Yale *Institute for Global Health*

2020 Yale Institute for Global Health Case Competition

Swachh Bharat Abhiyan: Achieving an Open Defecation Free Country through the Clean India Mission

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Special thanks to Marie Brault for review of the case.

Any characters described in this case are fictional and do not reflect any existing organizations or individuals. However, the background information and history provided are intended to portray an accurate representation of the open defecation issue and public health scenario of India. The data provided are sourced from independent research and are cited so that teams may verify and/or contest the findings as needed. It is the contestants' responsibility to confirm the accuracy of all information they use in their final presentation. The case scenario is complex and does not necessary have a perfect solution.

Introduction

India's Prime Minister Narendra Modi launched the Swachh Bharat Mission, or the Clean India Mission, in 2014, which aimed to end open defecation in the country by 2019.[1] The government has since built over 110 million toilets across the country. However, the mission has been criticized for being coercive and even violent—two children from India's lowest caste were reportedly beaten to death for defecating in the open, a harrowing example from just last year.[2] Further, just because the toilets are constructed, doesn't mean that people are actually using them. In October of 2019, Modi claimed that India was finally open defecation free, but many experts say this is not actually the case.[1] Open defecation is linked to a wide variety of poor health outcomes, especially those linked to infectious diseases and parasites. This critical issue is one that is being addressed on the world stage—clean water and sanitation is the United Nations' sixth Sustainable Development Goal[3]—yet there is still much to be done.

Further, climate change is exacerbating the issue of sanitation. Since 1880, the world has warmed by about 0.8 °C (1.4 °F).[4] As global worming contributes to more frequent extreme weather events, the damage that occurs because of these natural disasters can result in dangerous health implications. Damaged infrastructure can lead to contaminated water supplies, for instance, and standing water following a flood or hurricane can provide breeding grounds for insect vectors.[5] Further, climate change disproportionately affects the world's most vulnerable populations, often the same populations struggling most to access clean water and sanitation. Thus, finding sustainable solutions to our most pressing global health issues is necessary to ensure that interventions do not further contribute to the global disease burden.

Vignette #1

Ravi and Nidha are two children who live on the outskirts of a small town along the Ganges River. They were born into the lowest caste in Indian society, called "untouchables," and have dealt with marginalization and prejudice their entire lives. Both of their families live in small, one-room tin shanties without electricity, running water, or bathroom facilities. When members of the family need to use the bathroom, they go to the Ganges River and defecate on the riverbanks. They also wash, bathe, and gather drinking water from the Ganges. Because of this, their family often gets sick with a wide variety of bacterial infections, such as *E. coli*. Two years ago, Ravi got extremely ill when a cut on his arm got infected while bathing in the river, resulting in a severe case of gas gangrene requiring amputation above the elbow.

Recently, thanks to Swachh Bharat Abhiyan, public toilet facilities were built in the town in an effort to end open defecation and alleviate the pollution problem in the Ganges. Ministry officials went door-to-door the day the facilities opened, explaining the importance and availability of the toilets.

One day, Ravi and Nidha walked into town to use the public toilet facilities. Due to their caste status, a group of local townspeople refused to let them access the facilities, as they refused to share a toilet with "untouchables." Ravi and Nidha were thus forced to defecate openly. However, two men from the village caught Ravi and Nidha while they were defecating. They immediately started screaming

casteist slurs at the children and started chasing them through the streets. “Our village is dirty because of filth like you. If we get rid of you vermin, we wouldn’t have these problems!”

As they ran, the two men started to pick up sticks and rocks, hurling them at the children. One rock struck Ravi in the back of the head, causing him to fall to the ground and lose consciousness. Nidha stopped to try and help Ravi, but the two men caught up to them. One man continued to kick Ravi in the head as he lay unconscious on the ground. The other attacked Nidha, landing multiple severe blows to the torso, resulting in broken ribs, organ damage, internal bleeding. He also twisted her arm roughly behind her, dislocating her shoulder. Passersby saw the violent beating in action and called local authorities, who arrested both men. Ravi and Nidha both sustained severe injuries and ultimately passed away as a result.

This vignette is based on a true story.[6]

Vignette #2

Sindhu is a 14-year-old girl who lives in Coimbatore, Tamil Nadu. She, her mother, her father, and her baby sister live in a small home that has electricity, but no access to running water.

Sindhu and her mother used to struggle significantly during their menstrual cycles. Pads and tampons produced by large multinational companies are too costly for them to afford. During their cycles, they are required to look for old papers, dirty rags, and other scraps they can use in lieu of pads. Sometimes, they are unable to find any materials to make their own pads. When this happens, Sindhu and her mother do not leave their homes: due to stigma surrounding menstruation, they are greatly embarrassed to free-bleed in public. As a result, Sindhu misses an average of 1 week of school every month. But even staying home presents unique challenges: without a toilet in their home and without access to running water, Sindhu and her mother struggle to maintain good hygiene during their cycles. As a result, Sindhu has been experiencing frequent urinary tract infections ever since she started menstruating.

Recently, Swachh Bharat Abhiyan came to Sindhu’s town to install accessible toilets and running water in the village. Now, with access to a toilet in her home, Sindhu and her mother do not struggle as much during their menstrual cycles, and she has stopped experiencing so many infections. With easier access to running water, Sindhu is also able to maintain a supply of clean rags to use during her cycle, and no longer has to skip school. Sindhu is happy that her baby sister will grow without having to skip school like she did.

This story is inspired by the work of Arunachalam Muruganantham, a social entrepreneur working to address menstruation taboos in India, featured in the documentary Period. End of Sentence.[7]

Prompt

Your team represents an external non-governmental organization consulting for India’s Ministry of Jal Shakti. This ministry was established in 2019 by combining the Ministry of Water Resources and the Ministry of Drinking Water and Sanitation, which originally implemented the Swachh Bharat Mission.[8] Your objective is to determine the best strategy to address the public health issue of open defecation in India. You will need to provide justification for decisions leading to your strategy and any costs and trade-offs. The targeted time frame for

your strategy is five years. Based on the information from this case and your research, you will present your recommendations to the Ministry of Jal Shakti on Saturday, February 1st, 2020.

