

# WASH in Healthcare Facilities Literature Review

Updated October 2022

Emory University's Center for Global Safe WASH conducted this informal literature review, which includes 85 published articles from scientific journals that specifically focus on water, sanitation, hygiene, cleaning, and waste management in healthcare facilities in low- and middle-income countries dating from 2005 to October 2022. They are organized by themes: [conditions & infrastructure](#), [monitoring](#), [implementation](#), [health systems & enabling environment](#), [sustainability](#), [costing and budgeting](#), [behaviors](#), [care-seeking behaviors & patient/staff satisfaction](#), [healthcare-associated infections & antimicrobial resistance](#), [cleaners](#), [gender](#), and [enterprise](#). Note that COVID-19 is a crosscutting theme for many of the articles published between 2020-22 and is denoted by an asterisk.

Because of the breadth of literature on hand hygiene in HCF and infection prevention and control (IPC), we have not included them in this review beyond when they are discussed as part of a more explicit WASH in HCF articles. Similarly, we have not included articles that focus exclusively on healthcare waste management, as that is also a large body of research. We encourage members of the community to seek additional research to that end.

When this literature review was originally published in 2019, it included 64 journal articles, plus additional grey literature. In the process of updating this literature review in 2022, it was decided to focus only on published scientific articles due to the extensive grey literature on the subject. For those interested in case studies and other works not published in scientific journals, visit the Resources section on [WASHinHCF.org](#). The USAID Water Currents [issue on WASH in Healthcare Facilities](#) is also a key compilation of resources.

We encourage the community to share any resource missing from this review that furthers the community's knowledge of WASH in HCF.

## Conditions & Infrastructure

1. [\\*Status of water, sanitation, and hygiene and standard precautions in healthcare facilities and its relevance to COVID-19 in Afghanistan](#). Alemi et al. 2022. Environmental Health and Preventive Medicine. 27(0), 6.
2. [Health facility preparedness for cholera outbreak response in four cholera-prone districts in Cameroon: a cross sectional study](#). Ateudjieu et al. 2019. BMC Health Services Research, 19(1), 458.
3. [How health professionals can leverage health gains from improved water, sanitation and hygiene practices. Perspectives in Public Health](#). Bartram et al. 2010. Volume: 130 issue: 5, page(s): 215-221.
4. [Lack of toilets and safe water in health-care facilities](#). Bartram et al. 2015. Bulletin of the World Health Organization 93:210.
5. [Environmental factors and WASH practices in the perinatal period in Cambodia: implications for newborn health](#). Bazzano et al. 2015. International journal of environmental research and public health. 12(3): 2392–2410.

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**WASH in Healthcare Facilities Literature Review**  
**Updated October 2022**

