

# Reprioritizing Research-cum-intervention Strategies on Gastrointestinal Infections Considering Swachh Bharat Abhiyan

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**Keywords:** Implementation, Sanitation revolution, Swachh Bharat Abhiyan, Swachh Bharat Mission.  
*Journal of Gastrointestinal Infections* (2019); 10.5005/jp-journals-10068-3033

Over the ages, the gastrointestinal (GI) infections have been known to be responsible for significant morbidity and mortality all over the world. These infections have shown their might in the form of epidemics due to cholera killing millions, outbreaks due to diarrhea and dysentery, jaundice, poliomyelitis, and many other infections. Many of them are caused by parasites, bacteria, viruses, etc., leading to chronic infections, ill health, and also malnutrition. Feco-oral route has been mainly responsible for transmission of GI infections,<sup>1</sup> however, diseases like tuberculosis may be transmitted by both aerosol and oral routes. It is also a historical fact that GI infections declined rapidly in westernized world long ago and this decline could be directly linked to the socioeconomic development. Impact of improvement in sanitation and hygiene has been visible all over the world. Water, sanitation, and hygiene have been found to be beneficial in reducing enteric infections. Further, the adoption of these measures is not only found to be health related but also considered important for improvements in quality of life related to privacy, comfort, status, dignity, protection from harassment, and saving in cost and time.<sup>1</sup>

The Swachh Bharat Mission (SBM)/Swachh Bharat Abhiyan (SBA), launched by the Government of India as part of Mahatma Gandhi's 150th-year birthday celebration, can prove such a game changer for India. The SBA with an intense thrust, participation, and monitoring by honorable prime minister directly is a fitting tribute to the memory of Mahatma Gandhi, the Father of our Nation. It would be important to review the important historical developments related to the improvement in health in India and globally when considering the contemporary relevance of SBM and SBA.

Alma-Ata Declaration—1978 by the World Health Organization (WHO),<sup>2</sup> widely quoted the definition of health, emphasized that health is a state of physical, mental, and social being and not merely absence of disease. This declaration also stated that health is a fundamental human right and that the attainment of the highest possible level of health is a most important worldwide social goal, whose realization requires the action of many other social and economic sectors in addition to the health sector. Sanitation and hygiene are heavily dependent upon social and economic sectors, but ultimately impact all components of health included in the Alma-Ata Declaration.

The Bhore Committee, 1946<sup>3</sup> which analyzed in depth the reasons for ill health of Indian masses observed, "If it was possible to evaluate the loss, which this country annually suffers through the avoidable waste of valuable human material and the lowering of human efficiency through malnutrition and preventable morbidity, we feel that the result would be so startling that the whole country would be aroused and would not rest until a radical change had been brought about." The Bhore Committee Report provided the

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**How to cite this article:** Katoch VM. Reprioritizing Research-cum-intervention Strategies on Gastrointestinal Infections Considering Swachh Bharat Abhiyan. *J Gastrointest Infect* 2019;9(1):1–4.

**Source of support:** Nil

**Conflict of interest:** None

outline for setting up an organized public health system in India. Its emphasis was again on preventable morbidity which is an expected outcome of SBM/SBA.

Mahatma Gandhi, the Father of our Nation, had well-tested views on social, mental, spiritual, and physical well-being.<sup>4</sup> Thus, all components of health as defined by the WHO and also highlighted by Sir Joseph Bhore were part of his dream for the Indian people and the world at large. His definition of healthy person was simple but rigorous—physically fit to walk 10–12 miles after eating simple diet (which he had defined after personal experiments) and at peace with himself/herself and his/her god. Cleanliness/sanitation—the present Swachh Bharat campaign is perhaps the best tribute to Bapuji. Between 1906 and 1948, Mahatma Gandhi published several articles on health and hygiene.<sup>4,5</sup> According to one quote, Mahatma Gandhi said, "Sanitation is more important than independence."<sup>6</sup> He emphasized on scientific temperament to use evidence-based practices including diet, physical activity, clean habits, mental equilibrium, and being responsible for his/her own body; nonviolence for a healthy life and society were central to his philosophy.

