The State of Handwashing in 2016: Annual Review

What we learned about handwashing in 2016

The Global Burden of Disease Study 2015 reported that the prevalence of diseases attributable to no handwashing has steadily declined since the 1990s, and that mortality and disability-adjusted life years (DALY) attributed to no handwashing have declined since 2000. Progress in reducing environmental risks was mainly driven by sizeable reductions in mortality and disease burden attributable to unsafe water, sanitation, and hygiene (WASH). Between 2005 and 2015, the number of global deaths attributable to unsafe water and no handwashing with soap fell by more than 12%, whereas DALYs decreased by more than 20%.[1]

As such, it is important that we continue to seek to both learn more about handwashing and apply the latest evidence to programs in meaningful ways. In this summary, we outline key themes and findings from 59 peer-reviewed handwashing-related research papers published in 2016 relevant to low and middle-income countries.

This review, based on the biannual research summaries published in 2016, presents the overarching findings, includes useful resources, and explores specific data and context. Findings are categorized by five key themes: 1) benefits of handwashing with soap, 2) measuring handwashing compliance, 3) approaches to handwashing behavior, 4) determinants of handwashing with soap, and 5) measuring handwashing hardware efficacy.

Benefits of Handwashing

Handwashing is one of the most cost-effective investments in public health, and the economic benefit from handwashing is not unique to the prevention of diarrhea and pneumonia, but also most healthcare-associated infections (HAI), which are extremely costly to individuals, healthcare systems, and countries. Handwashing halts the spread of infection and is effective in preventing the spread of some diseases.

Diarrheal Diseases & Acute Respiratory Infections

Assessing the association between shared sanitation facility and moderate to severe diarrhea (MSD) in children under the age of 5, the Global Enteric Multicenter Study found that self-reported handwashing may have a protective effect. It found that the association between self-reported handwashing with soap or ash and MSD was significant at study sites in Mozambique and India, but not in Gambia, Kenya, Mali, Pakistan, Bangladesh.[2]

Annual net costs for diarrhea and acute respiratory infections combined can amount to billions of dollars per year, whereas estimated costs of a national handwashing program could result in billions in savings for an economy.[3]

Bacterial Infections

Handwashing with soap at home among primary caregivers was effective in reducing bacterial contamination of hands, showing the amount of bacteria on hands was significantly lower after cleaning under fingernails, using soap, and drying hands through rubbing on clothes or a clean towel than before handwashing.[4]

Viral Infections

Frequent, self-reported hand hygiene practice reduces the likelihood of seasonal influenza and flu-like illness.[5,6]

Helminthic Infections

Access to improved sanitation/hygiene and frequency of handwashing at key times lowers the likelihood of helminthic infections, such as hookworms, among children.[7] Schools with improved sanitation/hygiene facilities have significantly fewer students with parasites and lower infection intensities.[8] Still, the benefits of handwashing in preventing infections vary by whether schools maintain continuous access to an improved water source.[9]

Healthcare-Associated Infections

Studies show that improved hand hygiene compliance among hospital staff reduces the prevalence of HAIs.[10] Providing a hand hygiene education program for healthcare workers, as well as utilizing hygiene promotional posters and placing alcohol-based gels at sinks in wards results in decreased HAI incidence.[11]

Stunting

Children of mothers who wash their hands with soap or ash have higher mean height-for-age than those do not.[12]

School Absenteeism

School-based interventions can lower absenteeism due to diarrhea, but not the overall absenteeism rate.[13]