6. [Newborn Care in the Home and Health Facility: Formative Findings for Intervention Research in Cambodia.](#) Bazzano et al. 2016. Healthcare (Basel, Switzerland), 4(4), 94.
7. [\\*Access to and challenges in water, sanitation, and hygiene in healthcare facilities during the early phase of the COVID-19 pandemic in Ethiopia: A mixed-methods evaluation.](#) Berihun et al. 2022. PLoS one. 17(5), e0268272.
8. [Water, sanitation, and hygiene services in health care facilities in the Autonomous Province of Vojvodina, Serbia.](#) Bijelović et al. 2022. Journal of Water and Health. 20(1):12-22.
9. [Water availability at hospitals low- and middle-income countries: implications for improving access to safe surgical care.](#) Chawla et al. 2016. J. Surg Research 205, 169-178.
10. [Environmental conditions in health care facilities in low- and middle-income countries: Coverage and inequalities.](#) Cronk et al. 2018. Int J. Hyg. Environ. Health 221 (3), 409-422.
11. [Hygiene on maternity units: lessons from a needs assessment in Bangladesh and India.](#) Cross et al. 2016. Global Health Action. 9: 32541.
12. [Formative research for the design of a scalable water, sanitation, and hygiene mobile health program: CHoBI7 mobile health program.](#) George et al. 2019. BMC public health, 19(1), 1028.
13. [Water, Sanitation, and Hygiene in Rural Health-Care Facilities: A Cross-Sectional Study in Ethiopia, Kenya, Mozambique, Rwanda, Uganda, and Zambia.](#) Guo et al. 2017. Am. J. Trop. Med. Hyg. 97(4), 1033–1042.
14. [Predictors of water quality in rural healthcare facilities in 14 low-and middle-income countries.](#) Guo et al. 2019. Journal of Cleaner Production, 237, 117836.
15. [Access to emergency and surgical care in sub-Saharan Africa: the infrastructure gap.](#) Hsia et al. 2012. Health Policy and Planning. 27(3), 234–244.
16. [Water Supply, Sanitation, and Medical Waste Treatment and Disposal at Commune Health Centers in Vietnam.](#) Huong et al. 2018. Asia Pacific Journal of Public Health. 30(7)644-654.
17. [Water, sanitation and hygiene infrastructure and quality in rural healthcare facilities in Rwanda.](#) Huttinger et al. 2017. BMC Health Serv. Res. 517.
18. [Assessment of water, sanitation and hygiene service availability in healthcare facilities in the greater Kampala metropolitan area, Uganda.](#) Kayiwa et al. 2020. BMC Public Health. 20, 1767.
19. [\\*Access to water, sanitation and hygiene services in health facilities in sub-Saharan Africa 2013-2018: Results of health facility surveys and implications for COVID-19 transmission.](#) Kanyangarara et al. 2021. BMC Health Serv Res. 21(1):601.
20. [Water, sanitation and hygiene in Jordan’s healthcare facilities.](#) Khader et al. 2017. Int J. Health Care Qual. Assur. 30 (7), 645-655.

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**WASH in Healthcare Facilities Literature Review**  
**Updated October 2022**

21. [Association between infrastructure and observed quality of care in 4 healthcare services: A cross-sectional study of 4,300 facilities in 8 countries](#). Leslie et al. 2017. PLoS Medicine, 14(12), e1002464.
22. [A systematic review of waterborne infections from nontuberculous mycobacteria in health care facility water systems](#). Li et al. 2017. International Journal of Hygiene and Environmental Health. 220(3), 611-620.
23. [A cross-sectional assessment of primary healthcare facilities for provision of antenatal care: calling for improvements in Basic Health Units in Punjab, Pakistan](#). Majrooh et al. 2016. Health research policy and systems. 13(Suppl 1): 59.
24. [Status of water, sanitation and hygiene services for childbirth and newborn care in seven countries in East Asia and the Pacific](#). Mannava et al. 2019. Journal of Global Health. 9(2): 020430.
25. [Water, Sanitation, and Hygiene Service Availability at Rural Health Care Facilities in Southwestern Uganda](#). Mulogo et al. 2018. Journal of environmental and public health. 191:175.
26. [WASH infrastructure and practices in primary health care clinics in the rural Vhembe District municipality in South Africa](#). Potgieter et al. 2021. BMC Fam Pract. 22(1):8.
27. [Energy access in Malawian healthcare facilities: consequences for health service delivery and environmental health conditions](#). Reuland et al. 2019. Health Policy and Planning. czz118.
28. [Infrastructure and contamination of the physical environment in three Bangladeshi hospitals: putting infection control into context](#). Rimi et al. 2014. PLoS ONE, 9(2), e8.
29. [Rapid assessment of infrastructure of primary health care facilities - a relevant instrument for health care systems management](#). Scholz et al. 2015. BMC Health Services Research. 15, 183.
30. [Health-Care Facility Water, Sanitation, and Health-Care Waste Management Basic Service Levels in Bangladesh: Results from a Nation-Wide Survey](#). Unicomb et al. 2018. The American Journal of Tropical Medicine and Hygiene. 99(4): 916–923.

**Monitoring**

1. [Institutional WASH in the SDGs: data gaps and opportunities for national monitoring](#). Chatterley et al. 2018. J Water, San, Hyg. for Dev. 8(4): 595-606.
2. [Monitoring drinking water, sanitation, and hygiene in non-household settings: Priorities for policy and practice](#). Cronk et al. 2015. International Journal of Hygiene and Environmental Health. 218(8) 694-703.

