

# Nutrition-Sensitive Water Supply, Sanitation, and Hygiene

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# Nutrition-Sensitive Water Supply, Sanitation, and Hygiene

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# Pathways Linking WASH and Nutrition Outcomes



This document summarizes evidence and guidance on project design and results framework indicators for nutrition-sensitive water supply, sanitation, and hygiene (WASH) operations and components of other sector and subsector projects, including social protection, health, disaster risk management, and irrigation.

Inadequate WASH can impact child nutritional status through multiple pathways (figure 1). These include (1) fewer episodes of diarrheal disease; (2) improved gut health; (3) reductions in protozoa and helminth infection; (4) reductions in anemia; and (5) time and cost savings associated with fetching water, caring for sick household members, and seeking treatment.

This note presents evidence for the effects of WASH on nutritional outcomes for each hypothesized pathway. Only a handful of studies report the direct effects of WASH on nutritional outcomes. A systematic review and meta-analysis of WASH interventions on child nutritional outcomes (Dangour et al. 2013) analyzed five cluster randomized trials of WASH interventions (Du Preez, Mcguigan, and Conroy 2010; Du Preez et al. 2011; Luby et al. 2004, 2006; McGuigan et al. 2011). The authors have found a borderline statistically significant effect of water quality and handwashing interventions on height-for-age Z-scores (HAZ) (mean difference, 0.08; 95 percent Confidence Interval 0.00 to 0.16) in children less than five years old. At the time of the review there was insufficient experimental evidence on water supply and sanitation to include in the meta-analysis.

Since the publication of the systematic review, several experimental studies of the effect of sanitation on child nutrition have been published, which have shown mixed results. A community-led total sanitation (CLTS) intervention in Mali, which reduced open

defecation by 30 points, led to taller children on average, who were less likely to be stunted compared to children in control villages (Pickering et al. 2015). Improvements in child height were noted even though the intervention did not significantly reduce diarrheal disease in children. The authors posit that the program may have impacted child height through other pathways, such as a reduction in the incidence of intestinal worm infections or improved gut health.

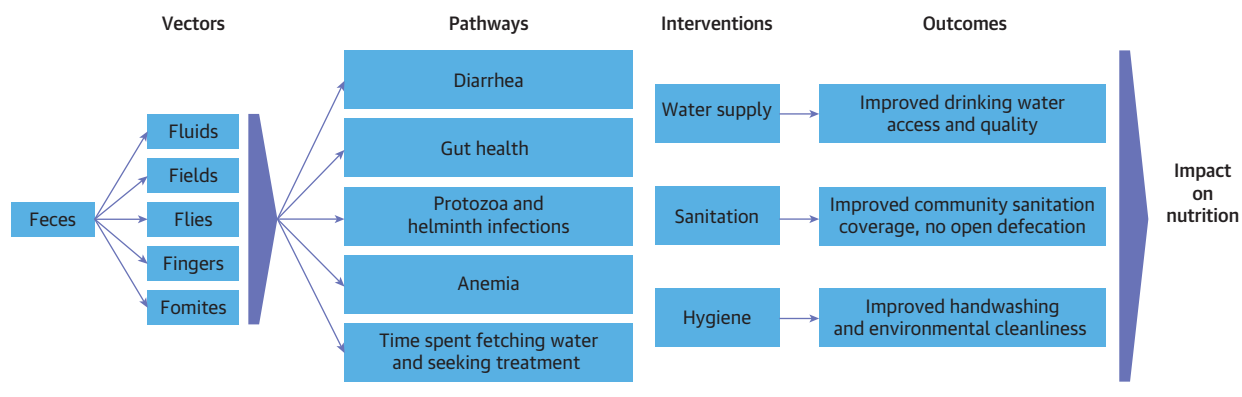
A CLTS intervention in Indonesia (Cameron, Olivia, and Shah 2019) reduced the prevalence of roundworm infestation by 46 points among children in treatment communities, compared to control communities. However, there were no improvements in hemoglobin levels, height or weight for children exposed to the CLTS intervention.

A quasi-experimental study in Maharashtra has found large increases in child HAZ despite only modest improvements in village sanitation, suggesting health effects may be largely driven by changes in open defecation, as opposed to infrastructure improvement (Hammer and Spears 2013). However, randomized studies of the Total Sanitation Campaign in India (Clasen et al. 2014; Patil et al. 2014) and a CLTS intervention in Tanzania (Briceño et al. 2017) have shown no evidence of effects on child nutrition outcomes.

The econometric literature has consistently found associations between open defecation and child stunting. For example, one study finds that open defecation, which is exceptionally widespread in India, could account for much or all of the excess stunting in India

**Evidence shows that inadequate WASH can impact child nutritional status through five key pathways.**

**FIGURE 1. Pathways Linking WASH to Nutrition Outcomes**



Note: WASH = water supply, sanitation, and hygiene.

(Spears, Ghosh, and Cumming 2013). The authors suggest that open defecation is especially harmful in areas of high population density (Hathi et al. 2017) and is therefore a high-risk factor for stunting in India. Other econometric analyses have also shown that improvements in sanitation were responsible for at least part of the decline in rates of stunting in Nepal (Headey and Hoddinott 2015) and Bangladesh (Headey et al. 2015).