A successful proposal will consider the following factors:

- What could and should be India's next steps in addressing the public health issue of open defecation?
- What educational and behavioral interventions could be effective in this country, given the lasting infrastructure and public sentiment left by the Swachh Bharat Mission?
- What is the most environmentally sustainable approach to addressing open defecation in India?
- Are there any stakeholders (civil society, public, private, domestic, international and global) you would need to partner with? Consider whether your strategy could function independently or would need collaboration with ongoing efforts by existing organizations working in India.
- Address any legal or ethical concerns and cultural acceptability of your proposal. What are some potential cultural, language and infrastructural barriers?
- Include a budget and timeline and justify your spending. You can consider that the Government of India spent about $3 billion per year on the Swachh Bharat Mission.[9] Recommendations for sources of funding beyond those provided by the government are welcome. You may choose to propose a strategy that requires lower or no costs.
- Include a plan to monitor and evaluate the effectiveness of your strategy.

Logistics

The time limit for each presentation is 15 minutes, with additional 10 minutes for question and answer with the judges. There is no requirement that each team member must speak during the presentation.

Questions regarding this case can be submitted to grace.chen@yale.edu until 11:59PM Friday, January 24th. Please include "[YIGH Case Question]" in the subject line. Questions and answers will be made available to all teams on the case competition website within 48 hours of receipt.

Final presentations must be submitted to the registration table by 9:00AM on Saturday, February 1st. Each team will turn in a flash drive containing the saved final presentation in PowerPoint format. Flash drives will be handed out to teams during the facilitated workday on Friday, January 31st. No changes to presentations are permitted after that time. The case competition committee will not return your flash drive.

Five points will be deducted from your team for each minute your presentation is late for the first 10 minutes after the submission deadline (9:00 to 9:10AM). Ten points will be

deducted for each minute after the first 10 minutes that your presentation is late (9:11 to 9:30AM). If a team turns in its presentation after 9:30AM, it will be disqualified from the competition.

History of Sanitation in India and the Swachh Bharat Mission

National Sanitation Initiatives in India

The United Nations' International Drinking Water Supply and Sanitation Decade, which spanned from 1981-1990, brought vigor to the global effort to improve clean water access and sanitation. [10] The initiative was largely in response to global population growth, economic recession, and deteriorating living conditions that made demands for clean water and sanitation increasingly difficult to fulfill, particularly in developing countries. It was during this decade, in 1986, that the Government of India established the Central Rural Sanitation Program (CRSP),[11] the nation's first central sanitation effort.[12] CRSP had two primary objectives: improving the quality of life of rural populations and protecting the privacy and dignity of women. A supply-driven effort,[13] the program attempted to achieve these goals through the construction of cesspools, pit latrines, and similar methods of human excreta disposal.[11]

CRSP was revised and retitled to become the Total Sanitation Campaign (TSC) in 1999.[13] TSC took a demand-driven approach to sanitation, utilizing education and awareness strategies to generate organic demand for sanitary facilities and improve individuals' capacity and agency to pursue options appropriate to their economic condition.[11] Financial incentives for households below the poverty line were also used to promote the construction and use of individual household latrines.[14] The government even implemented multimedia campaigns to encourage sanitation practices, for instance launching the Nirmal Gram Puraskar ("Clean Village") award in 2003.[13] TSC's successor program, Nirmal Bharat Abhiyan (NBA), was launched in 2012 and enhanced such incentives in an attempt to accelerate sanitation coverage in rural regions of India.[15]

While CRSP, TSC, and NBA made undeniable strides towards improving sanitation coverage in India, their success was limited by issues such as relatively low governmental priority and ineffective deployment of funds and resources.[13] One audit on the TSC from 2009 to 2014 revealed that more than 30% of individual household latrines were non-functional for reasons such as improper construction or lack of maintenance. Such issues reflected poor planning and thus wasteful use of funds. Available funds were found to be unused in some states—between 40 and 56% unspent on an annual basis. Furthermore, insufficient emphasis on the social aspects of TSC, such as education for behavioral change, also contributed to its overall limited success.

Finally, the Swachh Bharat Mission (SBM) was launched on October 2nd, 2014, becoming India's most recent and significant national sanitation initiative.[16] Prime Minister Shri Narendra Modi launched SBM to accelerate efforts towards universal access to sanitation, defined as the access to adequate disposal or treatment of excreta in UN Sustainable Development Goal 6,[17] and to pay tribute to Mahatma Gandhi by achieving a clean India by his

150th birth anniversary. SBM aimed to achieve a clean and completely open defecation free (ODF) India by October 2nd, 2019.

344 million people still practice open defecation in India today, and 21% of the country's communicable disease can be attributed to unsafe water and poor hygiene practices.[18] About two-thirds of rural households and one-fifth of urban households in India have no access toilet facilities.[19] Further, an increasing body of research reveals a dire need for sanitation facilities designed for the unique sociocultural and biological needs of women.[20] Such gender-responsive infrastructure would include privacy-minded stall layouts and discreet menstrual hygiene management facilities. These gender disparities in India's current sanitation infrastructure exacerbate other gender disparities, such as by driving young girls away from their educations.[21]

Structure and Approach of the Swachh Bharat Mission

A key feature of SBM's approach is its provision of flexibility to individual states by allowing them to decide their own methods of implementation, use of funds, and monitoring and evaluation strategy.[22] Thus, the role of the Government of India is essentially to complement, strengthen, and incentivize State activities. The overall strategy of SBM has three components: **planning, implementation, and sustainability**.[23]

During the **planning phase**, each district submits a project proposal to the State Government. These proposals will include detailed responsibilities at the Gram Panchayat (GP), or local governance, level. After scrutinization and consolidation, state governments formulate a final State Plan that is shared with the Government of India. Thus, the district is considered the base unit of intervention with the goal of creating open defecation free (ODF) GPs. District Swachhata Plans include establishment of a baseline status, scope of work for achieving an ODF district, timelines for implementation, and strategies for behavior change and toilet construction.