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**WASH in Healthcare Facilities Literature Review**  
**Updated October 2022**

3. [Water, Sanitation, and Hygiene Services in Public Health-Care Facilities in Indonesia: Adoption of World Health Organization/United Nations Children’s Fund Service Ladders to National Data Sets for a Sustainable Development Goal Baseline Assessment](#). Odagiri et al. 2018. Am J Trop Med Hyg. 99(2), 546-551.
4. [Assessment of water, sanitation and hygiene in HCFs: which tool to follow?](#) Patel et al. 2019. Rev Environ Health. 34(4):435-440.
5. [WASH activities at two Ebola treatment units in Sierra Leone](#). Mallow et al. 2018. PLoS ONE. 13(5):e0198235

**Implementation**

1. [Improving water, sanitation and hygiene in health-care facilities, Liberia](#). Abrampah et al. 2017. Bulletin of the World Health Organization. 95:526-530.
2. [\\*Evaluation of water, sanitation and hygiene status of COVID-19 healthcare facilities in Ghana using the WASH FIT approach](#). Ashinyo et al. 2021. Journal of Water, Sanitation & Hygiene for Development. 11(3): 398-404.
3. [Evaluation of a Water and Hygiene Project in Health Care Facilities in Siaya County, Kenya, 2016](#). Davis et al. 2019. The American Journal of Tropical Medicine and Hygiene. 1(3), 576-579.
4. [Randomized Controlled Trial of Hospital-Based Hygiene and Water Treatment Intervention \(CHoBI7\) to Reduce Cholera](#). George et al. 2016. Emerging infectious diseases, 22(2), 233–241.
5. [The Clean pilot study: evaluation of an environmental hygiene intervention bundle in three Tanzanian hospitals](#). Gon et al. 2021. Antimicrob Resist Infect Control. 10, 8.
6. [\\*Using the Water and Sanitation for Health Facility Improvement Tool \(WASH FIT\) in Zimbabwe: A Cross-Sectional Study of Water, Sanitation and Hygiene Services in 50 COVID-19 Isolation Facilities](#). Hirai et al. 2021. Int J Environ Res Public Health. 18(11), 5641.
7. [Evaluation of Membrane Ultrafiltration and Residual Chlorination as a Decentralized Water Treatment Strategy for Ten Rural Healthcare Facilities in Rwanda](#). Huttinger et al. 2015. International journal of environmental research and public health. 12(10), 13602–13623.
8. [The Impact of Water Sanitation and Hygiene \(WASH\) Improvements on Hand Hygiene at Two Liberian Hospitals during the Recovery Phase of an Ebola Epidemic](#). Kanagasabai et al. 2021. Int J Environ Res Public Health. 18(7), 3409.
9. [Water, sanitation, and hygiene \(WASH\) in healthcare facilities of 14 low- and middle-income countries: to what extent is WASH implemented and what are the ‘drivers’ of improvement in their service levels?](#) Kmentt et al. 2021. H2Open Journal. 4(1), 129-137.

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**WASH in Healthcare Facilities Literature Review**  
**Updated October 2022**