## MODERN EPIDEMIOLOGY AND SANITATION REVOLUTION

The birth of modern epidemiology is often attributed to John Snow's famous investigation of the 1854 cholera epidemic in London, and his identification of the Broad Street pump as the most important node in the cholera transmission network.<sup>7,8</sup> Sanitation revolution of the Victorian era is considered as the most important medical milestone since 1840 which led to a dramatic reduction in morbidity and mortality associated with infections transmitted by the feco-oral route in Britain and the surroundings. In 2007,

readers of the British Medical Journal voted that the introduction of clean water and sewerage—the “sanitation revolution” of the Victorian era—was the most important medical milestone since the 1840s, which is considered even more significant than anesthesia, antibiotics, or vaccines.<sup>9</sup>

## SANITATION PROGRAM(S) OF GOVERNMENT OF INDIA

Since 1986, the Government of India has taken several initiatives to improve the sanitation in the country.<sup>10</sup> It initiated the Central Rural Sanitation Programme in 1986, which is considered as a failure because the reality on the ground did not match the requirements for success. This was followed by the total sanitation campaign (TSC) launched in the year 1999, which was supposed to have been modified based on key lessons that were learned from previous program. The TSC is considered to be a partial success as the progress observed was uneven, but high citizen participation, strong monitoring, and political determination were intensified. In 2012, TSC was restructured and renamed as Nirmal Bharat Abhiyan in 2012. In 2014, the sanitation flagship program was redesigned once again and rechristened to SBM, which aimed at providing access to sanitation facilities and eradicating the practice of open defecation by 2019. Swachh Bharat campaign/Abhiyan launched in 2014 undoubtedly is one of the major social transformation steps of our government and happily it has gained momentum.

The SBM/SBA is expected to have an impact on the transmission dynamics of most of the pathogens responsible for GI infections. It will be most appropriate that research is focused on the progress of SBM/SBA, and implementation strategies are synchronized with the progress of this campaign for maximizing the clinical and public health benefits emanating from the impact of this program. Data published from such research is limited so far. There have been positive outcomes in terms of construction of toilets and their usage.<sup>11,12</sup> Some important findings available in public domain are the following:

- The Indian Space Research Organization (ISRO) center at Jodhpur in partnership with others from Hyderabad and other places has carried out an in-depth country-wide study on the impact of SBM using Integrated Disease Surveillance Project (IDSP) data from 2010 to 2018.<sup>10</sup> The year-wise count of acute diarrheal disease (ADD) outbreaks, summer and July season peaks, the total number of toilets constructed under SBM, and the total villages that gained the status of open defecation free were analyzed. It was observed that the years 2017 and 2018 recorded the lowest number of total ADD outbreaks. The summer peak of 2018 showed the lowest number of ADD outbreaks in comparison to those of the remaining years. This sudden decrease in the ADD outbreaks can be attributed to toilet usage. Economic significance of SBM/SBA has been rightly highlighted as the decrease in ADD outbreaks can significantly strengthen the gross domestic product.<sup>10</sup>
- A study carried out in the two blocks, viz., Bhandra in Lohardaga and Gola in Ramgarh district of Jharkhand, on the impact of SBA has also shown interesting results.<sup>6</sup> In this study, which was carried out by Aarogya Foundation India (Jharkhand Chapter), qualitative survey research methodology was utilized to estimate the impact of the program on the community. Random sampling method was used for the selection of revenue villages, beneficiaries, and the students and teachers from these two blocks. It was observed that more than 93% of respondents

knew about the program and over 60% directly participated in some activities related to it. Significantly, the diarrheal cases decreased by 23% and anemia by 10% in 1 year (2015–2016 vs 2016–2017). It was also observed that this program helped in improving the social harmony, i.e., clashes on garbage dumping, and water accumulation sharply decreased.

- A study on rural people of Nalgonda district in Telangana also showed positive changes on the knowledge, perception, and practices of these people extremely relevant to the evolution of SBM/SBA.<sup>13</sup>
- The WHO has also assessed the impact of Swachh Bharat program in rural areas and concluded that during 2014–2019 this program has saved more than 300,000 people from diarrhea and malnutrition. The WHO report has also noted that the use of toilets increased from 45% in 2014 to 89% in 2019. The report highlights that the program has saved 14 million disability adjusted life years (DALYS) due to diarrhea and malnutrition.<sup>14</sup> These observations appear very promising and positive, however, it will be important to read and analyze the findings when this report from WHO with data becomes available.

## HEALTH OF SANITATION WORKERS

It is well known that sanitation workers face many occupational health hazards which at times may also result in loss of life. A study carried out in Ahmedabad in 2014 before the SBA showed that street sweepers were found to be significantly underweight as compared to the administration staff. Only 12.3% of street sweepers were using any kind of personal protective equipment, 52.1% of them had low peak expiratory flow rate (PEFR) as compared to 20% of controls, i.e., the individuals working in the office.<sup>15</sup> The WHO report on the impact of Swachh Bharat seems to have concluded that one noticeable group who did not benefit from Swachh Bharat are the sanitation workers. They are forced to deal with the task of emptying the country's 13 million bucket of latrines and, in many instances, cleaning the country's sewers by hand. It would be important to target these workers in SBM/SBA for improving their health standards.