The WASH Benefits and the Sanitation Hygiene Infant Nutrition Efficacy (SHINE) trials in Kenya (Null et al. 2018), Bangladesh (Luby et al. 2018), and Zimbabwe (Humphrey et al. 2019) were large (greater than 5,000 newborns each) and well-funded studies. These cluster-randomized controlled trials were the first to test the *individual* and *combined* effects of water quality, sanitation, handwashing, and nutritional interventions on child health and development. Study findings are consistent across the three sites. The WASH interventions alone did not significantly improve child nutrition outcomes. The nutrition intervention—*independently* and when combined with the WASH intervention—increased child HAZ. However, there was no additional benefit for HAZ from the combined intervention when compared with the nutrition only or WASH only intervention. In addition, the WASH intervention did not reduce

diarrhea in Kenya or Zimbabwe but did in Bangladesh. There are several hypotheses as to why the WASH interventions failed to improve child growth. The lack of effect could be due to insufficient elimination of fecal contamination in the environment (Ercumen et al. 2018), especially the presence of animal feces; limited behavioral change among non-intervention households; and limited attention to other vectors of fecal-oral pathogen transmission, such as child hand contamination and toys or objects handled by children. Moreover, the intensity of hygiene promotion and other awareness raising measures may not have been sufficient to sustainably change behavior.

### Pathway 1: Reduction in Diarrheal Disease

The relative contribution of diarrhea to undernutrition is somewhat unclear, because poor nutrition is also a cause of diarrhea. However, there is good evidence that repeated episodes of diarrhea and severity of diarrhea in young children are associated with growth stunting (Checkley et al. 2008; Ferdous et al. 2013; Moore et al. 2010).

There is vast literature showing that poor WASH conditions such as fecal contamination of the household environment (Curtis, Cairncross, and Yonli 2000; Marquis et al. 1990), soil contaminated with human



and animal feces (Curtis et al. 2000; Pickering and Davis 2012), and unsafe disposal of infant and child feces contribute significantly to diarrheal disease episodes (Bawankule et al. 2017; Cronin et al. 2016; Mara et al. 2010). Water supply and sanitation interventions are associated with lower risk of diarrhea and better nutrition outcomes (Checkley et al. 2004; Esrey 1996; Fink, Günther, and Hill 2011). Meta-analysis of intervention studies shows (1) handwashing with soap reduces diarrhea by 30 percent compared to no intervention; (2) sanitation interventions reduce diarrhea by 25 percent compared to no intervention (with evidence for higher reduction at 45 percent when coverage is above 75 percent); and (3) piped water supply of higher quality and continuous availability to premises reduces diarrhea by 75 percent and 36 percent, respectively, compared to unimproved drinking water (Wolf et al. 2018).

There is wide variation in risk reduction for different service levels: high-quality piped water reduces diarrhea by 75 percent, but water filtered at point of use (POU) with safe storage achieves a risk reduction of 61 percent. Similarly, sewerage connections are associated with larger diarrhea risk reduction of 40 percent compared to a 16 percent risk reduction from improved household sanitation (Wolf et al. 2018).

Sanitation facilities shared between households are associated with increased odds of diarrheal disease compared to individual household latrines in a meta-analysis of 12 studies (Heijnen et al. 2014) reporting on diarrhea, although the analysis does not distinguish between types of shared facilities, which could include a household latrine shared with another family, latrines shared by more than one household, or community latrines. Moreover, 22 studies conducted in 21 countries show increased risk of adverse health outcomes associated with shared sanitation compared to individual household latrines. Few of these studies, however, report on factors—other than the type of sanitation facilities—that could be important confounders or effect modifiers, such as poverty, and that may

correlate with sharing of sanitation facilities and poor child health (Heijnen et al. 2014).

## Pathway 2: Improved Gut Health

Repeated exposure to pathogens found in feces is one of the primary contributors to environmental enteric dysfunction (EED), which is characterized by inflammation and physical deformation of the small intestine (Prendergast and Kelly 2012). EED inhibits the absorption and retention of essential nutrients, which researchers hypothesize is a major cause of child stunting (Gilmartin and Petri 2015; Humphrey 2009).

Household environments in low-income settings are highly contaminated with fecal matter from poor quality sanitation and open defecation practices. Freely roaming animals are common in such settings, especially where small-holder poultry farming is the norm (Harvey et al. 2003; Marquis et al. 1990; Ngunjiri et al. 2013), contributing to high concentrations of animal feces in the environment.

Both humans and animals tread on feces in the open, bringing pathogens into the domestic environment (Curtis et al. 2000) where infants and young children crawl, explore, play, and feed. Flies serve as another vector carrying pathogens from one place to another, especially onto food. Handwashing with soap is poorly practiced in these settings (Curtis et al. 2000), so it does not prevent the spread and ingestion of fecal bacteria.

