

Water, Sanitation, and Hygiene (WASH): Pillars of Global Health and Sustainable Development

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Abstract

Water, Sanitation, and Hygiene (WASH) are fundamental components that significantly impact global health, societal well-being, and economic growth. Throughout history, the evolution of sanitation practices and their intricate link to health outcomes has been evident, from ancient civilizations to modern times. While early human settlements managed waste in rudimentary ways, the transition to urbanization and larger populations necessitated organized waste disposal systems. In the contemporary era, the criticality of safe water, improved sanitation, and hygiene practices is underscored by statistics from the WHO/UNICEF Joint Monitoring Program, revealing substantial global populations lacking access to clean water and regulated sanitation. Poor sanitation leads to public health hazards, disproportionately affecting vulnerable groups such as women, children, and those with disabilities. The Sustainable Development Goals (SDGs), especially SDG 6, underscore the interconnectedness of water, sanitation, and health with other developmental objectives. Improved WASH infrastructure and practices are essential in preventing various diseases, including diarrheal diseases like cholera, pathogens like those causing schistosomiasis, lymphatic filariasis, and hepatitis A. This paper provides a comprehensive overview of the significance of WASH, its impact on health, and strategies for disease prevention and control. It outlines the relationship between improved sanitation, reduced mortality rates, and economic growth while emphasizing the urgent need for global initiatives to bridge the disparities in access to clean water and adequate sanitation. Achieving the WASH-related SDGs is pivotal for building healthier, more inclusive societies and fostering sustainable development worldwide.

Keywords: Water, Sanitation, Health, WASH, SDG, Sustainable Development

Introduction

Sanitation and hygiene have held immense significance since antiquity. In the earlier stages of human civilization, nomadic hunter-gatherer groups thrived for over 200,000 years. Waste in these communities naturally decomposed, presenting fewer disposal difficulties as their populations were relatively small. However, the advent of permanent settlements nearly 10,000 years ago brought about a shift towards agrarian ways of living. This change necessitated a more systematic approach to human waste disposal, leading to the adoption of practices like those outlined in the Mosaic Law of Sanitation, which involved managing excreta by depositing it in covered ground holes.

Sophisticated water and drainage systems have been traced back to ancient societies such as Harappa and Mohenjo-Daro. In Prehistoric Greece as well, advanced

infrastructure for water supply, drainage networks, and flushing toilets was utilized. Initially, the practice of open defecation was considered less problematic due to the presence of abundant open spaces and a lower population density.

However, with the advancement of urbanization, the act of open defecation emerged as a substantial concern impacting public health and human dignity, notably as cities and towns experienced rising population numbers. Consequently, this spurred a worldwide emphasis on reducing open defecation, underlining the crucial need for enhanced sanitation methods.

According to WHO/UNICEF Joint Monitoring Program (JMP) 2023 With 115 million people consuming surface water, 2.2 billion people still lacked access to safely managed drinking water and 419 million people

practiced open defecation out of the 3.5 billion people who still lacked access to safely regulated sanitation in 2022. Top of Form

As per the World Health Organization (WHO), environmental sanitation involves overseeing and regulating all environmental aspects that affect human physical growth, health, and existence, either currently or with potential harm. This comprehensive approach encompasses managing elements within the environment—such as air quality, water purity, waste disposal, and hygiene standards—that can directly or indirectly impact human well-being. The primary goal is to prevent or mitigate potential adverse effects, safeguarding public health and ensuring better living conditions worldwide through proactive measures and interventions.

Health plays a crucial role in a thriving society, as the fear of illness can impede productivity, consumption, leisure activities, travel, and overall human and economic well-being (Smith et al., 2019). Attaining good health and promoting social and economic progress require adequate sanitation, practicing proper hygiene, and ensuring access to safe water. In 2008, the Prime Minister of India echoed a statement made by Mahatma Gandhi in 1923, emphasizing that “sanitation is more important than independence.” Enhancing health conditions has the potential to significantly reduce disease rates and their severity, thereby improving the lives of numerous individuals, particularly children, in developing nations.

Sanitation and Health

The recognition of sanitation’s importance in fostering community well-being dates back to ancient times. Archaeological findings of latrines, cesspits, and drainage channels unearthed from various ancient civilizations such as the Mesopotamian Empire (present-day Iraq), Scotland (3200 B.C.), ancient Greece (3000 B.C.), China (2500 B.C.), and Egypt (2100 B.C.) attest to this fact (Bond et al., 2013).

