx](http://www.cleaninginstitute.org/clean_living/2010_aci_asm_handwashing_study.aspx) Accessed January 7, 2016
- 2005 ASM/SDA Hand Hygiene Survey. [http://www.cleaninginstitute.org/news/2005\\_amsda\\_hand\\_hygiene\\_survey.aspx](http://www.cleaninginstitute.org/news/2005_amsda_hand_hygiene_survey.aspx) Accessed January 7, 2016
- Prüss-Ustün A, Bartram J, Clasen T, Colford JM Jr, Cumming O, Curtis V, Bonjour S, Dangour AD, De France J, Fewtrell L, Freeman MC, Gordon B, Hunter PR, Johnston RB, Mathers C, Mäusezahl D, Medlicott K, Neira M, Stocks M, Wolf J, Cairncross S. 2014. Burden of disease from inadequate water, sanitation and hygiene in low- and middle-income settings: a retrospective analysis of data from 145 countries. *Trop Med Int Health*. Aug; 19(8):894-905. <http://www.ncbi.nlm.nih.gov/pubmed/24779548> Accessed February 3, 2016.
- Luby SP, Agboatwalla M, Feikin DR et al. Effect of handwashing on child health: a randomised controlled trial. *Lancet*. 2005; 366: 225-233. <http://www.ncbi.nlm.nih.gov/pubmed/16023513> Accessed January 7, 2016
- Talaat M, Afifi S, Dueger E, El-Ashry N, Marfin A, Kandeel A, Mohareb E, and El-Sayed N. 2011. Effects of Hand Hygiene Campaigns on Incidence of Laboratory-confirmed Influenza and Absenteeism in Schoolchildren, Cairo, Egypt Volume 17, Number 4, April 2011. <http://www.ncbi.nlm.nih.gov/pubmed/21470450> Accessed January 7, 2016
- Blencowe H, Cousens S, Mullany LC, Lee ACC, Kerber K, Wall S, Darmstadt GL, and Lawn JE. 2011. Clean birth and postnatal care practices to reduce neonatal deaths from sepsis and tetanus: a systematic review and Delphi estimation of mortality effect. *BMC Public Health*. 2011; 11(Suppl 3). <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3231884/> Accessed January 7, 2016
- Rhee V, Mullany LC, Khatri SK, Katz J, LeClerq SC, Darmstadt GL, Tielsch JM. Maternal and birth attendant hand washing and neonatal mortality in southern Nepal. *Arch Pediatr Adolesc Med*. 2008 Jul; 162(7):603-8. <http://www.ncbi.nlm.nih.gov/pubmed/18606930> Accessed January 7, 2016
- WHO/UNICEF. 2015. Water, sanitation and hygiene in health care facilities: Status in low- and middle-income countries and way forward. [http://www.who.int/water\\_sanitation\\_health/publications/wash-health-care-facilities/en/](http://www.who.int/water_sanitation_health/publications/wash-health-care-facilities/en/) Accessed January 7, 2016
- Hans Jörn Kolmos. 2012. Health Care Associated Infections: Sources and Routes of Transmission. In: *Infection Control - Updates*. Sudhakar C, Ed. InTechWeb.org. Croatia. <http://cdn.intechopen.com/pdfs-wm/28876.pdf> Accessed January 7, 2016
- WHO guidelines on hand hygiene in health care. 2009. <http://www.who.int/gpsc/5may/tools/9789241597906/en/> Accessed January 7, 2016
- WHO Antimicrobial resistance fact sheet. 2015. <http://www.who.int/mediacentre/factsheets/fs194/en/> Accessed January 7, 2016
- CDC. 2013. Antibiotic resistance threats in the United States. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. <http://www.cdc.gov/drugresistance/pdf/ar-threats-2013-508.pdf> Accessed January 7, 2016
- Morbidity and Mortality Weekly Report (MMWR) on Ebola: <http://www.cdc.gov/mmwr/>
- [http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6438a6.htm?cid=mm6438a6\\_w](http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6438a6.htm?cid=mm6438a6_w) Accessed January 12, 2016
- Daniels N, Simons L, Rodrigues A, Gunnlaugsson G, Forester T, Wells J, Hutwagner L, Tauxe R, Mintz E. First do no harm: making oral rehydration solution (ORS) safer in a cholera epidemic. *American Journal of Tropical Medicine and Hygiene* 1999; 60:1051-5.