The **implementation phase** includes emphasis on Behavior Change Communication (BCC), a key differentiator of SBM, through Information, Education, and Communication (IEC) and Interpersonal Communication (IPC). IEC includes approaches to awareness generation within the community and triggering demand for sanitary facilities to be placed in homes, schools, Anganwadis (rural child care centers), and other places of community congregation. IPC similarly encourages social behavior change through means such as house-to-house intervention.

The need for a dedicated, trained workforce at the village level is met by an army of "foot soldiers" known as Swachhagrahis. These Swachhagrahis can be engaged from existing institutions such as community-based organizations or water linemen already working in GPs, or be trained specifically for the SBM purpose. States decide the guidelines for remuneration of their Swachhagrahis. Incentives can be up to 150 rupees per toilet constructed or some amount per village declared ODF. Swachhagrahis must meet certain qualifications such as good command over the local language, and each village must have at least one Swachhagrahi.

States may also engage Civil Society Organizations (CSOs) to carry out interventions, in which case Swachhagrahis may also be placed under the responsibility of CSOs. Self-help groups, non-governmental organizations, and other international, national, and local organizations may also be engaged.

The Ministry's *Handbook on Technical Options for On-Site Sanitation* provides a comprehensive list of technology options for sanitation to meet varying user preferences and needs.[24] The criteria for a sanitary latrine include not contaminating ground water, inaccessibility of excreta to flies or animals, no handling of fresh excreta, and no contamination of surface water or soil, among others.

Financial incentives for the construction of individual household latrines (IHHLs) are available and can be administered to individual households.[23] Incentives can also be given to communities as a whole, such as when an entire village is ODF for a certain period of time. These incentives are intended to bolster demand for and encourage the construction of sanitary facilities in GPs, districts, and other, especially rural, communities.

States have the power to regulate the utilization of the IHHL incentive and can administer financial incentives at multiple stages of the construction process. However, actual construction of latrines is ideally conducted by individual beneficiaries themselves as to promote a sense of ownership.

Community-based monitoring mechanisms, under the responsibility of state, district, and GP governments, are used to generate peer-pressure. Effective monitoring mechanisms measure two outcomes: toilet construction and toilet usage. Social Audit is one example of a community-led monitoring system.

Lastly, the **sustainability phase** encompasses rigorous requirements for verification of ODF status. Once ODF status is declared, two verifications must be carried out to confirm it. ODF communities are sustained through efforts to maintain sanitary behavior, continual engagement of ODF villages, reorientation of the roles of Swachhagrahis to activities required for sustainability, and more. Other activities can include a monthly "Walk of Pride," yearly socio-cultural celebrations of ODF status, identification of vulnerable people most likely to revert back to open defecation, and the strategic planting of vegetation to discourage open defecation there.

Ethical Considerations

Barriers to Latrine Use and Proper Sanitation Behaviors

Besides mere lack of access to proper latrines, cultural norms and lack of education regarding the health consequences of open defecation also contribute to India's sanitation issue. Open defecation is a socially accepted norm in some parts of society, particularly in areas where poverty and lack of lavatories have made open defecation unavoidable. Further, some studies report that people who choose to defecate in the open despite the availability of latrines often do

so because they find it more convenient, enjoyable, and healthy due to the long walks and socialization.[25] Women sometimes go for defecation in groups as a socialization activity, while men sometimes associate open defecation with masculinity while their wives, children, and sick family members defecate at home using a toilet. Thus, policymakers and health workers must consider the more personal and cultural aspects of open defecation in the development of sanitation campaigns.

Public health initiatives like Swachh Bharat aiming to bring about behavioral change in a population are included under the banner of "health promotion" within the field of public health. Most ethical considerations about health promotion activities fall under one of the following two categories: efficacy-related and autonomy-related.[26] Concerns related to efficacy seek to ensure that initiatives are cost-effective and effective in bringing about their desired change. Concerns based on autonomy are concerned with how interventions may infringe on the free choice of individuals, including issues of coercion, persuasion, manipulation, and paternalism. When one's autonomy is threatened, there is risk of individuals feeling offended, vulnerable, and powerless.

Coercion

Coercion is defined as "using power to gain advantages over others, punishing non-compliance with demands, and imposing one's will on the will of others."[27] While all governments act paternalistically through the creation of laws and regulations that limit freedom for the supposed better interest of citizens, most generally agree that health promotion strategies should use the least coercive means possible. Coercion has been a major issue in promoting the use of toilets in India. A study released in January 2019 by the Research Institute for Compassionate Economics analyzing the success of the Swachh Bharat mission from 2014-2018 stated the following:

> *"If sustained, the SBM's reduction in open defecation is likely to improve health, but it comes at a social cost. Coercion and threats were commonplace and sanctioned by local officials; violence sometimes occurred. Most respondents had heard of coercion in their village: people being stopped while defecating in the open, government benefits being threatened, and fines. Among households that own a latrine, Dalits [who are outcasts of the caste system] are over twice as likely to report experiencing one of these three forms of coercion as households from other social backgrounds. Adivasis [who are ethnic minorities] were almost three times as likely."* [28]

In addition to having already released an advisory against coercion in 2017, the Department of Drinking Water and Sanitation issued a statement in September 2019 condemning "coercive action taken by anybody, including government or elected officials" under threat of persecution "to the fullest extent of the applicable law."[29]

Persuasion and Manipulation

Persuasion plays an important role in health promotion and is defined as the intentional and successful attempt to induce a person, through appeals to reason, to freely accept the beliefs,

attitudes, values, intentions or actions advocated by the influencing agent.[30] It takes on a more authoritative nature when people with perceived high status are doing the persuading, such as a doctor or a government official. Ethical questions may arise when "the issue or problem, and how it should be dealt with, is wholly determined by the professional without taking into account what the individual (or group) wants, and pressure is put on them to comply with the advice given." Manipulation, on the other hand, is when one deliberately and successfully "influences people by non-persuasively altering their understanding of a situation, thereby modifying perceptions of the available options." In practice, it is not easy to completely distinguish persuasion and manipulation as many theories for behavioral change may contain elements of both.