Benefits of Handwashing	Location
Diarrheal Diseases & Acute Respiratory Infections	
Association between self-reported handwashing with soap or ash and prevention of moderate-to-severe diarrhea in children under the age of 5 was significant.[2]	India, Mozambique
Association between self-reported handwashing with soap or ash and moderate-to-severe diarrhea in children under the age of 5 was not significant.[2]	Multiple countries
Incidence of diarrhea among children under 36 months receiving early-child stimulation with hygiene promotion was 2.8 episodes per year compared to 3.1 episodes for those only receiving the former.[14]	Peru
Annual net cost of diarrhea and ARI was $23 billion per year, while estimated cost of a national handwashing program would be $62 million and bring $5.64 billion in savings.[3]	India
Annual net cost diarrhea and ARI was $12 billion per year, while estimated cost of a national handwashing program would be $77 million and bring $2.64 billion in saving.[3]	China
Bacterial Infections	
E. coli contamination on primary caregivers' hands was significantly lower after cleaning under fingernails, scrubbing fingertips, using soap, and drying hands on clothes or a clean towel.[4]	Zimbabwe
Viral Infections	
Self-reported hand hygiene habits were associated with lower odds of seasonal influenza; progressively more frequent handwashing was associated with progressively lower odds of seasonal influenza.[5]	China
Those who reported practicing optimal hand hygiene had lower prevalence of flu-like illness than those who did not report practicing optimal hand hygiene (44.2% vs. 49.5%).[6]	
Children under the age of 10 who reported often washing their hands after using the toilet had lower odds of hand, foot, and mouth disease. However, the association was not statistically significant.[16]	
Those who often reported washing their hands before meals had significantly lower odds of infections. Study did not distinguish between rinsing with water alone and handwashing with a cleansing agent.[15]	
Helminthic Infections	
Better quality of sanitation and hygiene was associated with lower levels of hookworm infections.[7]	Ethiopia
Schools with better availability of latrines with soap or ash, basins, and water for handwashing had significantly fewer pupils with fewer infections and lower infection intensities of certain types of worms (*A. lumbricoides* and *T. trichiura*). However, differences were not statistically significant.[8]	Kenya
Handwashing was associated with lower odds of *A. lumbricoides* in children who attended schools with an improved water source, but was non-significant in schools without improved water sources.[8]	
Benefit of handwashing in preventing *A. lumbricoides* infection varies by whether the school has continuous access to an improved water source.[8]	
Factors associated with soil-transmitted infection among school-aged children showed that drying hands with a clean towel after handwashing was associated with significantly lower odds of infection.[9]	
Healthcare-Associated Infections	
Improved hand hygiene compliance among hospital staff was associated with lower HAI prevalence.[10]	China
Hand hygiene compliance among hospital workers showed HAI prevalence decrease from 3.56% to 2.25%.[11]	
Stunting	
Children of mothers who washed their hands with soap/ash had higher mean height-for-age than those children whose mothers who did not.[12]	India
School Absenteeism	
A school intervention reduced diarrhea-related absenteeism, but not the overall absenteeism rate.[13]	Mali

Handwashing Compliance

Several studies reveal a gap between knowledge about handwashing with soap and optimal handwashing behavior by staff and patients in healthcare settings, by students in schools, and by mothers whom are caregivers of children at the home and in the community.

Hand Hygiene in Healthcare Settings

Evidence from several studies suggests that the highest compliance by health professionals occurs after touching a patient and after body fluid exposure, and the lowest compliance occurs after touching the patient's surroundings and before performing aseptic procedure.[16,17] Gaps also exist between attitudes toward compliance with safe behaviors, as well as awareness of the minimal amount of time needed for effective handwashing practice and the need to wash hands prior to putting on and removing surgical gloves.[18,19,20]

Handwashing in Schools

Studies have found a discrepancy between knowledge and practice of handwashing. In one study, 85.6% of students had knowledge about the need to wash hands at critical times (before eating and after using the toilet), but only 24.9% practiced proper handwashing.[21] In another, the extent of handwashing practice among secondary school students showed handwashing was seldom practiced, with handwashing occurring more frequently after touching genitals than before eating meals or after using toilets.[22]

Handwashing among Primary Caregivers of Children under the Age of 5

A community-based cross-sectional study of caregivers of children under 5 years of age found differences between urban and rural areas with regards to self-reported handwashing with soap after using the toilet (94% and 54%, respectively), before preparing food (74% and 13%), before feeding a child (79% and 27%), and after contact with a child's feces (98% and 85%).[23]