Recent research has focused on testing the hypothesis that EED caused by poor WASH (Crane, Jones, and Berkley 2015) is a major cause of child stunting, with evidence pointing to the link between intestinal and systematic inflammation and stunting (Harper et al. 2018). Observational research shows associations between household environmental cleanliness, such as access to water supply and sanitation infrastructure, biomarkers for environmental enteropathy, and child HAZ and WAZ (Lin et al. 2013). However, intervention studies of handwashing (Langford, Lunn, and Panter-Brick 2011) and results from WASH-Benefits trials in

Kenya (Null et al. 2018) and Bangladesh (Luby et al. 2018) have not led to lower mucosal damage or chronic infections nor have they slowed growth faltering.

### **Pathway 3: Reduction in Protozoa and Helminth Infections**

Protozoa and helminth infections are transmitted through soil (soil-transmitted helminthiasis, STH) and water (schistosomiasis) contaminated with feces. These infections cause poor appetite, nutritional deficiencies, and anemia and exacerbate malnutrition (O’Lorcain and Holland 2000; Stephenson 1987; Stephenson, Latham, and Ottesen 2000; Stoltzfus et al. 2004). Studies have shown giardia and helminth infections to be associated with stunting (Crompton and Nesheim 2002; Heimer et al. 2015; Simsek et al. 2004).

Where helminths are highly prevalent, deworming medication is administered as preventative chemotherapy through organized campaigns. This is a cheap and effective strategy to reduce infections, but cannot prevent future reinfection, especially in places with poor sanitation. Therefore, sanitation promotion is often recommended as a complementary strategy to deworming and health education. Meta-analysis shows a protective effect between any sanitation (presence or use) compared to no sanitation and the risk of soil-transmitted helminths (Barreto et al. 2010; Freeman et al. 2017; Moraes et al. 2004; Ziegelbauer et al. 2012) and giardia infections (Goto et al. 2009). The WASH-Benefits trial in Bangladesh has found that individual handwashing and hygienic sanitation interventions significantly reduced childhood giardia infections (Lin et al. 2018).

### **Pathway 4: Reduction in Anemia**

Anemia is a blood disorder that most commonly results from insufficient dietary intake and absorption of iron. Iron can be absorbed through diet, but malnutrition can inhibit its absorption. Iron deficiency anemia is the most

common nutritional deficiency in the world and highly prevalent in low- and middle-income countries (LMICs). Blood loss and inflammation due to WASH-related infections, including malaria, acute respiratory infections, diarrhea, and hookworm infection (Stoltzfus et al. 1996), are a major cause of anemia (Weiss and Goodnough 2005). Without treatment, anemia can lead to chronic conditions that include poor fetal development, delayed cognitive development, higher risk of infection, fatigue, weakness, dizziness, and drowsiness. Dietary interventions that include iron supplementation have resolved fewer than half of the burden of childhood anemia globally (Stoltzfus, Mullany, and Black 2002). A trial of WASH improvements in Bangladesh has reported a protective effect on the risk of anemia, but a similar trial in Kenya has not found any added effect of the WASH interventions on anemia when compared with the nutrition-specific intervention (Stewart et al. 2019).

### **Pathway 5: Time and Cost Savings**

Reducing the time that caregivers spend fetching water has been shown to reduce diarrhea and improve nutritional outcomes in children under age five (Pickering and Davis 2012). The exact mechanism is not clear, although better access to water may enable improved hygiene practices (Aiello et al. 2008; Motarjemi et al. 1993) and allow more time for caregiving (Burger and Esrey 1995; Cairncross and Cliff 1987; Diaz et al. 1995; Miller and Urdinola 2010) or income-generating activities (Koolwal and Van de Walle 2013). About 44 percent of the world’s population must leave their homes to fetch water for drinking and other domestic uses (WHO and UNICEF 2010). The high costs associated with accessing improved WASH services and the time and cost of treating WASH-related illness could crowd out household expenditures for other nutrition-related inputs such as nutrient-dense food. In addition, households far from a water source may face barriers to home gardening and other income generating activities that have a direct or indirect effect on improving nutrition (Moriarty et al. 2003).

# Entry Points for Improved Nutritional Outcomes

The current body of evidence on the links between WASH and nutrition provides important clues as to what nutrition sensitive enhancements are needed to achieve greater impacts on early child nutrition. The following six principles aim to address some of the limitations that are found with conventional WASH interventions.



## Radically Improve Quality of Services

The Sustainable Development Goals (SDGs) have raised the quality standard to safely managed water supply and sanitation. The shift from addressing just *access* to quality, equitable, and sustainable services is an important enhancement that has the potential to improve child health and nutrition impacts of WASH services. At present, what may be defined as improved water supply and sanitation services are the *source of disease*, rather than *protection from disease*. For example, water samples tested across sources in five countries under the World Bank WASH Poverty Diagnostic (2017b) have had *E. coli* contamination from 48 percent to nearly 100 percent of the time, and there have been no differences found comparing piped to other improved water sources, such as protected wells.

A similar shift toward quality of service has accompanied the health SDG goal of universal health coverage, which encompasses equity, quality, and financial risk protection. This is based on the recognition that having access to health care has not necessarily translated into better health *outcomes*.



## Converge Nutrition-Specific and Nutrition-Sensitive Programs for Vulnerable Populations

Available evidence suggests that improvements in water supply and sanitation need to be combined with other nutrition-specific and nutrition-sensitive interventions to reduce child stunting (World Bank 2017b).