However, the widespread acknowledgment and advocacy of the link between sanitation and disease only gained momentum in the 1800s during the Sanitary “Awakening” or “Revolution.” Despite the existence of toilets and sewer systems in many historical cities (Angelakis et al., 2010), their functioning was akin to systems prevalent in several parts of the world today, where wastewater remains untreated (Naughton & Mihelcic, 2017). This untreated wastewater can contribute to the spread of diseases and environmental deterioration.

Moreover, traces of harmful parasites and pathogens, such as whipworm (*Trichuris trichiura*), roundworm

(*Ascaris lumbricoides*), and dysentery-causing agents like *Entamoeba histolytica*, have been discovered in ancient toilets and other waste disposal sites (Mitchell, 2017).

Moreover, there exists compelling evidence indicating that sanitation quality significantly influences psychosocial stress and well-being. Elements like safety, privacy, aversion to unhygienic conditions, and conflicts stemming from collective action failure can profoundly impact individuals’ mental and emotional states (Shiras et al., 2018).

Among the most vulnerable groups, including women, children, and individuals with disabilities, there is limited research on the sanitation needs of disabled persons, but ample studies focus on the demands of women and children in this regard. Children under five years old are particularly susceptible to diarrheal diseases, while women suffer physically, psychologically, and socially when proper sanitation facilities are lacking.

The absence of adequate facilities at home exacerbates women’s workload, forcing them to travel long distances for suitable sanitation and safe drinking water. Improper waste disposal also leads to the proliferation of disease-carrying flies, further endangering public health.

The major faecal-oral disease transmission pathways are demonstrated in the “F Diagram” which illustrates the importance of particular interventions, notably the safe disposal of faeces, in preventing disease transmission

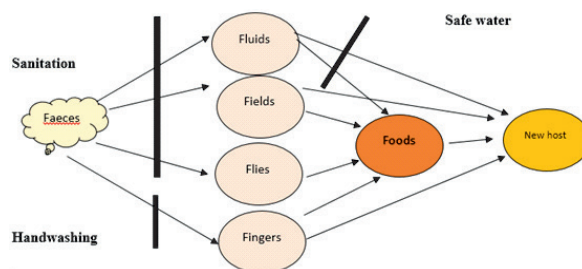


Figure 1 Faecal-oral disease transmission pathways “F Diagram”

According to WHO data 2019 the significance of death rates attributed to unsafe sanitation practices is an indicator of mortality impacts across different countries and over time. It emphasizes the comparative nature of death rates, which provide a standardized measure by calculating the number of deaths per 100,000 individuals in a specific country or region. The death rates from unsafe sanitation globally depicts stark disparities between countries. It significantly elevated death rates in lower-income nations, particularly in regions like Sub-Saharan Africa and Asia.

One striking observation is the vast discrepancy in death rates between low-income countries and wealthier ones. The statement suggests that in numerous low-income countries, death rates due to unsafe sanitation practices are more than 1000 times higher when compared to rates in affluent or high-income countries.

This disparity sheds light on the substantial impact of inadequate sanitation on mortality in less economically developed nations, underlining the urgent need for improved sanitation infrastructure, access to clean water, and enhanced public health measures to mitigate these disparities and improve overall well-being.

Water Sanitation and Sustainable Goal

In 2012 United Nation's conference on Sustainable Development (SDGs) in Rio de Janeiro the Sustainable Development Goals (SDGs) were born. With the aim of outline a set of global goals of development focusing on environmental, political and economic challenges. It reaffirms the developmental challenges by replacing Millennium Development Goals (MDGs) which was introduced in 2000 to eradicate poverty mainly. Among all 17 sustainable development goal (SDG), SDG 6 is interconnected with rest of 16 (Zheng et al., 2016).