Public Health Considerations

Public Health Risks Associated with Open Defecation

Open defecation is a public health issue across the globe, particularly in Sub-Saharan Africa and India. In 2012, the WHO reported that 626 million people practiced open defecation in India, accounting for 90% of people in South Asia who practiced open defecation.[31] Globally, 59% of the 1.1 billion people in the world who practice open defecation live in India. In 2018, more than half of India's population defecated openly despite the launch of the Swachh Bharat Mission in 2014. The adverse health consequences of open defection (OD) illustrate the importance of reaching open defecation free status particularly in rural villages, small towns, and low-income peri-urban areas not only in India but across the globe.

The adverse public health consequences of OD can be divided into acute and chronic health effects. The acute effects include infectious intestinal diseases such as diarrheal diseases which are exacerbated by poor sanitation and limited access to clean water. Infectious excreta-related intestinal diseases are more devastating in young children whose immune systems are still developing. Other acute health effects of OD include adverse pregnancy outcomes and life-threatening violence against women and girls.[32] OD exposes pregnant women and their newborns to infections which may lead to adverse pregnancy outcomes, sepsis, and mortality. Women and girls who have no access to toilets are at high risk of non-partner sexual violence, as they are attacked at night while practicing OD in dimly lit environments such as railway tracks.[33] Public toilets themselves can also be a location of "eve teasing," the sexual harassment of girls and women in public spaces.[34]

The chronic health effects of OD include soil-transmitted helminths, anemia, giardiasis, environmental enteropathy, and small intestine bacterial overgrowth.[35] Open defecators repeatedly come into contact with soil infested with fecal bacteria and pathogens. This can cause stunting and impaired cognition especially in young children whose immune systems have not fully developed. For example, young children living in conditions of poor sanitation ingest large quantities of fecal bacteria, putting them at high risk for enteric dysfunction, which causes poor nutrient absorption in the small intestines and leads to stunting.[36]

Antimicrobial resistance is another major long-term public health concern of OD. This is caused by the recurrence of infectious diseases that prompt the use of antibiotics, which exert a selective pressure on bacteria.[36] Further, OD decreases economic productivity as school and work attendance plummets due to recurring infections. These "lost generations" of physically-impaired and cognitively-challenged children and adults are the ultimate public health consequence of open defecation.[37]

Disease profiles of major sanitation-related diseases

Diseases related to poor sanitation contribute to 4.0% of all deaths and 5.7% of the global disease burden.[38] These diseases include fecal-oral infections, soil-transmitted helminths, and insect-vector diseases. Common fecal-oral infections include diarrhea, cholera, dysentery, typhoid fever, and polio.

Diarrhea, a preventable and treatable disease, is the second leading cause of death in children under five globally. [39] High incidence of diarrhea is due to transmission of pathogens via the fecal oral route due to poor water supply, sanitation, and hygiene. Diarrhea can last several days and cause severe dehydration and fluid loss. Improved sanitation and oral rehydration therapy are key in preventing and treating diarrhea.

Cholera, a water-borne disease, is caused by the bacterium *Vibrio cholerae.* [40] The most common symptom is severe acute watery diarrhea which can result in death in a few hours if left untreated. In 2017, 227,391 cases of cholera and 5,654 deaths were reported in 34 countries. However, these figures may underreport the true number of cases since many are not reported due to fear of impact on trade and tourism in affected countries. Treatment for cholera includes oral rehydration for mildly dehydrated patients and intravenous rehydration for patients who are severely dehydrated. Proper disposal of feces from infected people is crucial in preventing cholera outbreaks.

Dysentery is an infection of the intestines that causes passage of bloody stools mixed with mucus. [41] It is usually caused by bacteria of the *Shigella* species or by *Entamoeba histolytica,* both of which are transmitted via the fecal-oral route. Dysentery due to *Shigella* is the second most common cause of diarrhea in children under 5.[42] Dysentery is the most common cause of child mortality worldwide.[43] First line antibiotics used for dysentery are fluoroquinolones such as ciprofloxacin.[44] Second line treatment includes use of β-lactams and cephalosporins.

Typhoid fever is a life-threatening systemic infection caused by *Salmonella Typhi* through ingesting contaminated food or water or direct contact with an infected person. [45] It is commonly associated with poor sanitation and lack of clean drinking water. Between 11 and 21 million cases and 128,000 to 161,000 typhoid-related deaths occur annually worldwide. Symptoms include prolonged fever, headache, nausea, and gastrointestinal problems such as loss of appetite, constipation, and diarrhea. Vaccination programs, education, and sanitation are important in controlling and preventing the disease.[46]

Polio is a highly infectious disease usually transmitted via the fecal-oral route.[47] It mainly affects children under 5 years of age and can cause permanent paralysis. Initial symptoms include fever, fatigue, headache, vomiting, stiffness, and limb pain. Wild poliovirus has been successfully decreased by over 99% since 1988 with the introduction of polio immunizations. To be globally polio-free, it is important to promote good sanitation practices to prevent the spread of the disease in areas where it is still endemic.[48]

Soil-transmitted helminths are intestinal worms passed through soil contaminated with feces.[49] These parasitic worms include human roundworm and hookworm. WHO reports that more than a quarter of the global population is infected by soil-transmitted helminths, particularly in sub-Saharan Africa, the Americas, China and East Asia.[50] Soil-transmitted helminth infections are transmitted by eggs passed in the feces of infected people. Children, women of reproductive age, and farm workers are at high risk of becoming infected and suffering from cognitive impairment and growth stunting. Recommended treatment for soil-transmitted helminth infections includes regular deworming of people who live in high-risk areas. Hygiene education and improved sanitation help reduce transmission and reinfection.

Insect-vector diseases are diseases transmitted by insects such as malaria, dengue, and filariasis especially in tropical and subtropical regions.[51] Infected insects transmit deadly diseases to humans through their bites. Major vector-borne diseases constitute about 17% of all infectious diseases and disproportionately affect the poorest populations. Educating people on behavioral changes necessary to protect themselves from disease-carrying vectors is important in preventing disease. Additionally, improved access to clean water and sanitation is critical as many insect vectors breed in or around standing water.