WASH interventions alone cannot address other deprivations faced by children living in poverty, such as low rates of breastfeeding, low-caloric intake, and consumption of a diet low in diversity.

Studies show that reductions in stunting are more likely to materialize when the multiple contributing factors—food security, access to health care, child care practices, and access to water supply and sanitation—are adequately addressed for a child. For example, analysis across 33 countries in Sub-Saharan Africa shows the prevalence of stunting for children with simultaneous access to adequate levels of key nutrition drivers is significantly lower than the prevalence of stunting for children who do not have access to these drivers (World Bank 2018). Moreover, there is evidence that multisectoral interventions work. An observational before-after study of multisectoral interventions in nine sub-Saharan African countries has documented large reductions in childhood stunting prevalence in program areas, while levels of stunting at the national level remained unchanged (Remans et al. 2011).

Reductions in stunting are more likely to materialize when the multiple contributing factors—food security, access to health care, child care practices, and access to water supply and sanitation—are adequately addressed for a child.

## Focus on Demographic and Geographic Targeting and Inclusion



While WASH interventions are typically delivered at the community level, there is justification for targeting certain behavioral interventions to pregnant women and households with children under two years of age (the first 1,000 days of a child's life). These include interventions that address infant food hygiene and containment of animal feces. Diarrhea risk increases during the infant weaning period in low-income settings, and child growth often falters after the initiation of weaning foods (Motarjemi et al. 1993). Therefore,

contaminated weaning foods may be a more important contributor to diarrheal disease than contaminated drinking water in these settings (Lanata 2003). Animal feces remain a common source of contamination in low-income settings, even in areas of high sanitation coverage and low rates of open defecation. Crawling infants are frequently exposed to these contaminants in the household environment as they practice exploratory and mouthing behaviors.

Geographic inclusion is another approach to target resources to areas that are more likely to realize health and nutrition benefits from improvements in WASH. Geospatial mapping can identify target areas where undernutrition and underlying deprivations, such as lack of access to water supply and sanitation, are high. In Tanzania, the WASH Poverty Diagnostic (2017a) produced maps (map 1, panels a and b) to illustrate the cross-section of sanitation, water supply, and stunting. Areas marked in red highlight where access to improved sanitation or

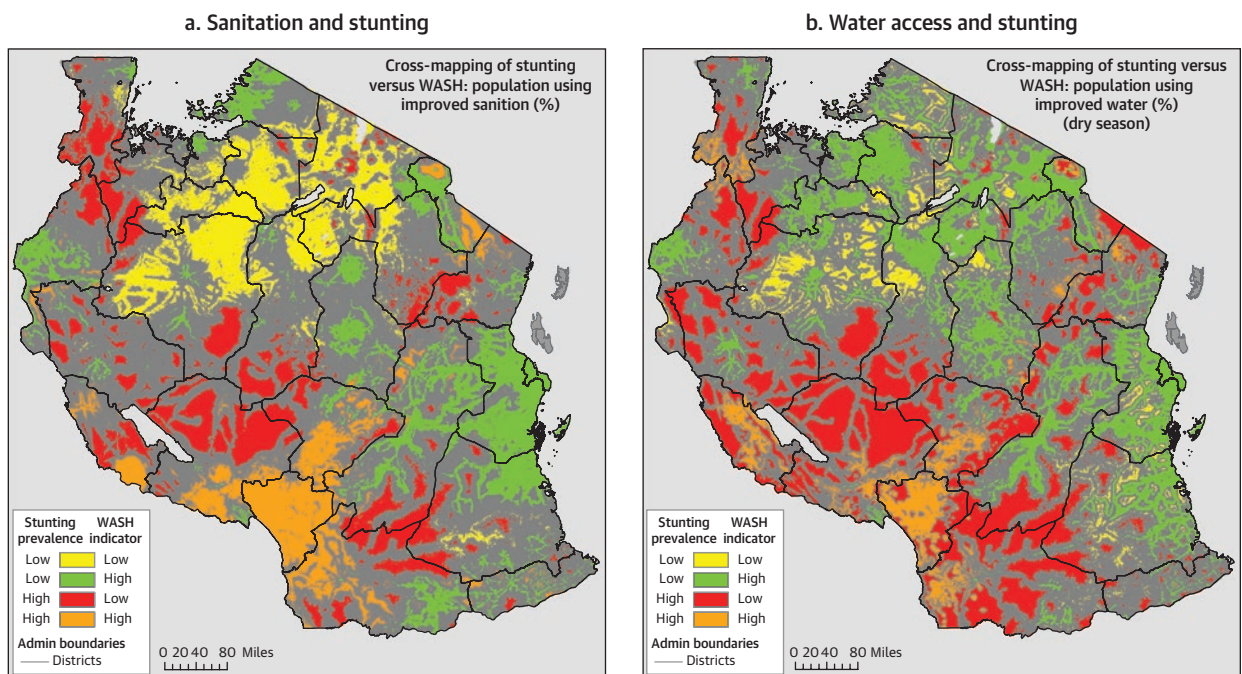
water supply is low and stunting levels are high. These maps have been used to engage in a dialogue with the Tanzanian government to identify target areas for WASH investments under the Rural Water Supply and Sanitation Program-for-Results operation.