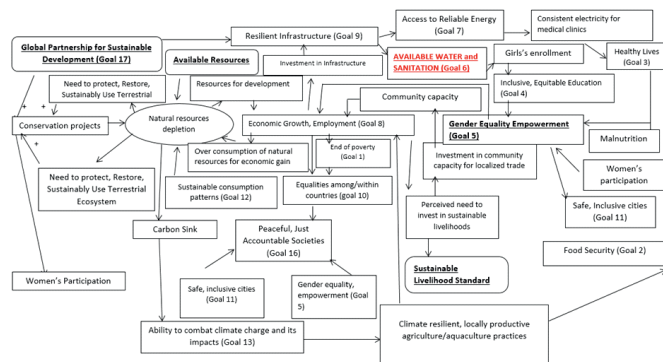


Figure 2 Conceptual systems model of the Sustainable Development Goals and Their Interconnection

Source: "More than Target 6.3: A Systems Approach to Rethinking Sustainable Development Goals in a Resource-Scarce World" (Zhang et al., 2016)

The figure demonstrates that by establishing robust infrastructure (Goal 9), it paves the way for creating sanitation facilities (Goal 6). This development not only leads to improved school enrollment for both genders but particularly benefits young girls, offering them safety, protection from violence, privacy (Goals 4 & 5). Addressing dropout rates promotes equal opportunities, reducing inequality and the gender gap. Women, being primary educators, ensure literacy for the next generation, fostering human capital for the economy. This pathway contributes to attaining Goal 5.

Enhanced access to water and sanitation diminishes illness, reducing morbidity and mortality rates, consequently saving substantial income spent on healthcare, treatment, and lost productive days. Time spent collecting water detracts from educational pursuits and income-generating activities, aligning with Goal 6, essential for providing a healthy life (Goal 3).

The safety issues faced by women and children when venturing out for sanitation needs expose them to physical and sexual assaults. Addressing these concerns fosters safety, empowerment, inclusive cities, and community well-being (Goal 11), achieved by meeting water and sanitation objectives related to health. Strengthening community capacity and promoting economic growth (Goal 8) occur through increased community participation and investment in resilient infrastructure (Goal 9), enhancing localized trade and city resilience. Moreover, achieving access to energy infrastructure (Goal 7) links to building resilient infrastructure (Goal 9).

The objective of promoting human health (SDG 3) and fostering economic growth and employment (SDG 8) are intrinsically linked. Within SDG 12, specifically in section 12.2 aiming for sustainable management and efficient utilization of natural resources, treating wastewater becomes pivotal. Energy retrieval from wastewater via anaerobic digestion is a viable method (Naughton & Mihelcic, 2017). Typically, the most significant component of wastewater is water, accounting for approximately 99% (Naughton & Mihelcic, 2017), offering a solution to water scarcity by reusing treated water for various purposes. Additionally, apart from water and energy, wastewater comprises essential nutrients like nitrogen and phosphorus. Top of Form

WASH and the illnesses that stem from insufficient practices in these domains

Diarrhea

Diarrheal Disease, a widespread fecal-oral illness globally, results in an estimated 1.6–2.5 million deaths annually, disproportionately affecting children under 5 years old in developing nations (Mathers CD, Lopez AD, Murray CJL, 2006). In scenarios where sanitation and hygiene standards are inadequate – such as the lack of proper handwashing facilities or improper feces disposal – human waste can contaminate hands, subsequently leading to food contamination or person-to-person transmission. Diarrhea remains a significant cause of mortality among children under five, particularly in developing nations. The World Health Organization (WHO) underscores the critical role of enhanced access to clean water, sanitation facilities, and improved hygiene practices in preventing diarrheal diseases and associated fatalities.

Pathogens originating from feces typically enter water-based sewage systems via flush toilets or latrines, potentially contaminating surface waters and groundwater. Additionally, human waste can directly pollute soil, posing risks upon contact, while flies might transport pathogens from waste to food. These pathways create a potential risk of contracting diarrheal diseases through the consumption of contaminated drinking water, recreational water, or food. Animal waste similarly acts as a source for transmitting pathogens. The primary transmission route depends on factors like the survival traits of the pathogen, local infrastructure, and human behavior.

Several interventions have demonstrated their effectiveness in interrupting the transmission cycle of pathogens at various stages. Improved sanitation practices have proven highly impactful in reducing rates of diarrheal diseases, with research indicating a decrease ranging from 32% to 37% (Fewtrell et al., 2009). In a longitudinal cohort study carried out in Salvador, Brazil, it was observed that increasing sewerage coverage from 26% to 80% within the specified population resulted in a notable 22% decline in the occurrence of diarrhea among children under the age of 3.