<ol style="list-style-type: none"><li>10. <a href="#">Implementing the Clean Clinic Approach Improves Water, Sanitation, and Hygiene Quality in Health Facilities in the Western Highlands of Guatemala.</a> Lopez et al. 2020. Glob Health Sci Pract. 8(2), 256-259.</li><li>11. <a href="#">Evaluating the foundations that help avert antimicrobial resistance: Performance of essential water sanitation and hygiene functions in hospitals and requirements for action in Kenya.</a> Maina et al. 2019. PLoS ONE. 14(10): e0222922.</li><li>12. <a href="#">Extending the use of the World Health Organisations' water sanitation and hygiene assessment tool for surveys in hospitals – from WASH-FIT to WASH-FAST.</a> Maina et al. 2019. PLoS ONE 14(12): e0226548.</li><li>13. <a href="#">Impact of mhealth messages and environmental cues on hand hygiene practice among healthcare workers in the greater Kampala metropolitan area, Uganda: study protocol for a cluster randomized trial.</a> Mugambe et al. 2021. BMC Health Serv Res. 21:88.</li><li>14. <a href="#">Water treatment and handwashing practices in rural Kenyan health care facilities and households six years after the installation of portable water stations and hygiene training.</a> Rajasingham et al, 2018. J Water Health 16(2), 263-274.</li><li>15. <a href="#">Strengthening Healthcare Facilities Through Water, Sanitation, and Hygiene (WASH) Improvements: A Pilot Evaluation of “WASH FIT” in Togo.</a> Weber et al. 2018. J Health Security 16(S1), S54-S65.</li><li>16. <a href="#">A conceptual evaluation framework for the water and sanitation for health facility improvement tool (WASH FIT).</a> Weber et al. 2019. J Water, San, Hyg. for Dev. 9(2), 380-391.</li></ol>
<b>Health Systems &amp; Enabling Environment</b>
<ol style="list-style-type: none"><li>1. <a href="#">The implementation of environmental health policies in health care facilities: The case of Malawi.</a> McCord et al. 2019. International Journal of Hygiene and Environmental Health. 222(4), 705-716.</li><li>2. <a href="#">*What COVID-19 Reveals about the Neglect of WASH within Infection Prevention in Low-Resource Healthcare Facilities.</a> McGriff et al. 2020. 103(5): 1762-1764.</li></ol>
<b>Sustainability</b>
<ol style="list-style-type: none"><li>1. <a href="#">A systematic tool to assess sustainability of safe water provision in healthcare facilities in low-resource settings.</a> Robb et al. 2019. Waterlines 38(3), 197–216.</li></ol>
<b>Costing &amp; Budgeting</b>
<ol style="list-style-type: none"><li>1. <a href="#">Budgeting for Environmental Health Services in Healthcare Facilities: A Ten-Step Model for Planning and Costing.</a> Anderson et al. 2020. International Journal of Environmental Research and Public Health. 17(6), 2075.</li></ol>

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**WASH in Healthcare Facilities Literature Review**  
**Updated October 2022**

2. [Development and application of tools to cost the delivery of environmental health services in healthcare facilities: a financial analysis in urban Malawi](#). Anderson et al. 2021. BMC Health Services Research. 21, 329.
3. [Safe Healthcare Facilities: A Systematic Review on the Costs of Establishing and Maintaining Environmental Health in Facilities in Low- and Middle-Income Countries](#). Anderson et al. 2021. International Journal of Environmental Research and Public Health. 18(2), 817.
4. [Estimating the cost of achieving basic water, sanitation, hygiene, and waste management services in public health-care facilities in the 46 UN designated least-developed countries: a modelling study](#). Chaitkin et al. 2022. Lancet Global Health. 10(6): 840-849.
5. [Cost analysis of the implementation of portable handwashing and drinking water stations in rural Kenyan health facilities](#). Freedman et al. 2017. J Water, San, Hyg. for Dev. 7(4), 659-664.
6. [Estimating the cost of interventions to improve water, sanitation and hygiene in healthcare facilities across India](#). Tseng et al. 2020. BMJ Glob Health. 5(12):e003045

**Behaviors**

1. [Acceptability and use of portable drinking water and hand washing stations in health care facilities and their impact on patient hygiene practices, Western Kenya](#). Bennett et al. 2015. PLoS ONE, 10(5), e0126916. doi:10.1371/journal.pone.0126916.
2. [Unpacking the enabling factors for hand, cord and birth-surface hygiene in Zanzibar maternity units](#). Gon et al. 2016. Health Policy Plan. 32(8), 1220–1228.
3. [Evaluation of the impact of a simple hand-washing and water-treatment intervention in rural health facilities on hygiene knowledge and reported behaviours of health workers and their clients, Nyanza Province, Kenya, 2008](#). Sreenivasan et al. 2015. Epidemiology and Infection. 143(4), 873-880.

**Care-Seeking Behaviors & Patient/Staff Satisfaction**

1. [Cross-sectional observational assessment of quality of newborn care immediately after birth in health facilities across six sub-Saharan African countries](#). de Graft-Johnson et al. 2017. BMJ Open. 7:e014680.
2. [Determinants of hygiene practices among mothers seeking delivery services from healthcare facilities in the Kampala metropolitan area, Uganda](#). Kayiwa et al. 2020. International Journal of Environmental Health Research. 32(2), 292-304.
3. [Factors associated with health facility deliveries among mothers living in hospital catchment areas in Rukungiri and Kanungu districts, Uganda](#). Mugambe et al. 2021. BMC Pregnancy and Childbirth. 21, 329.