India's disease burden

Infectious and associated diseases dropped from 61 to 33% of India's total disease burden measured in disability-adjusted life-years (DALYs) between 1990 and 2016.[52] These include communicable, maternal, neonatal, and nutritional diseases. Despite this decrease, five of the ten leading individual causes of disease burden were still an infectious or associated disease in 2016. India's disease burden in DALYs for diarrheal diseases, iron-deficiency anemia, tuberculosis is about three times higher than the global average for countries at similar levels of development. Further, the proportion of total disease burden caused by infectious and associated diseases is highest among children, contributing to the disproportionately higher overall disease burden suffered by children under five.

Meanwhile, India faces an increasing burden of non-communicable diseases.[53] The four leading chronic diseases in India are cardiovascular diseases, diabetes mellitus, chronic obstructive pulmonary disease, and cancer. WHO reports that common non-communicable diseases were the leading cause of death across all classes and regions in India.[54] India's rapidly increasing GDP has led to an epidemiological transition, from a state vulnerable to communicable diseases to one plagued by lifestyle diseases such as cardiovascular diseases. Risk factors for such diseases include poor diet, pollution, tobacco use, and alcohol use.[55]

Sanitation and Climate Change

Climate change has been linked to the declining health of many populations,[56,57] ranging from infectious to exposure-related disease. Some of the most vulnerable sectors of our population, children, pregnant women, and the elderly, are especially vulnerable to rising temperatures and extreme weather. Increased particulate matter in the air has been associated with increased rates of preterm birth and low birth weight,[58] and heat is linked with higher risk of certain diseases such as *Salmonella typhi*[59] and *Campylobacter jejuni*[60]. While low- and middle- income countries are responsible for only a small percentage of global greenhouse gas emissions, they do not escape the effects of climate change and are often more vulnerable to them. [61] This is true in India, where millions of people live below the poverty line and in rural areas.

Climate change exacerbates sanitation-related and water-borne disease specifically through a variety of means. Floods and droughts triggered by climate change impact access to and quality of water.[62] Changes in precipitation patterns and temperature can influence the spread of disease through shifting insect-vector disease maps, as well as result in extreme weather events that damage infrastructure and lead to water contamination and/or scarcity.

The effects of climate change must be considered when implementing sanitation initiatives like the Swachh Bharat Mission.[63] As climate change leaves water availability uncertain and unpredictable, many people in water-scarce situations resort to open defecation rather than a toilet that requires flushing. India was ranked the sixth most vulnerable country in the world to extreme weather events in the 2018 Global Climate Risk Index partially because of its insufficient availability of climate-resilient toilets. Constructing secure, easily maintained, and climate-resilient latrines is a unique challenge in the face of climate change. By extension, the dangers of climate change also require sanitation initiatives to be environmentally sustainable themselves, as to not contribute further to the global climate crisis.

The timeline for action to avert even more catastrophic health outcomes of climate change has been estimated to be a little over a decade.[64] Coordinated movements within the medical and global health communities to protect health by promoting sustainable solutions to health and public health issues are crucial.

Yale is taking its own steps towards advancing sustainable health ventures. The Sustainable Health Initiative (SHI) is a business accelerator for early stage companies to address complex global health challenges, including in India.[65] SHI follows the Sustainable Development Goals as set by the UN, which recognize that global health equity will be achieved through strategies to address health and education *while* promoting sustainability. Currently, SHI has selected startups from Yale and India that aim to address five challenges: infectious and vector-borne disease; urban health and the environment; maternal, child, and newborn health; water and sanitation; and non-communicable disease. Thus, the potential solution to India's sanitation problem is not limited to public health or behavioral change interventions—it could even be business in nature.

India Country Profile

Demographics

India is a large, multiethnic country located in South Asia that spans 3.1 million square kilometers.[66] Standing as the second most populated country in the world, it is home to 1.3 billion people, with a population density of 419 per square kilometer. The largest city is Mumbai near the west coast, and the capital is New Delhi in the northern Delhi region.[67] The literacy rate as of 2011 was 74%, with significant gaps between the sexes and between those living in rural and urban areas.[68] Approximately 34% of the nation lives in urban areas as of 2018.[69] Hindi and English are the official languages used by the government, however state legislatures have the power to adopt any regional language as the official language of that state.[70] SIL International's Ethnologue reports 415 total languages in India, but there more than a thousand individual mother tongues and dialects. Approximately 80% of the population subscribes to the Hindu religion, 14% to Islam, 2% to Christianity, 2% to Sikhism, 1% to Buddhism, and 0.5% to Jainism.[71] As of 2017, the average life expectancy for women is 70 years and for men is 68 years.[72] About 35% of Indians are aged 0-14, 60% were 15-64 years old, and 5% were above the age of 65.[73]

Political Structure[74,75]

India is the most populous democratic nation in the world. British colonization of India spanned 200 years from 1858 to 1947,[76] after which the partition of India split British India into the independent Union of India and the Dominion of Pakistan.[77] The Constitution of India came into effect in 1950, after the country's independence, and governs India's 29 states and 6 union territories. It is a parliamentary democracy, with a parliament divided into the Upper House or "Lok Sabha" and Lower House or "Rajya Sabha." In the Lok Sabha seats are reserved for specific castes and tribes, and members are elected every five years. Members of Rajya Sabha are appointed by the president or elected by "the assemblies of the states and union territories" for terms of six-years. The President is the head of state but serves a primarily ceremonial role. The Prime Minister is elected by the Lok Sabha and serves as the head of government. Narendra Modi, who is the leader of the right-wing Bharatiya Janata Party, was first elected to the role of Prime Minister in May 2014 and was re-elected for a second term in May 2019.