Handwashing Compliance	Location
Handwashing in Healthcare Facilities	
Hand hygiene compliance among healthcare workers was 32% and ranged from 22% (after touching patient's surrounding) to 42% (after touching a patient).[16]	Taiwan
Hand hygiene compliance at a teaching hospital was 39%, with the highest level of compliance after patient contact (54%) and lowest before performing aseptic procedure (18%).[17]	Jamaica
Overall compliance among nurses was highest after body fluid exposure risk (93%) and lowest before touching a patient (18.5%).[24]	Kosovo
Compliance with safe behaviors, including handwashing, was relatively low at obstetric units despite awareness of the benefits of handwashing.[18]	Colombia
85.5% of medical students had knowledge about hand hygiene and reported practicing routinely, but only 33.87% were aware of the minimal time needed. [19]	Qatar
Glove wearing/removal was significantly associated with hand hygiene compliance among nurses, with 14.8% before putting on gloves and 56.6% after removal.[20]	Iran
Handwashing in Schools	
85.6% of students had knowledge of the need to wash hands at critical times but only 24.9% practicing proper handwashing.[21]	India
Extent of handwashing practice among secondary school students was low, with handwashing occurring more frequently after touching genitals than before eating meals and after using toilets.[22]	Nigeria
Handwashing among Primary Caregivers of Children under the Age of 5	
In rural areas, 54% of caregivers washed their hands after using the toilet, 13% before preparing food, 27% before feeding a child, 85% after contact with a child's feces.[23]	India
In urban areas, 94% of caregivers washed their hands after using the toilet, 74% before preparing food, 79% before feeding a child, 98% after contact with a child's feces.[23]	

Behaviour Change

Evidence demonstrates that cues and emotional drivers can impact behavior change. Social norms are created and governed by the community, so people are more likely to wash their hands when others observe them.

Handwashing Behavior Change through Cues

Disgust-based cues are more effective at increasing handwashing behavior than conventional reminder posters.[25] Non-verbal environmental cues are effective at changing behavior without using traditional methods of behavior change communication. An intervention study in two primary schools in rural Bangladesh showed that the proportion of handwashing after latrine use among students increased after adding handwashing infrastructure, footpaths from the toilet to handwashing station, and handprints on the handwashing station.[26]

Hand Hygiene Behavior Change in Healthcare Facilities

Introduction of alcohol-based hand rub combined with educating healthcare workers on proper hand hygiene practice and posting hand hygiene reminders throughout the workplace can foster stronger hand hygiene compliance, particularly before touching a patient, before a clean/aseptic procedure, after touching a patient, and after touching a patient's surroundings. However, they do not significantly change hand hygiene compliance after body fluid exposure risk.[27]

Handwashing Behavior Change among New Mothers

Pregnant women are more receptive to learning about hand hygiene compliance than new mothers. Researchers learned in a study in Bangladesh that pregnant women who received an intensive handwashing intervention during the perinatal period were more likely to practice handwashing at home than mothers who received the same intervention after the end of the perinatal period.[28]

Children as Agents of Behavior Change

Children are likely to disseminate information about WASH at home after learning about handwashing in school, are generally enthusiastic about engaging with their parents and are successful at constructing handwashing stations at home. Mothers also report trusting the messages that their children brought home from school. In other words, students can communicate knowledge to family members, thus enacting small changes.[29]

Multiple Behavior Change Interventions

The implementation of multiple behavior change interventions (e.g., radio messaging, clinic events, community events) can achieve increased use of soap during handwashing. Communities that receive such interventions experience higher prevalence of self-reported handwashing with soap behavior after risk of contact with feces.[30]

Handwashing Behavior Change in Public Health Campaigns

Receiving oral cholera vaccine (OCV) combined with exposure to vaccination messaging and other WASH educational activities helps increase soap use and the availability of soap at handwashing stations.[31] Additionally, hospitalization for cholera can serve as a teachable moment for WASH behavior change, including handwashing, as household members of cholera patients are more likely to wash hands with soap and use soapy water at key times after teaching them about handwashing to prevent cholera spread.[32]

Implementing and sustaining large-scale hygiene promotion programs remains a challenge. For instance, evaluation of a UNICEF-assisted WASH program showed that the coverage rate of handwashing places in schools remained inadequate after the end of the program period.[33] Furthermore, data collected in response to the Global Analysis and Assessment of Sanitation and Drinking Water 2013/2014 Survey showed large variations by country with regard to the definitions of hygiene and hygiene-related activities. Challenges in hygiene promotion included poor implementation of policies, weak coordination mechanisms, human resources limitations, and lack of available hygiene promotion budget data.[34]