- Siegel J, Rhinehart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee. 2006. Management of Multidrug-Resistant Organisms in Healthcare Settings. <http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf>. Accessed January 7, 2016
- Jarvis WR. Handwashing--the Semmelweis lesson forgotten? *Lancet* 1994;344(8933):1311-2. Cited in (15). <http://www.ncbi.nlm.nih.gov/pubmed/7968023> Accessed January 7, 2016
- Daniels IR, Rees BI. Handwashing: simple, but effective. *Ann R Coll Surg Engl* 1999;81:117-8. Cited in (15).
- Larson EL, Early E, Cloonan P, Sugrue S, Parides M. 2000. An organizational climate intervention associated with increased handwashing and decreased nosocomial infections. *Behav Med*;26(1):14-22. Cited in (15)
- Pittet D, Boyce JM. Hand hygiene and patient care: pursuing the Semmelweis legacy. *Lancet Infect Dis* 2001;9:20. Cited in (15)
- Sehulster LM, Chinn RYW, Arduino MJ, Carpenter J, Donlan R, Ashford D, Besser R, Fields B, McNeil MM, Whitney C, Wong S, Juraneck D, Cleveland J. 2004. Guidelines for environmental infection control in health-care facilities. Recommendations from CDC and the Healthcare Infection Control Practices Advisory Committee. [http://www.cdc.gov/hicpac/pdf/guidelines/eic\\_in\\_HCF\\_03.pdf](http://www.cdc.gov/hicpac/pdf/guidelines/eic_in_HCF_03.pdf) Accessed January 7, 2016
- Rutala W, Weber DJ, and the Healthcare Infection Control Practices Advisory Committee. Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008. [http://www.cdc.gov/hicpac/Disinfection\\_Sterilization/acknowledg.html](http://www.cdc.gov/hicpac/Disinfection_Sterilization/acknowledg.html) Accessed January 7, 2016
- Siegel J, Rhinehart E, Jackson M, Chiarello L, and the Healthcare Infection Control Practices Advisory Committee. 2007. Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings. <http://www.cdc.gov/hicpac/pdf/isolation/Isolation2007.pdf> Accessed January 7, 2016
- FDA consumer update. 2013. <http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm378393.htm#antibacterial> Accessed January 7, 2016
- The Hygiene Improvement Framework. 2004. EHP, UNICEF/WES, USAID, World Bank/WSP, WSSCC. [http://www.ehproject.org/PDF/Joint\\_Publications/JPO08-HIF.pdf](http://www.ehproject.org/PDF/Joint_Publications/JPO08-HIF.pdf) Accessed January 7, 2016
- Larson E, Kretzer E. 1995. Compliance with handwashing and barrier precautions. *J Hosp Infect*. Jun;30 Suppl:88-106. <http://www.ncbi.nlm.nih.gov/pubmed/7561001> Accessed January 7, 2016
- WHO Guidelines on Hand Hygiene in Health Care: First Global Patient Safety Challenge. 2009. Cited in Making Health Care Safer II: An Updated Critical Analysis of the Evidence for Patient Safety Practices. 2013. Evidence Reports/Technology Assessments, No. 211. Agency for Healthcare Research and Quality MD USA. <http://www.ncbi.nlm.nih.gov/books/NBK133371/>
- WHO guidelines on hand hygiene in health care. 2009. World Health Organization <http://www.who.int/gpsc/5may/tools/9789241597906/en/> Accessed January 7, 2016
- Declaration of the G7 Health Ministers, October 9, 2015, Berlin. <http://www.g8.utoronto.ca/healthG8/2015-berlin.html>. Accessed January 7, 2016
- WHO/UNICEF. 2015. Water, sanitation and hygiene in health care facilities: Status in low- and middle-income countries and way forward. [http://www.who.int/water\\_sanitation\\_health/publications/wash-health-care-facilities/en/](http://www.who.int/water_sanitation_health/publications/wash-health-care-facilities/en/) Accessed January 7, 2016