Economy[78,79]

The GDP per capita of India as of 2018 was $2,010, which was 5 times below the world average. It has the third largest GDP in the world of $2.597 trillion in 2017. The service sector accounts for 56% of the economy, industry for 26% and agriculture for 18%. During the post-colonial period up until the 1980s, the economic policy of the nation focused on "poverty reduction strategies" through industrialization and government investment in public-sector enterprises. These improvements primarily improved the lives of those living in urban areas with limited effect on those living in rural areas, where 70% still rely on agriculture. In the 1990s to

2000s, the government worked to deregulate trade and industry and privatize infrastructure and state enterprises.

Caste System[80,81]

The caste system is a form of social stratification that is believed be over 3000 years old. Hindus are divided into the Brahmins, Kshatriyas, Vaishyas and Shudras based on their fitting work and duty. The caste with the most power and influence is the Brahmins, who are deemed to be intellectuals capable of occupying the highest positions in society such as priests and teachers. They are followed by Kshatriyas, who are warriors and rulers; Vaishyas, who are farmers and merchants; and Shudras, who are menial laborers. Lastly, the Dalits are seen as outcasts or "untouchables" who are outside of the caste system and are destined to be street sweepers and latrine cleaners.

The caste system has structured social interaction among Hindus for generations with segregated communities and sanctions against intermarrying. It is argued by some historians that strong caste divisions came into prominence in Indian during the 18th century. Some anthropologists argue that British colonial censuses also worked to cement this a defining social feature of Indian society. Caste-based discrimination was outlawed in 1950 and India's constitution put in quotas for government jobs and school positions based on castes. Although in recent decades discrimination based on caste has decreased and intermarrying has increased, "caste identities remain strong."[80]

Further, the exclusion of non-Hindus from the caste system has contributed to the marginalization of certain populations, such as India's Muslim and Buddhist populations. For instance, many Indian Muslims are regarded as "untouchables" because Islam does not recognize caste.[82]

Geography[83]

India is the seventh largest country in the world and sits on its own subcontinent. The south borders the Indian ocean and the north is bordered by Pakistan, China, Nepal, Bangladesh, Bhutan and Myanmar. The Himalayan and Karakoram mountain ranges and other forested mountainous regions define the northern landscape, and the Deccan Plateau defines most of southern India. Climate ranges greatly throughout this expansive country but includes among the world's most pronounced monsoon season. The three general weather periods are hot wet weather from July to September, cool dry weather October to February, and hot dry weather from March to June.

Appendices

Appendix A: India Country Map

Source: https://www.nationsonline.org/maps/India-States-Map.jpg

Appendix B: India Country Profile & Demographics

INDIA

GOVERNMENT

Chief of State
President Ram Nath KOVIND

Head of Government
Prime Minister Narendra MODI

Government Type
federal parliamentary republic

Capital
New Delhi

Legislature
bicameral Parliament or Sansad consists of Council of States or Rajya Sabha (245 seats) and House of the People or Lok Sabha (545 seats)

Judiciary
Supreme Court (consists of 28 judges, including the chief justice)

Ambassador to US
Ambassador Harsh Vardhan SHRINGLA

US Ambassador
Ambassador Kenneth I. JUSTER

GEOGRAPHY

Area
Total: 3,287,263 sq km
Land: 2,973,193 sq km
Water: 314,070 sq km

Climate
varies from tropical monsoon in south to temperate in north

Natural Resources
coal (fourth-largest reserves in the world), antimony, iron ore, manganese, mica, bauxite, rare earth elements, titanium ore, chromite, natural gas, diamonds, petroleum, limestone, arable land

as of February 2019

ECONOMY

Economic Overview
the diverse economy encompasses traditional village farming, modern agriculture, a wide range of modern industries, and a multitude of services fueled by a large percentage of English speakers

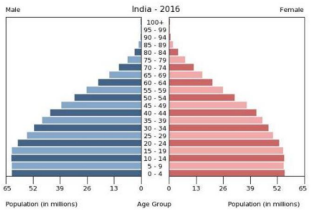
GDP (Purchasing Power Parity)
$9.474 trillion (2017 est.)

GDP per capita (Purchasing Power Parity)
$7,200 (2017 est.)

Exports
$304.1 billion (2017 est.)
partners: US 15.6%, UAE 10.2%, Hong Kong 4.9%, China 4.3% (2017)

Imports
$452.2 billion (2017 est.)
partners: China 16.3%, US 5.5%, UAE 5.2%, Saudi Arabia 4.8%, Switzerland 4.7% (2017)

PEOPLE & SOCIETY



Population
1.3 billion (July 2018 est.)

Population Growth
1.14% (2018 est.)

Ethnicity
Indo-Aryan 72%, Dravidian 25%, Mongoloid and other 3% (2000)

Language
Hindi 43.6%, Bengali 8%, Marathi 6.9%, Telugu 6.7%, Tamil 5.7%, Gujarati 4.6%, Urdu 4.2%, Kannada 3.6%, Odia 3.1%, Malayalam 2.9%, Punjabi 2.7%, Assamese 1.3%, Maithili 1.1%, other 5.6% (2011 est.)

Religion
Hindu 79.8%, Muslim 14.2%, Christian 2.3%, Sikh 1.7%, other and unspecified 2% (2011 est.)