## SAFE DRINKING WATER AND HYGIENICALLY PREPARED AND STORED FOOD

Most agents of enteric diseases are spread by one of two routes: direct person-to-person contact or ingestion of contaminated vehicles (food or water). More than four decades ago, Barker<sup>16</sup> reported that annual mortality from enteric diseases ranged from 1 per 100,000 in highly developed countries to as much as 500 per 100,000 in developing countries. This report recommended that an effective control program should focus on common epidemiologic factors, rather than on agent-specific remedies such as vaccines or antibiotics. It was suggested that the major operational components of such a program should include oral fluid replacement therapy, improvements in environmental sanitation, health education to promote personal hygiene and proper food handling, and epidemiologic surveillance to monitor public health needs and evaluate the impact of health measures.<sup>16</sup>

Studies have shown that provision of safe drinking water decreases the incidence of infections caused by various GI infections. Wang et al.<sup>17</sup> observed that construction and use of deep well tap water systems with household taps is associated with decreased incidences of El Tor cholera, viral hepatitis A, and acute

watery diarrhea. Not only in the developing countries, investments in drinking water provision in rural settings have also been reported to be highly cost beneficial in the developed world as well.<sup>18</sup>

Weaning foods prepared under unhygienic conditions have been found to be contaminated with pathogens and thus are a major factor in the cause of diarrheal diseases and associated malnutrition.<sup>19</sup> It is generally expected that safe disposal of excreta will reduce the chance of food being contaminated by controlling the source and will impact the incidence of diarrheal diseases and problems associated with these infections. This will be the expected outcome of SBM/SBA as well.

## VACCINES

Vaccination has been considered as an important component of strategy to control epidemics and outbreaks due to important water and foodborne pathogens such as cholera and typhoid and important waterborne viral diseases such as poliomyelitis. It would be important to analyze lessons learnt from some important studies on cholera.<sup>20–22</sup> Murray et al.<sup>20</sup> has reported that in the population at risk of endemic cholera, mass vaccination was the least cost-effective intervention compared with the provision of safe drinking water and sanitation or with treatment of the disease. In a refugee population at risk of epidemic disease, the cost-effectiveness of vaccination was observed to be similar to that of providing safe drinking water and sanitation alone, though less cost-effective than treatment alone or treatment combined with the provision of water and sanitation. Bhattacharya et al.<sup>21</sup> has reported that cumulative protective efficacy of a bivalent killed whole cell cholera vaccine at 5 years was 65% (95% confidence interval 52–74;  $p < 0.0001$ ), and point estimates by year of follow-up suggested no evidence of decline in protective efficacy. Thus, cholera vaccine will be useful in limited situations. Verma et al.<sup>22</sup> has opined that cholera vaccine should be used in areas where cholera is endemic, particularly in those at risk of outbreaks, in conjunction with other prevention and control strategies. In general, focusing the attention on sanitation and safe drinking water will be an attractive approach for most pathogens transmitted through feco-oral route with water as vehicle, as benefits will be much broader and bigger than impact of a pathogen-specific vaccination.

## GENOTYPING—MOLECULAR EPIDEMIOLOGY

Molecular techniques have provided useful tools for sensitive and specific detection of various pathogens including those causing GI infections. Further genotyping of these pathogens helps in tracing the sources of these infections and also defining the transmission chains. Such knowledge is of great importance in developing and implementing robust public health strategies. There are several examples of these applications in cholera, polio, rota virus, hepatitis, and other GI infections. Successful stories of the use of molecular detection and genotyping to understand the transmission of polio virus and rota virus have proved valuable in fine-tuning our national programs.<sup>23,24</sup> Genotyping of polio virus strains demonstrated a strong link between the quality of supplementary immunization activities and the risk of wild poliovirus persistence.<sup>23</sup> Molecular detection and genotyping have been successfully used for the detection of sources of infection, defining the chain of transmission and finding the gaps in the program—vaccine not being accepted by some but never reported. Molecular epidemiology of rota viruses circulating in the environment has been found to be very useful for epidemiological purposes.<sup>24</sup>