### Adapt “Child-Centric” Water Supply and Sanitation Interventions



Conventional WASH interventions may still bypass some of the dominant fecal contamination pathways that affect small children. An emerging approach known as “baby WASH” or “child-centered WASH” includes food hygiene, clean play environment, management of animal and child feces, and infant and child handwashing. It has been proposed to address these neglected pathways (Ngure et al. 2014). In some contexts, it may be more efficient to deliver these child-focused interventions through community health and other social engagement platforms that

**MAP 1. Sanitation and Stunting and Sanitation and Poverty Levels in Tanzania**



Source: World Bank 2017a.



frequently interface with caregivers of young children. Coordination with community agriculture and livelihoods programs is also important, because these sometimes introduce livestock, which could result in animal feces contaminating the living environment. Baby WASH interventions could include the following:

- Sweeping and washing of child’s play environment, including play objects, to ensure it is free of child and animal feces
- Fencing off or caging poultry and livestock so they cannot contaminate the household environment
- Washing infant’s and child’s hands with soap before eating or breastfeeding
- Using clean and treated or boiled drinking water for preparation of weaning foods
- Using cups, not bottles, since the latter can harbor bacteria



### Emphasize Behavioral Change and Use Innovative Approaches to Ensure Sustainable Behavior Change

Until universal access to safely managed water supply and sanitation services is achieved, human behavior will continue to be critical for early child health impacts. However, behavioral change is hard to achieve, let alone sustain. Experience shows that just teaching people about behaviors such as handwashing, drinking water treatment, and toilet use is necessary, but it is not sufficient, because knowledge of these behaviors is already high in many contexts.

Behavior change campaigns need to first appeal to the desires and behavioral biases of the target population. Health benefits, for example, are seldom a strong motivator for changing behavior—people respond more strongly to emotional appeals such as a desire to be clean and modern or appeals to one’s pride or dignity. Behavioral biases often dictate people’s decision making, more so than rational thinking, so understanding these may help to design more effective

behavior change campaigns (Coville and Orozco 2014; Kahneman and Tversky 1979).

Analysis shows that behavior change messages delivered at high frequency and intensity are more likely to lead to changes in behavior that are maintained over time; however, this level of intensity is not practical in many low-resource settings. More effective behavior change will benefit from the use of disruptive technologies; unconventional media; and information, communication and technology (ICT) tools, techniques, and devices that can deliver messages more effectively and that can cater to known behavioral biases.

### Mainstream WASH in Other Sector Programs



Social protection, health, nutrition, and livelihoods programs provide a community-based platform for delivery of nutrition-related services and may be suitable for integration of WASH interventions. These programs sometimes target services to households that have pregnant women and young children. They can provide a suite of services to beneficiaries, while reducing the costs associated with parallel or convergence programming. For example, conditional cash transfer programs use targeting systems that enable both geographic and demographic (first 1,000 days of a child’s life) targeting of nutrition-specific and -sensitive services without incurring additional costs. WASH integration may be more practical in some rural and hard-to-reach areas where infrastructure solutions are not feasible or cost-effective. Services that can address WASH behaviors and practices include the following:

- Social mobilization to construct and use household toilets, or to construct small-scale community water supply systems

• **Baby WASH goes beyond conventional WASH interventions to address food hygiene, clean play environment, management of child and animal feces, and infant and child handwashing.**

- Parental counseling and behavior change communication around household sanitation and hygiene
- Provision of simple consumables such as clean birth kits, soap, and water purification tablets during household or community meetings, or during prenatal and well-child visits
- Training of health and education staff on sanitation and hygiene behaviors and practices

WASH integration has limitations because the programs may not address institutional capacity needed to sustain service delivery. For example, without adequate operational and maintenance support to keep community water systems functioning, they can break down, leaving households with no option but to revert to an unimproved water source. Some programs rely heavily on behavioral change, which is difficult to achieve and sustain.

# Guidance for Nutrition-Sensitive Monitoring and Evaluation

Building the evidence base on the effectiveness and impact of nutrition-sensitive WASH interventions requires enhancing existing monitoring and evaluation efforts. Table 1 presents a set of results framework indicators to support nutrition-sensitive WASH monitoring in water supply and sanitation (WSS)

lending operations. These indicators can also be used for WASH components of projects in other sectors, such as health sector projects. The selected indicators would need to be adapted to the project context, including data availability, project components, and monitoring and evaluation capacity.