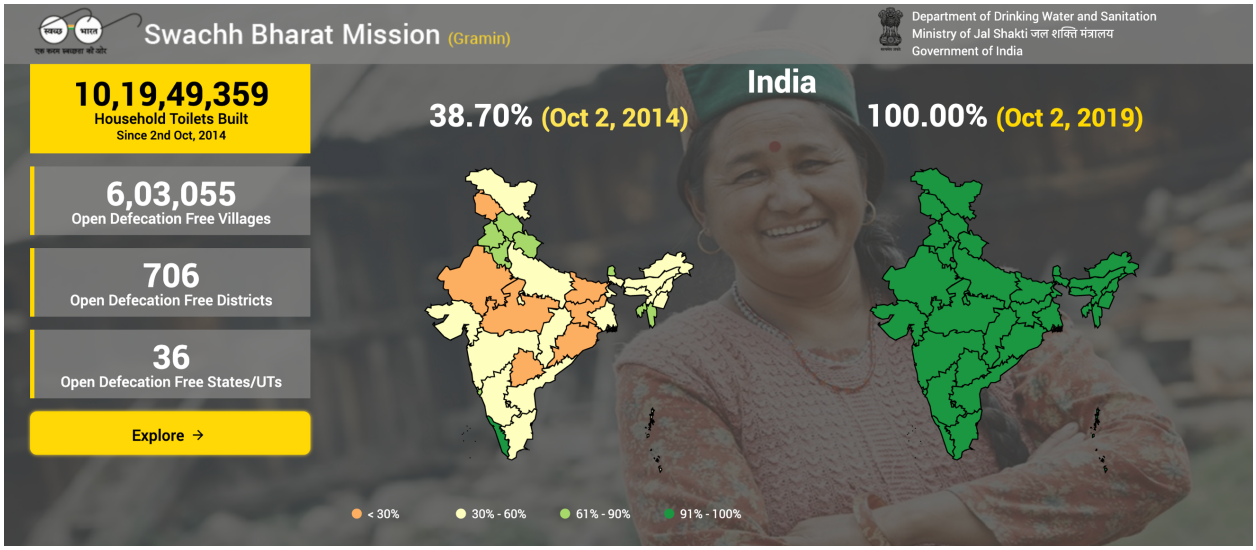
Urbanization
urban population: 34% of total population (2018)
rate of urbanization: 2.37% annual rate of change (2015-20 est.)

Literacy
71.2% (2015 est.)

WORLD FACTBOOK

Source: https://www.cia.gov/library/publications/the-world-factbook/attachments/summaries/IN-summary.pdf

Appendix C: Swachh Bharat By the Numbers



Source: https://sbm.gov.in/sbmdashboard/ (explore website for more data)

Appendix D: Abbreviations related to the Swachh Bharat Mission

AEO	Assistant Executive Officer
AIP	Annual Implementation Plan
AIR	All India Radio
APL	Above Poverty Line
ASHA	Accredited Social Health Activist
BCC	Behavioral Change Communication
BDO	Block Development Officer
BPL	Below Poverty Line
BPMU	Block Project Management Unit
BSO	Block Sanitation Officer
CAS	Community Approaches to Sanitation
CBO	Community-Based Organisation
CCDU	Communication and Capacity Development Unit
CEO	Chief Executive Officer
CLTS	Community-Led Total Sanitation
CRSP	Central Rural Sanitation Programme
CSC	Community Sanitary Complex
CSR	Corporate Social Responsibility
DAVP	Directorate of Advertising & Visual Publicity
DD	Doordarshan
DRDA	District Rural Development Agency
DSBM	District Swachh Bharat Mission
DSBMMC	District Swachhh Bharat Mission Monitoring Committee
DWSC	District Water and Sanitation Committee
DWSM	District Water and Sanitation Mission
GOI	Government of India
GP	Gram Panchayat
HRD	Human Resource Development
IAY	Indira Awas Yojana
ICDS	Integrated Child Development Scheme
IEC	Information, Education and Communication
IHHL	Individual Household Latrine
IPC	Interpersonal Communication
JMP	Joint Monitoring Program
KRC	Key Resource Centre
M&E	Monitoring & Evaluation
MDWS	Ministry of Drinking Water and Sanitation
MHM	Menstrual Hygiene Management
MIS	Management Information System
MLALADS	Member of Legislative Assembly Local Area Development Scheme
MLC	Member of Legislative Council
MNREGS	Mahatma Gandhi National Rural Employment Guarantee Scheme
MPLADS	Member of Parliament Local Area Development Scheme
NBA	Nirmal Bharat Abhiyan
NFDC	National Film Development Corporation
NGO	Non-Governmental Organisation
NGP	Nirmal Gram Puraskar
NIC	National Informatics Centre
NRC	National Resource Centre
NRDWP	National Rural Drinking Water Program
NRHM	National Rural Health Mission
NRLM	National Rural Livelihood Mission
NSSC	National Scheme Sanctioning Committee
NSSO	National Sample Survey Organisation
ODF	Open Defecation Free
PAC	Plan Approval Committee
PC	Production Centre
PHC	Public Health Centre
PHED	Public Health Engineering Department
PPP	Public Private Partnership
PR	Panchayati Raj
PRA	Participatory Rural Appraisal
PRI	Panchayati Raj Institution
PTA	Parent Teachers Association
RALU	Rapid Action Learning Unit
RDAC	Research and Development Approval Committee
RSM	Rural Sanitary Mart
SBCC	Social & Behavior Change Communication
SBM (G)	Swachh Bharat Mission (Gramin)
SHG	Self Help Group
SLSSC	State Level Scheme Sanctioning Committee
SLTS	School Led Total Sanitation
SLWM	Solid and Liquid Waste Management
SO	Support Organisation
SPMU	State Project Monitoring Unit
SSA	Sarva Shiksha Abhiyan
SSBM	State Swachh Bharat Mission
SWSM	State Water and Sanitation Mission
TSC	Total Sanitation Campaign
VGF	Viability Gap Funding
VWSC	Village Water and Sanitation Committee
WASH	Water, Sanitation and Hygiene
WSSO	Water and Sanitation Support Organisation

Source:
http://swachhbharatmission.gov.in/sbmcms/writereaddata/images/pdf/Guidelines/Complete-set-guidelines.pdf