## LOOKING AHEAD

For building a strong future, we need to be realistic and truthful. India has a huge network of laboratories [IDSP network coordinated by National Centre for Disease Control (NCDC), Viral Research and Diagnostic Laboratories (VRDL) network of Indian Council of Medical Research/ Department of Health Research (ICMR/DHR)], National Institute of Virology (NIV), networks for specific viruses, institutions like All India Institute of Medical Sciences (AIIMS) (original and newer AIIMSs), Postgraduate Institute of Medical Education and Research, Chandigarh (PGIMER), Dayanand Medical College (DMC), Sanjay Gandhi Post Graduate Institute of Medical Sciences (SGPGI), Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), and many others including those in ICMR/ Indian Council of Agricultural Research (ICAR)/Defence Research and Development Organization (DRDO) systems. In addition, we have a big network of laboratories in medical colleges that may not be covered by IDSP/VDRL networks. Issue is whether they are focused on research relevant to SBM/SBA. Till October 2019, there were over 170 papers in PubMed dealing with the application of molecular epidemiology tools to GI pathogens. Only 9 (5%) had Indian connection and 5 of them were led by Indian investigators (overall 3.5%). All 5 Indian papers were published up to 2014 and none after that. It is clear that India has made very little research efforts in the recent use of molecular epidemiological approaches specially the area of assessing the impact of SBM/SBA on the transmission of GI infections.

It is high time to carry out in-depth studies on impact of Swachh Bharat on incidence/prevalence as well as the profile of relevant diseases in different parts of India. Some of the important areas for such research could be:

### Studies on Transmission Dynamics

It would be fruitful to focus on strains and sources of infection, transmission by appropriate genotyping methods and analyze this information in the context of progress of SBM/SBA at clinical- and community-level scenario in selected populations.

### Social and Economic Aspects

Social and economic aspects linked to above impact/variable impact of SBA have started gaining attention; however, much bigger effort to investigate these aspects will be necessary.

### Environmental Enteropathy

Studies on phenomenon such as environmental enteropathy are necessary as vaccines have been found to have varying efficacy in different populations. It would be important to investigate these aspects in India in relation to the impact of SBM/SBA. We need to find out whether in the emerging scenario future vaccines will have a major role in the control of GI infections.

### Diagnosis of Gastrointestinal Infections

Strategies for diagnosis of various GI infections will have to be researched continuously as the relative importance of various techniques/tools may change as SBM/SBA progresses.

### Other Areas Such as Microbiomes, Tools Such as Vaccines and Anti-infectives

These expensive but interesting as well as relevant areas will not lose their importance but will require dynamic approach as needs will certainly change. It will be logical to reprioritize as we move on.

### Clinical Situations and Outbreaks

Efficient management of clinical situations and outbreaks at community level will always remain important, but tools and methods will change as SBM/SBA makes impact.

### Area-specific Interventions

Area-specific interventions based on recent evidence/information about situation in those areas will be the right “mantra” for achieving cost-effective results.

### Synchronization of Health Systems

Health systems will need to be synchronized with medical, sociobehavior along with economic interventions to optimize the gains. In-depth health system’s research and deployment of appropriately trained human resource aligned with actual needs will be desirable.

The above suggestions are just a matter of opinion worthy of consideration by stakeholders. These should not be considered as dogma but just thoughts that may help in synergizing our efforts after careful analysis and action.

### CONTINUOUS UPDATING OF KNOWLEDGE

Clinicians, technologists, and other staff in the hospitals and public health professionals should be aware of changes happening in disease scenario due to SBA. This awareness and updating of knowledge will make the interventions cost-effective both at clinical and public health levels.

Professional societies/associations with interest on GI infections such as Gastrointestinal Infection Society of India (GISI), Indian Association of Medical Microbiologists (IAMM), and other associations focused on such pathogens; and various relevant clinical and public health-oriented professional bodies will need to play their legitimate roles by reorienting their thoughts and action to the likely, expected vs actual impact of SBM and SBA. The activities could be in the brainstorming sessions/symposia/workshops for the development of research cum action agenda and for analysis of research outcomes for the development of new/improved guidelines and their dissemination. As GISI is dedicated to the control and management of GSI infections, it should consider playing a core role and partner with other associations/professional bodies to achieve the results. Funding agencies/government departments like ICMR/Department of Health Research (DHR), Department of Biotechnology (DBT), Department of Science and Technology (DST), Ministry of Health and Family Welfare (MoHFW), etc., will certainly support if players emerge and plan the game. All these appear to be a dream at the moment but are achievable. The outcome will certainly be satisfying for all those who join this great mission of high-quality impact-making science for the better health of our people and a true tribute to the Father of our Nation.

### ETHICAL STATEMENT

This editorial is based on the key note address delivered at GISICON 2019, Ludhiana, Punjab, India.

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