**TABLE 1. Nutrition-Sensitive Indicators for WSS Lending Operations**

Key results indicators for WSS operations	Additional key results indicators for nutrition-sensitive WSS operations	Data source and calculation	Qualifies as gender indicator
<b>Access/quality</b>			
<ul style="list-style-type: none"> <li>• People provided with access to improved water sources**(number)</li> <li>• People provided with access to improved sanitation**(number)</li> <li>• Number of improved latrines constructed</li> <li>• Number of communities/households with access to SLWM services</li> </ul>	Beneficiary households with children under 5 (number)	Project-level data collected by implementing agencies or MIS, combined with administrative/population survey data	
Percentage of water quality tests that meet required standards	Percentage of source or stored water quality tests that meet required standards	Project level data collected by implementing agencies or MIS	
Number of schools and health centers with improved WSS facilities	Number of health centers providing antenatal/maternal care with improved WSS facilities	Project-level data collected by implementing agencies or MIS	✓
<b>Hygiene behavior/open defecation</b>			
Number of communities/villages certified as ODF	Number of children under 5 benefiting from living in villages certified as ODF	Using administrative data on population of under-5 children (birth rate), estimate number of children in villages certified as ODF	✓
None	Proportion of households practicing safe disposal of child and animal feces	Baseline and follow-up household surveys	
<ul style="list-style-type: none"> <li>• Behavior change campaign designed and implemented</li> <li>• Percentage of target audience reached through behavior change awareness campaign</li> <li>• People trained to improve hygiene behavior or sanitation practices</li> </ul>	<ul style="list-style-type: none"> <li>• Number of frontline workers who have received nutrition-sensitive WASH behavior change communication training</li> <li>• Number of behavior change communication plans that incorporate child-centered WASH behavior change</li> </ul>	Project-level data collected by implementing agencies	
Schools/health centers with handwashing facilities	Number of health centers providing antenatal/maternal care with handwashing facilities	Project-level data collected by implementing agencies or MIS	✓
Percentage of target audience that practice hygiene behavior (e.g., handwashing with soap, use of latrines) at key times (e.g., after defecation)	Percentage of caregivers of children under 5 who are washing hands with soap after using latrine	Baseline and follow-up household (sticker diary method recommended) <sup>a</sup>	✓

*table continues next page*

**TABLE 1. continued**

<b>Key results indicators for WSS operations</b>	<b>Additional key results indicators for nutrition-sensitive WSS operations</b>	<b>Data source and calculation</b>	<b>Qualifies as gender indicator</b>
<b>Institutional strengthening</b>			
Staff trained in O&M of schemes	Number of water scheme operators (e.g., district officers) receiving environmental health training	Project-level data collected by implementing agencies	
<b>Monitoring and evaluation</b>			
Number of communities/villages maintaining information on WSS services/MIS	Number of communities/villages in project areas that use an MIS harmonized with health MIS	Project-level data collected through MIS	
None	Number of communities/villages in project areas participating in surveillance system for safe drinking water	Project-level data collected by implementing agencies	

*Note:* Indicators are indicative and may require modification to match the context of a particular project. MIS = management information system; ODF = open defecation free; O&M = operations and maintenance; SLWM = solid and liquid waste management; WASH = water supply, sanitation, and hygiene; WSS = water supply and sanitation.

a. The sticker diary is a survey methodology developed by Unilever and the London School of Hygiene and Tropical Medicine in which respondents are given a set of pictorial representations of common daily activities and are asked to create a "diary" of daily behaviors under the guidance of a trained enumerator. The method has been successfully applied in India and Vietnam, and has shown to reduce over-reporting of handwashing behaviors, while being less costly than traditional observation methods.



# Rationale for Measuring the Suggested Nutrition-Sensitive Indicators

## Access and Quality Indicators

A key pathway to improved nutrition is through improvements in service quality, including the quality of infrastructure. The SDGs define an ambition for WASH service delivery that goes beyond building pipes and toilets to providing services that effectively reduce environmental fecal contamination, including water quality, continuity of service, septage and fecal sludge management, and hygiene practices. Moreover, the SDGs emphasize inclusion of vulnerable populations, women, and children, which is critical for meeting nutrition objectives. The following indicators reflect these aspects of the SDGs.

### Access to Improved Water Sources and Improved Sanitation Facilities for Beneficiary Households with Children under Five

Improvements in infrastructure are a critical factor for nutritional outcomes. Higher levels of service show greater risk reduction for diarrheal disease in meta-analysis of intervention studies (Wolf et al. 2018). Monitoring access among children under five can demonstrate the reach of WSS service delivery for a priority population for achieving stunting reduction targets.

### Source and Stored Water Quality Tests

Dangour et al. (2013) have found a statistically significant effect of water quality on HAZ scores in children less than five years old, demonstrating the importance of water quality for child outcomes. At a minimum, nutrition-sensitive water supply interventions should test water quality at the source—at the water utility or community-based water system—routinely and report these results through a MIS. If feasible in the project context, water quality should be tested at the point-of-collection (e.g., standpipe) and point-of-use

using random sampling. Box 1 mentions the key characteristics of a water quality testing kit and the three approaches employed in testing water quality. Evidence shows that water collected outside the home is frequently recontaminated in the home due to poor storage methods and unsafe access practices (e.g., unsanitary storage vessels or those with no covers and dipping utensils) (Clasen and Bastable 2003; Wright, Gundry, and Conroy 2004). Beneficiary and household surveys can include water quality testing. This is usually done by asking the respondent to fetch a glass of water usually given to the child under five in the home and testing it for quality.

### Health Centers Providing Antenatal and Maternal Care with Improved Water and Sanitation Facilities

Provision of basic water supply<sup>1</sup> and sanitation<sup>2</sup> in the health care facility premises is critical to ensuring maternal, newborn, and child health. Improved WASH facilities in health settings enhances quality of care, which encourages mothers to seek prenatal care and deliver in facilities rather than at home, which are important for reducing maternal and newborn deaths (Russo et al. 2012). A systematic review of WASH and quality of care shows associations between adequate WASH services in health care facilities and care-seeking and patient satisfaction, with positive impact on health outcomes (Bouزيد and Hunter 2018).