Knowledge Practice Gap

Improving handwashing with soap knowledge alone is typically insufficient to change handwashing behavior. Evidence suggests that while handwashing awareness-raising campaigns can increase knowledge about the benefits of handwashing, there may be little effect on changing intention to wash hands with soap.[35] Furthermore, the knowledge-practice gap is more narrow for handwashing than for treatment of drinking water and sanitation. In Kenya, a WASH program showed that while the intervention significantly improved the proportion of handwashing after defecation, there was a decrease in the proportion of respondents who washed their hands after attending to a child who had defecated.[36]

Behavior Change	Location
Handwashing Behavior Change through Cues	
Probability of handwashing with soap in a food service setting using four different cues—disgusting image (visual cues), disgusting sound (auditory cues), disgusting odor (olfactory cues), and regular handwashing posters/controls—indicated the probability of handwashing was lowest in control (18%), followed by visual cues (40%), auditory cues (40%), and odor (73%).[25]	N/A
Proportion of handwashing after latrine-use among students in two rural primary schools increased from 4% to 18% after adding handwashing infrastructure, to 58% after adding the footpaths, and then to 68% after adding the footpath and handprints. Proportion remained at 74% at follow-up visits.[26]	Bangladesh
Hand Hygiene Behavior Change in Healthcare Facilities	
Hygiene compliance increased from 34.1% to 68.9% when alcohol-based hand rub was combined with education on hand hygiene practice and the use of reminders throughout the healthcare workplace.[27]	Rwanda
Handwashing Behavior Change among New Mothers	
Probability of handwashing at home was not significantly different between new mothers who received intensive handwashing interventions during the perinatal period and new mothers who received the intervention after the perinatal period.[28]	Bangladesh
Children as Agents of Change	
Schoolchildren disseminated information about WASH at home after learning about handwashing in school and mothers reported trust in the messages that their children brought home from school.[29]	Zambia
Multiple Behavior Change Interventions	
Communities that receive multiple behavior change interventions (e.g., radio messaging, clinic events, and community events) had higher prevalence of handwashing with soap at key times or after risk of contact with feces than communities receiving only standard care (32% vs. 28%).[30]	Zambia
Handwashing Behavior Change in Public Health Campaigns	
Reported use of soap to wash hands increased 66% to 85% when handwashing information, cholera prevention practices, and WASH educational activities were shared during OCV campaigns.[31]	Thailand
Soap availability at handwashing stations increased 84% to 95% when handwashing information, cholera prevention practices, and WASH educational activities were shared during OCV campaigns.[31]	
Teaching household members about handwashing with soap and water treatment to initiate standard of care and reduce risk of contracting cholera resulted in a decrease in infection prevalence (7%) compared to the control arm (14%). Prevalence of symptomatic cholera infection was 0% and 5% respectively.[32]	Bangladesh
Household members of cholera patients were significantly more likely to wash hands with soap at key times (50% vs. 18%) and use soapy water (71% vs. 9%) after learning how handwashing prevents cholera.[32]	
Coverage rate of handwashing places in schools remained inadequate after a WASH program.[33]	Nigeria
Knowledge Practice Gap	
A handwashing-awareness campaign increased knowledge about the benefits of handwashing, but had little effect on changing intention to wash hands with soap.[35]	India
Gaps in the awareness of the importance of hygiene in communities were smaller (85%) than gaps in treated drinking water (49%) and sanitation (37%). Proportion of handwashing after defecation improved, but a decrease occurred in the proportion of respondents who washed their hands after attending to a child who had defecated.[36]	Kenya

Determinants of Handwashing

When environments are enabling, handwashing practice can take place with greater ease. Successful handwashing behavior change requires both the availability of facilities (i.e., a handwashing station with soap and water) and adoption of a good handwashing habit.