\*Denotes crosscutting theme of COVID-19 & WASH in HCF

**WASH in Healthcare Facilities Literature Review**  
**Updated October 2022**

4. [Impact of the Integration of Water Treatment, Hygiene, Nutrition, and Clean Delivery Interventions on Maternal Health Service Use.](#) Fagerli et al. 2017. The American Journal of Tropical Medicine and Hygiene, 96(5), 1253–1260.
5. [Respectful care during childbirth in health facilities globally: a qualitative evidence synthesis.](#) Shakibazadeh et al. 2018. BJOG: An International Journal of Obstetrics and Gynaecology, 125(8), 932–942.
6. [Availability and satisfactoriness of latrines and hand washing stations in health facilities, and role in health seeking behavior of women: evidence from rural Pune district, India.](#) Steinmann et al. 2015. Journal of Water, Sanitation and Hygiene for Development. 5 (3): 474-482.

***Healthcare-Associated Infections & Antimicrobial Resistance***

1. [What's wrong in the control of antimicrobial resistance in critically ill patients from low- and middle-income countries?](#) Dondorp et al. 2017. Intensive care medicine, 44(1), 79–82.
2. [Prevention and control of health care–associated waterborne infections in health care facilities.](#) Exner et al. 2005. American Journal of Infection Control. 3(5) Supplement, S26–S40.
3. [What are the threats from antimicrobial resistance for maternity units in low- and middle-income countries?](#) Graham et al. 2016. Global health action. 9, 33381.
4. [A systematic review of nosocomial waterborne infections in neonates and mothers.](#) Moffa et al. 2017. International Journal of Hygiene and Environmental Health. 220, 1199–1206.
5. [Interventions to improve water supply and quality, sanitation and handwashing facilities in healthcare facilities, and their effect on healthcare- associated infections in low-income and middle-income countries: a systematic review and supplementary scoping.](#) Watson et al. 2019. BMJ Global Health 4, e001632.
6. [Quick fix for care, productivity, hygiene and inequality: reframing the entrenched problem of antibiotic overuse.](#) Willis et al. 2019. BMJ Global Health. 4:e001590.

***Cleaners***

1. [An invisible workforce: the neglected role of cleaners in patient safety on maternity units.](#) Cross et al. 2019. Global Health Action. 12(1), 1480085.
2. [The role of environmental cleaning in the control of hospital-acquired infection.](#) Dancer. 2009. The Journal of Hospital Infection. 73(4), 378-385.
3. [Four Steps to Hospital Cleaning: Look, Plan, Clean and Dry.](#) Dancer et al. 2019. The Journal of Hospital Infection. 103(1), e1-e8.

\*Denotes crosscutting theme of COVID-19 & WASH in HCF

**WASH in Healthcare Facilities Literature Review**  
**Updated October 2022**

4. [A Better Disinfectant for Low-Resourced Hospitals? A Multi-Period Cluster Randomised Trial Comparing Hypochlorous Acid with Sodium Hypochlorite in Nigerian Hospitals: The EWASH Trial](#). Gon et al. 2022. 10(5):910.
5. [Time for a renewed focus on the role of cleaners in achieving safe health care in low- and middle-income countries](#). Storr et al. 2021. Antimicrob Resist Infect Control. 10:59.

**Gender**

1. [WASH and gender in health care facilities: The uncharted territory](#). Kohler et al. 2017. Health Care for Women Int. 40(1), 3-12.

**Enterprise**

1. [MBR technology: a promising approach for the \(pre-\)treatment of hospital wastewater](#). Beier et al. 2012. Water Sci Technol. 65 (9): 1648-1653.
2. [Small Water Enterprise in Rural Rwanda: Business Development and Year-One Performance Evaluation of Nine Water Kiosks at Health Care Facilities](#). Huttinger et al. 2017. Int J. Environ. Res. Public Health. 14, 1584.

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