Appendix E: Health Impacts of Unsafe Sanitation

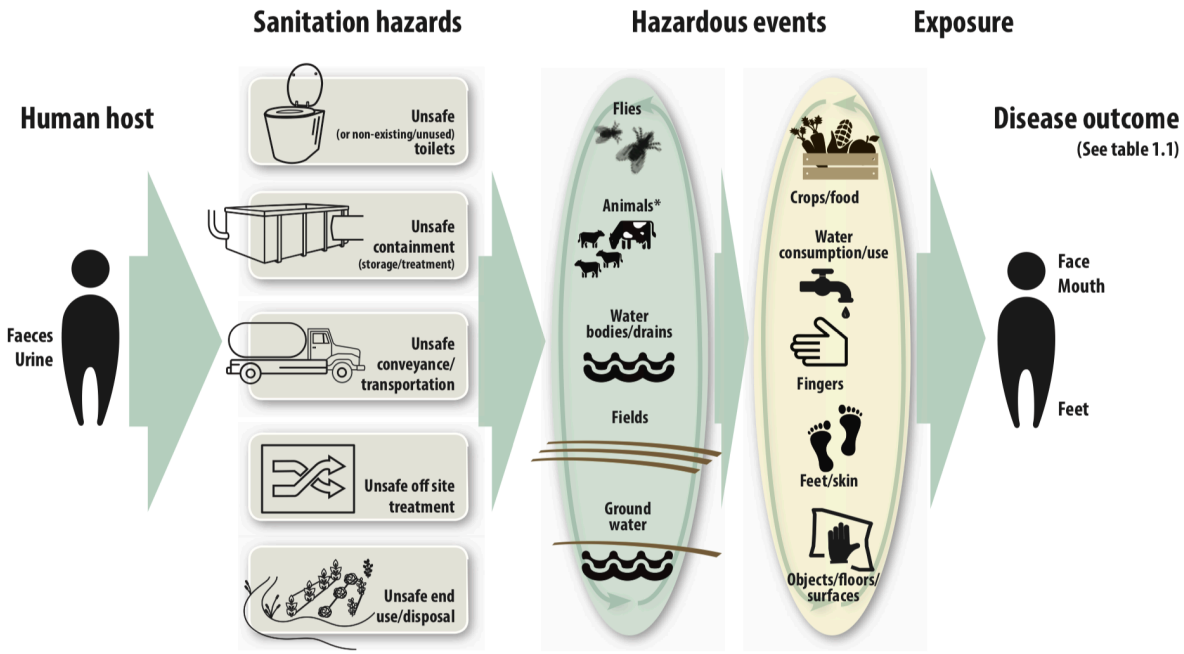
Direct impact (infections)	Sequelae (conditions caused by preceding infection)	Broader well-being
Faecal-oral infections • Diarrhoeas (incl. cholera) • Dysenteries • Poliomyelitis • Typhoid **Helminth infections** • Ascariasis • Trichuriasis • Hookworm infection • Cysticercosis (Taenia solium/ infection) • Schistosomiasis • Foodborne trematodes **Insect vector diseases** (vectors breed in faeces or faecally-contaminated water) • Lymphatic filariasis • West Nile Fever • Trachoma	**Stunting/ growth faltering** (related to repeated diarrhea, helminth infections, environmental enteric dysfunction) **Consequences of stunting** (obstructed labour, low birthweight) **Impaired cognitive function** **Pneumonia** (related to repeated diarrhea in undernourished children) **Anaemia** (related to hookworm infections)	**Immediate:** **Anxiety** (shame and embarrassment from open defecation, shared sanitation) and related consequences and not meeting gender specific needs **Sexual assault** (and related consequences) **Adverse birth outcomes** (due to underuse of healthcare facilities with inadequate sanitation) **Long-term:** School absence Poverty Decreased economic productivity Anti-microbial resistance

Collated from: Bartram & Cairncross, 2010; Bouzid et al, 2018; Campbell et al, 2015; Cumming & Cairncross, 2016; Cairncross et al., 2013; Schlaudecker et al, 2011.

Source: https://apps.who.int/iris/bitstream/handle/10665/274939/9789241514705-eng.pdf?ua=1

Appendix F: Transmission of Excreta-Related Pathogens

Figure 1.1 Transmission of excreta-related pathogens



The commonly-used F-diagram on faecal-oral disease transmission (various versions adapted from Wagner and Lanoix, 1958) is not used in these guidelines, although several of its elements can be clearly discerned (human hosts, and the elements described as "hazardous events" in this diagram). The purpose of this figure is to highlight the role of safe sanitation systems as a primary barrier to transmission by showing the way in which unsafe management at each step of the sanitation chain spreads excreta in the environment; additionally, the diagram captures transmission routes that are not faecal-oral and shows the complex ways in which different hazards and hazardous events interrelate. The diagram forms a conceptual basis for risk assessment and management for sanitation systems.

Source: https://apps.who.int/iris/bitstream/handle/10665/274939/9789241514705-eng.pdf?ua=1

Appendix G: Health Problems Associated with Poor Sanitation and Management of Wastes

Disease-causing agent	Disease	Description
Bacteria	Shigellosis	Causes abdominal pains and diarrhoea (see below).
	Typhoid	Mild to severe fever lasting from a few days to several weeks.
	Cholera	An infection of the intestines that can cause watery diarrhoea leading to dehydration.
	Diarrhoeal diseases (note these can also be caused by viruses)	Production of frequent watery faeces that can lead to dehydration. Can be fatal, particularly among young children. Diarrhoea is a symptom of several other diseases in this table.
Viruses	Hepatitis A	An infection of the liver that can cause pain, diarrhoea and jaundice.
	Polio	Can cause temporary or permanent muscle weakness, and sometimes death.
Protozoa	Amoebiasis (also known as amoebic dysentery)	Infection that can occur up to several years after exposure to the protozoa. Can cause mild to severe diarrhoea and liver damage.
	Giardiasis	Infection of the small intestine. It is usually symptomless but can have a variety of intestinal symptoms, such as chronic diarrhoea, abdominal cramps, gas production and frequent loose, pale and greasy stools.
Parasitic worms	Ascariasis (roundworm)	One in four of the world's population has this infection, which can lead to weight loss, malnutrition and anaemia. It is very common in Ethiopia.
	Hookworm infection	Two species of nematodes that inhabit the small intestine, from where they suck blood, leading to anaemia.
	Tapeworm infection	A worm that normally lives in the intestines which can cause anaemia and malnutrition. This is usually spread through eating improperly cooked food that contains the worm or its eggs.
	Bilharzia or schistosomiasis	A disease caused by the Schistosoma worm that can cause diarrhoea and blood in the urine and faeces. In the long term, it can lead to liver and kidney damage.

Source:
https://www.open.edu/openlearncreate/mod/oucontent/view.php?id=80399&printable=1

Appendix F: The Caste System

Source: https://www.bbc.com/news/world-asia-india-35650616

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