## Sanitation and Hygiene Behaviors

Hygiene behaviors are a critical link between improvements in infrastructure and health and nutrition outcomes. This is particularly important in places with lower quality services.

### BOX 1. Low-Cost, Low-Tech Options for Microbial Testing

*[Water quality testing kits] should be portable, low-skill, self-contained, lab-free, and electricity-free. It should be available globally at a cost of less than \$0.10 (USD) per test, and it should be easy to interface with data reporting and communications technologies. It should also be integrated into education programs to mobilize stakeholders. To this we might add that (semi)quantitative results should be available quickly, without a 12 (24, 48, etc.) hour incubation period.*

—Dr. Mark Sobsey, University of North Carolina at Chapel Hill

#### Water quality tests take one of three approaches:

**Presence-absence (P-A).** P-A tests change color to show whether microbial contamination has been detected. They don't provide quantitative information about microbial water quality. Test kits are comparatively inexpensive, but often involve adding a powdered nutrient mixture and an incubation period of 24 hours for organisms to grow. P-A tests are suitable for screening in situations when microbial contamination is not expected (e.g., deep groundwater).

**Most probable number (MPN).** MPN tests are semi-quantitative. Several samples of the same water are tested in tubes, plastic bags, or small plastic plates with multiple wells. The user adds a nutrient solution ("culture media") and waits 12–48 hours for organisms to grow before counting the number of positive samples, indicated by a color change. The user then converts that number of positives to a statistical estimate of bacterial concentration, as per the instructions for the particular test.

**Membrane filtration.** Membrane-based tests are the most quantitatively accurate. In general, a 100-milliliter water sample is forced or vacuumed through a small, round filter paper (the membrane) using a little hand pump. All the bacteria in the sample are caught on the filter as the water passes through. The filter is then incubated with some sort of culture media. Each bacterium caught on the filter will multiply into a little colony. After the incubation, the user counts the colonies—possibly with the aid of a magnifying glass—to determine how many "colony-forming-units" were present in the original sample. Due to the filtration step, membrane-based tests are more difficult when water samples contain a lot of suspended material, and they can take time.

Source: Mistry and Lawson 2018.

### Children under Five Benefiting from Open Defecation Free

Open defecation, particularly in areas of high population density (Hathi et al. 2017), places children at high risk of illness, and there is mounting evidence that high levels of coverage of sanitation in a community are associated with lower probability of disease and lower rates

of stunting (Larsen et al. 2017; Pickering et al. 2015). Monitoring open defecation practices rather than counting number of toilets built has been a key shift in approach to rural sanitation (Verma and Sengupta 2018). This indicator provides an estimate of the number of children benefiting from improved sanitary conditions and is a proxy for better health outcomes.

### Households Practicing Safe Disposal of Child and Animal Feces

The domestic environment can become contaminated with feces even when improved latrines are available. Young children often practice open defecation when they are too young to be easily trained to use the latrine or due to fears of falling into the pit. If these feces are left in the open, they can contaminate the environment. Free-roaming animals such as chickens are common in low-income settings, and their feces is difficult to manage. It is estimated that approximately one-third of deaths among children under five years is due to pathogens found in animal feces alone (Wang et al. 2015). This indicator is a proxy for fecal contamination in the environment.

### Frontline Workers Who Have Received Nutrition-Sensitive Behavior Change Communication Training

Frontline health communicators are essential for improving child nutrition (Sunguya et al. 2013). Many countries and programs train these agents to communicate social and behavior change messages at the community level, either through household visits, in group settings, or in health and educational institutions. Nutrition-sensitive behavior change messages that address the child-specific pathways of fecal transmission (such as handwashing with soap for caregivers of young children, child handwashing, use of clean utensils for feeding, and use of boiled water for preparation of weaning foods) can enhance traditional WASH behavior change messaging by better targeting the fecal transmission pathways that pose the most danger to young children and infants.

### Behavior Change Communication Plans that Incorporate Child-Centered WASH Behavior Change

Traditional WASH behavior change messages may bypass some of the dominant fecal contamination pathways that affect small children. Child-centered

WASH focuses on interrupting exposure pathways that are most strongly associated with enteric infections known to cause malnutrition. This includes ensuring the cleanliness of a child's play environment and play objects by practicing safe disposal of child and animal feces, separation of livestock and domestic animals from the main housing compound, washing infant's and child's hands with soap before eating or breastfeeding, using only clean or treated drinking water for preparation of liquid and solid foods for infants and young children, and use of child cups (not bottles because they can harbor bacteria). Behavior change communication plans should explicitly address nutrition-sensitive behaviors and identify delivery platforms to increase effectiveness and efficiency. For example, delivery of child-focused interventions may be more effective through health workers.