Enabling Environments

To wash their hands properly, people must have access to the necessary materials, including a functional handwashing station with soap in a convenient location. When handwashing stations are visible and accessible they can serve as environmental cues to remind people to wash their hands. Several studies indicate that frequency of handwashing with soap is associated with:

- Routine, whether someone is busy or tired, and being concerned with good manners.[37]
- Desire to smell nice, interpersonal influences, presence of handwashing places within the kitchen and the toilet, and key handwashing moments.[38]
- Absence of soap and water at stations and lack of awareness of the importance of handwashing.[39]
- Ease of access to hardware and reinforcement of key hygiene behaviors when four key emotional drivers are present (perceived threat, disgust, comfort, shame/stigma).[40]

Action Control & Psychosocial Factors

Action control is the continuous evaluation of one's own handwashing behavior. In Costa Rica, action control was the most proximal factor in handwashing behavior and was determined to be the bridge of the planning-behavior gap among students.[41] Alternatively, psychosocial and contextual factors together explained nearly half of the variation in handwashing frequency among caregivers of schoolchildren in Burundi.[42]

The Household & the Community

Household handwashing behavior is associated with having both an improved sanitation facility and improved water source. Defined as having a specific place for handwashing and having cleansing materials and water available at that specific place, handwashing behavior is positively associated with the education level and ethnicity of the household head, the household wealth index, having an improved sanitation facility and having improved water sources.[43]

Healthcare Facilities

Perceived risk of infection amongst healthcare workers may influence one's decision to practice proper hand hygiene. However, handwashing among healthcare workers is significantly limited when sinks are non-functioning and lack clean towels for hand drying. While staff often report washing hands between patient contact and felt that the current facilities were adequate, many indicate selective hand hygiene practice, for instance, use alcohol-based hand rub only when dealing with a patient who appeared to be infective.[44]

Primary Caregivers of Children under the Age of 5

Among mothers, the availability of handwashing facilities may influence handwashing with soap after defecation. Other determinants of handwashing may also depend on the activities around the behavior. For instance, the frequency of handwashing before eating may vary depending upon the type of food to be eaten or handwashing before cooking food may be influenced by the perceived threat of germs.

Despite mothers of children reporting handwashing after defecation, their soap use is still weak. For instance, in Zimbabwe, less than one-fourth of mothers reported having washed with soap. Reasons for no handwashing included forgetting to wash hands after returning from defecating in the bush, due to the long-time interval, and not having a handwashing facility at latrines at the home. In this same study, all mothers reported handwashing before eating main meals and cooked foods; reasons for no handwashing included the belief that the cooking process would kill germs. Focus group discussions showed that unavailability or a limited supply of water for handwashing was a barrier to handwashing at critical moments.[45]

Inclusive WASH

Living with a disability impacts handwashing, primarily due to physical barriers. For instance, when investigators interviewed disabled persons and caregivers in Malawi, water access was the most commonly reported challenge among disabled respondents in rural areas, as piped water is not available and disabled individuals cannot readily take a container to buy water from the kiosks. As such, they must pay for both the water and for another person to carry water for them. None of the participants reported soap availability as a challenge. Physical barriers make handwashing problematic for disabled individuals because clean hands must be placed back on crutches, wheelchairs, or other surfaces that are unclean.[46]