Neglected Tropical Disease

Neglected Tropical Diseases (NTDs) are widespread infections that afflict individuals in Sub-Saharan Africa, especially those residing below the poverty line set by the World Bank. Nearly every person in this demographic is affected by one or more NTDs. These diseases encompass soil-transmitted helminths, schistosomiasis, onchocerciasis, lymphatic filariasis, trachoma, and malaria. Soil-transmitted helminths, parasitic worms residing in the human intestine, infect over a billion individuals. Roundworm, whipworm, and hookworm infections are prevalent in tropical and subtropical regions, particularly in developing nations where there is inadequate access to safe drinking water and proper sanitation practices (including the disposal of human waste) (Ziegelbauer et al., 2012).

Infected individuals excrete the eggs of these helminths, leading to soil contamination. Roundworm or whipworm infections occur when individuals consume raw, unwashed vegetables or neglect to wash their hands after touching contaminated soil. This mode of transmission is especially prevalent among children. Enhancements in water, sanitation, and hygiene (WASH) infrastructure, alongside the encouragement of appropriate hygiene habits, play a vital role in attaining long-term control, elimination, or eradication of numerous neglected tropical diseases (NTDs). Top of Form

Schistosomiasis

Worm parasites are the cause of the acute and chronic disease schistosomiasis. When schistosomiasis patients contaminate freshwater sources with their excrement, which contains parasite eggs, transmission takes place. These eggs hatch into larvae that grow into adult schistosomes in water. The adult worms live in blood arteries, especially in the veins close to the bladder or intestines, where the females deposit their eggs. A portion of the eggs leave the body through urine or faeces, which completes the parasite's life cycle. Others, however, lodge in bodily tissues and trigger immunological reactions as well as organ damage over time (WHO).

Infections with Schistosomiasis come in two varieties. The first kind, known as urogenital schistosomiasis, is prevalent in the Philippines, China, Indonesia, Africa, the Middle East, the Caribbean, Brazil, Venezuela, Suriname, and some parts of Cambodia and the Lao People's Democratic Republic.

One of the most debilitating symptoms of chronic intestinal schistosomiasis is hepatosplenomegaly, or the enlargement of the liver and spleen (Gryseels, 2006; Colley, 2014). On the other hand, bladder cancer risk has been linked to urogenital schistosomiasis, among other severe bladder issues (Rollinson, 2009). In addition to household hygiene practises, community-wide hygiene practises also affect an individual's risk of contracting the disease.

Lymphatic Filariasis (Elephantiasis)

The main goal of schistosomiasis control efforts is to reduce the disease by regularly treating a large portion of the population with praziquantel, a prescription drug used as an anti-worm treatment. A more thorough solution, however, entails putting policies in place to supply drinkable water, guarantee sufficient hygienic facilities, and manage snail populations – which serve as the parasite's intermediary hosts. Most *Schistosoma* eggs can be contained by having access to and using adequate sanitation facilities, which will stop the miracidia stage from infecting intermediate host snails (Grimes et al., 2015).

Wuchereria bancrofti, *Brugia malayi*, or *B. timori* are the three species of filarial nematodes that cause this disease; they are spread by mosquitoes (WHO, 2013). These worms belong to the family Filariodidea and are nematodes, or roundworms, that live in the lymphatic system. Classified as a Neglected Tropical Disease (NTD), this kind of infection negatively affects the lymphatic system and frequently causes aberrant expansion of bodily parts, which causes pain, severe disability, and social disgrace.

Dracunculiasis (Guinea Worm)

Dracunculiasis, commonly known as Guinea worm disease, is caused by the parasitic infection of *Dracunculus medinensis*, a type of nematode or roundworm. This disease primarily affects humans and is transmitted through contaminated drinking water that contains water fleas carrying the infective larvae of the Guinea worm. Once ingested, the larvae mature and develop into long, thread-like worms inside the human body.

The adult female Guinea worm can grow up to several feet in length and typically emerges from painful blisters, often in the lower limbs. This painful emergence of the worm through the skin causes intense discomfort and leads to incapacitation, making it challenging for those infected to carry out their daily activities. Treatment primarily involves slowly extracting the worm by winding it around a stick over several days, while preventing the wound from being submerged in water to avoid releasing more larvae into the environment.