### Health Centers Providing Antenatal and Maternal Care with Handwashing Facilities

Proper hand hygiene is the most effective way to reduce risk of infection at the lowest cost (Larson 1988; Mathur 2011). Evidence shows that simple behaviors such as handwashing with soap by birth attendants can dramatically reduce neonatal deaths (Rhee et al. 2008). Basic hand hygiene is defined under the SDGs as availability of (1) either alcohol hand rub or water and soap at points of care, and (2) handwashing facilities with water and soap at the toilets (JMP 2018). Pregnancy provides a window of opportunity to instill new habits in mothers that will benefit the health of their children.

### Caregivers of Children under Five Washing Hands with Soap after Using the Latrine

Maternal caregiver handwashing with soap reduces the risk of diarrhea by 40 percent (Freeman et al. 2014) and is therefore a critical behavior for improving child health. There are innovative methods for measuring handwashing that reduce cost and bias.

The sticker diary is a methodology developed by Unilever and the London School of Hygiene and Tropical Medicine whereby respondents are given a set of pictorial representations of common daily activities and are asked to create a “diary” of daily behaviors under the guidance of a trained enumerator. The method, applied in India and Vietnam, has shown to reduce overreporting of handwashing behaviors, while being less costly than traditional observation methods. The percentage of caregivers of children under five washing hands with soap after using the latrine can be estimated by dividing the number of respondents who report washing hands with soap by the total number of respondents.

## Institutional Strengthening

Institutional actors should be held accountable for ensuring the quality and functionality of WASH services, which in turn improves health outcomes among the population using those services.

## Number of Water Scheme Operators Receiving Environmental Health Training

Environmental health training should be a core component of capacity building for water scheme operators (e.g., district officers). It should cover issues around source water quality and associated health risks of agricultural or industrial run-off; groundwater contamination; drinking water treatment to prevent biological or chemical contamination; and health risks associated with low water pressure, leaks, broken pipes, and sedimentation.

## Monitoring and Evaluation

WASH sector monitoring and surveillance systems that are harmonized with health management information systems can improve coordination across these sectors for better planning and rapid response to health risks.

## Number of Communities or Villages in Project Areas that Use an MIS System Harmonized with Health MIS

Harmonization of MIS across sectors refers to the use of consistent indicator definitions and coordinated data collection. This improves the efficiency of monitoring and enhances cross-sectoral coordination. In the case of WASH and nutrition, this can enable cross-tabulation of access indicators with select health and nutrition outcomes.

## Number of Communities or Villages in Project Areas Participating in Surveillance System for Safe Drinking Water

A surveillance system provides routine monitoring of water quality at specific locations throughout the system. It can be used to document the quality of service provided and enable rapid response to health risks.

## Measuring Health and Nutrition Outcomes

Including health outcomes in the project results framework raises issues of attribution and cost. These challenges are outlined here for various outcome measures. It is uncommon even for health operations to measure these outcomes. For multisectoral projects that adopt a convergence approach, it may be appropriate to measure health and nutrition outcomes at the program or portfolio level, so projects share in the accountability for health and nutrition outcomes and no single project claims attribution.

**Diarrheal disease.** Prevalence of diarrhea is relatively easy to collect, but it is highly variable and requires large sample sizes to estimate with precision. Self- or caregiver-reported diarrhea can be biased downward due to placebo effects, social desirability bias, and recall attenuation bias, and therefore may show impact where there is none. Moreover, diarrhea is caused by multiple factors, and without an appropriate research design to attribute causality, data may not be sufficiently specific to demonstrate impact. Measures of diarrhea include (1) incidence of diarrhea in previous

seven days (or two weeks) for children under five or for adults; (2) symptom-based recall of watery stools and three or more stools per day, or blood in stool.

**Anthropometrics.** Child anthropometrics are objective measures of nutrition, but are costly to measure because they require specialized equipment and well-trained staff. Moreover, they have low specificity because growth can be influenced by many factors. Some growth measures, such as height-for-age, are best measured in the long term, which is not always practical for typical project and evaluation time frames. Systematic administrative data on height and weight are uncommon and population-level data are typically collected only every five years. Measures include height- and length-for-age, weight-for-age, and head and arm circumference.

**Stunting.** Defined as the share of the population of children under five whose HAZ and length-for-age Z-score (LAZ) is less than 2 standard deviations below the median of the reference population. National-level statistics on prevalence of stunting are typically updated every five years. In some cases, figures are available at regional, provincial, or district levels.

**Anemia.** Anemia, measured by levels of hemoglobin in the blood, is an objective measure of nutrition but requires a

finger prick, specialized equipment, and training, which may not be practical for most projects. Moreover, anemia has many causes that are not affected by WASH.

**Helminth and protozoa infection.** The presence of these parasites can be measured in stool samples of children. Stool is collected and tested in a laboratory. These measures have high specificity because they are spread through contaminated food and water. However, stool sample testing can be costly and logistically challenging.

**Enteric infection biomarkers.** New methods to predict long-term nutritional outcomes using stool samples are being developed. Noninvasive saliva samples can be tested for the presence of antibodies to common diarrheal disease pathogens. Further research is needed to establish the validity and reliability of these measures.

## Notes

- 1 Health care facilities with an improved water source on-premises with water available at the time of the questionnaire or survey will be classified as having basic service.
- 2 Health care facilities with improved latrines or toilets which are usable, separated for patients and staff, separated for women with menstrual hygiene facilities, and meet the needs of people with limited mobility are classified as having basic service.

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