Determinants of Handwashing	Location
Enabling Environments	
Handwashing correlated with knowledge of hand hygiene, non-availability of handwashing spaces or soap.[47]	India
Handwashing was significantly associated with the desire to smell nice, interpersonal influences, presence of handwashing places within 10 paces of the kitchen and toilet, and key handwashing moments.[38]	Indonesia
Action Control	
Belief in one's capacity to wash one's hands whenever required and the expected benefits of handwashing predicted the intention for handwashing.[41]	Costa Rica
Psychosocial Factors	
Contextual factors among school children accounted for 13% of the variation in handwashing frequency, with amount of water per person was the most significant contextual factor.[42]	Burundi
Self-efficacy, planning, and remembering to wash hands were significant psychosocial factors, resulting in 41% of the variation in handwashing frequency.[42]	
The household & the Community	
Handwashing behavior was positively associated with education level and ethnicity of the household head, household wealth index, having an improved sanitation facility and improved water source.[43]	Vietnam
Frequency of handwashing with soap is associated with routine (i.e., how automatically it is performed), whether someone is busy or tired, and concern for good manners.[37]	Global
Ease of access and reinforcement of key hygiene behaviors when four key emotional drivers of hygiene behavior change (perceived threat, disgust, comfort, and shame/stigma) reinforced a handwashing habit.[40]	Nepal
Handwashing practice was associated with subjective norms, but not with perceived barriers, availability of handwashing facilities, and sex.[48]	Indonesia
Among university students, handwashing behavior was significantly associated with age group, marital status, educational status, and mother's education.[49]	Bangladesh
Healthcare Facilities	
Perceived risk of infection amongst healthcare workers may influence their decision to practice proper hand hygiene. At two hospitals, handwashing did not happen at 80% of all handwashing opportunities, in which staff used alcohol-based hand rub only when dealing with a patient who appeared to be infective.[45]	Uganda
Barriers to hand hygiene among healthcare workers included high workload, lack of resources, lack of scientific information, and perception that priority is not given to hand hygiene, while previous training is associated with self-reported hand hygiene practice.[50]	India
Better hand hygiene practice, hand hygiene knowledge, attitude, and practice among nursing students were associated with good attitude towards hand hygiene, being male, awareness of the benefits of hand hygiene, attending hand hygiene trainings and seminars, and being in the early years of the nursing program.[51]	Saudi Arabia
Nurses with more healthcare experience have significantly higher hand hygiene compliance and awareness of the importance of infection control.[52]	Cyprus
Reported hand hygiene compliance among medical students was lowest (70%) after cadaver work due to lack of time (41% of respondents who reported never washing their hands), lack of perceived necessity (31%), and unavailability of hygiene materials (28%).[53]	Dominica
Common barriers to hand hygiene practice among dentists included lack of educational program, time constraint, inconvenient location of handwashing place, false sense of security against infection, lack of supplies, and lack of guidance.[54]	Pakistan

Primary Caregivers of Children under the Age of 5	
While all mothers reported handwashing after defecation, only 23% washed their hands with soap.[45]	Zimbabwe
Mothers who practiced open defecation reported that they tended to forget to wash their hands after returning home from defecating in the bush due to the long time interval.[45]	
Mothers with latrines at home identified not having a handwashing facility at home as a limiting factor.[45]	
While all mothers reported handwashing before eating main meals and cooked foods, only 63% said that they washed their hands before eating fruits, nuts, and maize.[45]	
Mothers highlighting that they did not wash their hands because the food would go through a cooking process which would kill germs.[45]	
Unavailability or limited water supply was a barrier to handwashing at critical moments.[45]	
Inclusive WASH	
Water access was the most commonly reported challenge among disabled respondents in rural areas, as piped water is not available. None of the participants reported soap availability as a challenge.[46]	Malawi

Handwashing Hardware & Soap Efficacy

Measurement of handwashing behavior and efficacy across studies remains a challenge. A review of methods for evaluating the efficacy of handwashing in preventing transmission of harmful pathogens showed a large variation regarding how the hands are inoculated with microorganisms, the methods used to recover microorganisms from the hands, and the indicator organisms tested. These variations can make it difficult to compare studies. As such, there is a need to both develop more standardized handwashing test methods and form guidelines on minimal information required before handwashing experiment results can be published.

Handwashing Efficacy & Soap Efficiency	Location
Availability of Soap	
Soap was present in only 7% of handwashing places available to cholera patients and their families during spot-checks at hospitals.[32]	Bangladesh
78% to 92% of handwashing locations for doctors and nurses had soap. 4% to 30% of handwashing locations for patients and family members had soap.[32]	
Use of communal handwashing bowls in preschools tends to reduce effectiveness of eliminating microbes. Samples detected *Staphylococcus* bacteria as the most common microbe found.[55]	Ghana
Soapy Water	
4 months after the delivery of intervention, uptake of soap or soapy water was found in 18% of households with only promotion; 60% of households with promotion and handwashing station; 71% in households with promotion, station, and detergent refill; 6% in houses with no intervention.[56]	Bangladesh
Antimicrobial Agents	
There was no evidence that antimicrobial products had a superior effect compared to handwashing with plain soap, except when the frequency, duration, and product concentrations were higher than a level that could be expected in low-income settings.[57]	N/A
There was no significant difference between plain foaming and liquid soap regarding microbial removal. However, foaming soap removed significantly fewer MS2 bacteriophage compared to *E. coli*.[58]	N/A
Povidone-iodine scrub significantly reduced the number of colony-forming units of bacteria after application on bare hands among clinical and paraclinical personnel.[59]	India

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