Efforts to eradicate Guinea worm disease have been successful in reducing its prevalence significantly, with ongoing initiatives focused on complete eradication worldwide. Public health interventions primarily revolve around improving access to clean and safe drinking water, community education about disease prevention, and the implementation of effective control measures to interrupt the life cycle of the Guinea worm.

As of October 30, 2020, a total of 198 countries, territories, and areas have been officially certified as free from dracunculiasis transmission. Among the remaining seven countries yet to receive certification, one country, the Democratic Republic of the Congo, has no recent history of dracunculiasis transmission. The other six countries fall into two categories: some are still endemic (Angola, Chad, Ethiopia, South Sudan, and Mali), meaning they still experience ongoing cases of the disease, while others are in the precertification phase (Sudan), working towards meeting the criteria for being declared free of dracunculiasis transmission.

Onchocerciasis

The parasitic disease known as human onchocerciasis, or river blindness, is brought on by the filarial worm *Onchocerca volvulus*. Black flies (*Simulium* spp.), which breed in swift-moving rivers and streams and are primarily found in isolated communities close to fertile terrain where people depend on agriculture, are the carriers of the virus. As per WHO (2018), it is the second leading cause of infectious blindness worldwide. Onchocerciasis, a rare but potentially fatal illness, results in severe impairment and chronic suffering; each year, it claims 1.5 million impairment-Adjusted Life-Years

(DALYs) (Remme et al 2006). An onchocerca infection weakens the immune system, impairs host immunity, and makes the body more susceptible to illness (Remme et al 2006). Thirty-one African countries include more than 99 percent of the infected individuals. It is also found in Yemen and a small portion of Latin America. For a minimum of ten to fifteen years, the WHO advises ivermectin treatment every year. According to estimates from the Global Burden of Disease Study, there were 20.9 million *O. volvulus* infections that were commonplace worldwide in 2017. Of those infected, 14.6 million suffered from skin diseases, and 1.15 million experienced visual loss.

Hepatitis A

A viral liver disease called hepatitis A can produce mild to severe symptoms. In the liver, viruses multiply. An increased risk of contracting hepatitis A is linked to inadequate sanitation and hygiene, including hand hygiene. (WHO, 2019) About 7134 people died in 2016 with hepatitis A, which accounted for 0.5% of all deaths from viral hepatitis. Male patients have a greater incidence of acute A hepatitis (Jung et al., 2012; Hennessey et al., 2009). This is due to the fact that men must travel more frequently than women and are exposed to unclean environmental conditions more frequently. The main way that the hepatitis A virus spreads is through oral faeces, although an infected person's poor hygiene habits can also spread the infection.

Conclusion

In conclusion, the nexus between Water, Sanitation, and Hygiene (WASH) and public health is undeniable. Across history, from ancient civilizations to contemporary societies, the impact of inadequate sanitation practices on health has been profound. The lack of access to safe water and proper sanitation facilities leads to a multitude of diseases, ranging from diarrheal illnesses to neglected tropical diseases like schistosomiasis, lymphatic filariasis, and hepatitis A.

These diseases are particularly rampant in regions with poor sanitation infrastructure, limited access to clean water, and inadequate hygiene practices. Diarrheal diseases, for instance, remain a significant cause of mortality, especially among children under five years old in developing nations. Neglected tropical diseases affect millions of individuals, perpetuating a cycle of illness and poverty.

Efforts to combat these diseases involve multifaceted approaches, encompassing improvements in WASH infrastructure, community education on proper hygiene practices, disease-specific treatments, and public health interventions. Access to clean water, enhanced sanitation

facilities, and hygiene education are crucial in preventing the transmission of these diseases and improving overall health outcomes, especially among vulnerable populations such as women and children.

The Sustainable Development Goals (SDGs) established by the United Nations highlight the significance of achieving universal access to water, sanitation, and hygiene. These goals underscore the interconnectedness between WASH and various facets of human development, including health, gender equality, education, economic growth, and environmental sustainability.

To mitigate the impact of these diseases, concerted global efforts are required to address the root causes by investing in infrastructure, promoting education and behavioral changes, and implementing effective interventions. By prioritizing WASH initiatives, we can alleviate the burden of preventable diseases, improve livelihoods, and create healthier and more resilient communities worldwide.

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