"Welcome to the Hospital"

An intervention for improving insufficient hygiene standards and practices arising from overcrowding in Indian public hospitals

BY

Lucia Lopez
Nicholas Moroz
Aditi Sharma
Anushree Warrier

University of Toronto - Geneva Challenge 2019

Abstract

Inadequate Water, Sanitation and Hygiene (WASH) standards in healthcare facilities is a major cause of Hospital Acquired Infections (HAI) transmission in India, resulting in some of the highest neonatal and maternal mortality rates in the world within the country. Overcrowding at major public hospitals is another risk factor related to the transmission of HAIs, which becomes a challenging dimension of the problem due to a high population density in India. To assess new interventions to help address this issue, our team visited New Delhi, India and met with stakeholders from hospitals, NGOs and various government agencies. While WASH and infection controls within the major hospitals visited were found to be of a high standard, an issue was identified with the overcrowding of hospital visitors in the wider hospital campuses. The overcrowding inadvertently exacerbated the maintenance of hygiene within the hospital premises, affecting all stakeholders within the hospital ecosystem. We propose a multi-pronged intervention called “Welcome to the Hospital” to improve the WASH standards of large public hospitals in New Delhi. This approach aims to promote a culture of prevention of HAIs, targeting the wider hospital campus while tackling overcrowding. This innovative intervention consists of several complementary components to positively reinforce hygienic behaviors designed around behavioral incentivization and creative infrastructure upgrades.

The team

Nicholas Moroz is a recent Master of Public Health graduate from the Dalla Lana School of Public Health at the University of Toronto. He has also completed a Collaborative Specialization in Public Health Policy. He is interested in global health and public health policy development along with communicable disease epidemiology. He has previous experience in global health case competitions at the University of Toronto. Nicholas is from Canada.

Lucia is a recent graduate from the Munk School of Global Affairs and Public Policy's Master of Global Affairs Program at the University of Toronto. Prior to graduate school, Lucia has worked with the Department for International Trade in the UK where she focused on business development, trade promotion and coordinated the UK's efforts to engage with multilateral organizations in Latin America. She has also worked with UNICEF ESARO and York University on research projects on social policy, protection and welfare. Lucia is from Venezuela.

Anushree Warrier is a recent graduate from the Munk School of Global Affairs and Public Policy's Master of Global Affairs. With a background in Economics, Anushree has over four years of diverse international experience in economic development, inclusive growth, innovation and international partnerships. Anushree is from India.

Dr. Aditi Sharma is currently pursuing her Master of Public Health from the Indian Institute of Public Health, Delhi (IIPH-DELHI) with a concentration in WASH and maternal and newborn health care. Recently she worked as an Intern at United Nations Development Program, India, in the Health System Strengthening Unit. Prior to joining IIPH-DELHI, Aditi worked as Research Assistant at an NGO for dental health care awareness and provision. Dr. A. Sharma is from India.

Acknowledgements

The team would like to acknowledge all the people who made “Welcome to the Hospital” possible.

Most prominently, we express our most sincere thanks to Anupama Achal Sharan, first year PhD student in Chemical Engineering and Applied Chemistry at the University of Toronto for fully supporting the project and guiding the literature and field research as well as contributing to this submission report. This endeavor would not have been possible without her help.

The team also acknowledges Chen Yu (Jennifer) Wang, undergraduate student in Chemical Engineering and Applied Chemistry for her help with the cost analysis of the project.

The team would like to convey their gratitude to all faculty members at the University of Toronto who provided us with advice, information and guidance over the past year of project development. Many thanks to Dr. Erica Di Ruggiero, Director of the Office of Global Public Health Education and Training, Associate Professor, Dalla Lana School of Public Health and Dr. Yu-Ling Chen, Distinguished Professor in Global Engineering, and Professor, Department of Chemical Engineering & Applied Chemistry for their detailed feedback on the report. Thanks also to Dr. Anita M. McGahan**,** Professor of Strategic Management and the George E. Connell Chair in Organizations & Society at the Rotman School of Management and Dr. Joseph Wong, Vice-Provost & Associate Vice-President, International Student Experience, at the University of Toronto, Ralph and Roz Halbert Professor of Innovation at the Munk School of Global Affairs and Public Policy and Professor of Political Science for their guidance over the past year.

Finally, the team recognizes all the people from different organizations in India who were kind to give their time and share their experiences with us that lead to the seeding and development of the intervention. Dr. Suparna Ghosh-Jerath, Additional Professor and Adjunct Faculty (AcSIR) Head, Community Nutrition, Indian Institute of Public Health Delhi (IIPH-Delhi) and Public Health Foundation of India (PHFI), helped arrange most of our site visits and interviews in Delhi and we are indebted to her for her support.

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Executive Summary

Inadequate Water, Sanitation and Hygiene (WASH) standards in healthcare facilities is a major cause of Hospital Acquired Infections (HAI) transmission in India, resulting in some of the highest neonatal and maternal mortality rates in the world within the country. Overcrowding at major public hospitals is another risk factor related the transmission of HAIs, which becomes a challenging dimension of the problem due to a high population density in India. To assess new interventions to help address this issue, our team visited three major public hospitals in New Delhi, India. While WASH and infection controls within the major hospitals visited were found to be of a high standard, an issue was identified with the overcrowding of hospital visitors in the wider hospital campuses. The overcrowding inadvertently exacerbates maintenance of hygiene within these premises, affecting all stakeholders within the hospital ecosystem. We propose a multi-pronged intervention called “Welcome to the Hospital” to improve the WASH standards of large public hospitals in New Delhi. This approach aims to promote a culture of prevention of HAIs targeting the wider hospital campus. This innovative intervention consists of several complementary components to positively reinforce hygienic behaviors designed around behavioral incentivization and creative infrastructure upgrades.

The sensitization campaign will consist of signs to educate hospital visitors and promotion of hygiene on the hospital campus through incentives and written commitments to encourage hygiene. The new infrastructure component consists of installation of shelters for visitors and new hand sanitizing stations. A long-term goal of this intervention is to promote a larger attitudinal shift to increase hygiene compliance in India, aiming to create a norm of maintaining low HAIs throughout entire hospital campuses. Solutions found from implementing and evaluating this intervention could be transferred to different public hospitals in India. Inadequate WASH standards and overcrowding of patients and visitors is general across hospitals in India, thus the interventions developed in this project can be scaled across India, and beyond to other geographic areas with similar challenges. The proposed solution is also closely aligned with the United Nations Sustainability Development Goals (SDGs) in the areas of water safety, infection reduction and health promotion, and hygiene education and outreach (SDGs 3, 6 and 10).

1. Background

1.1 Inadequate WASH facilities and implications for public health in India

Water, Sanitation and Hygiene (WASH) facilities are some of the most important determinants of public health quality globally. Therefore, healthcare institutions and stakeholders are universally striving to achieve some of the predominant Sustainable Development Goals (SDGs) dedicated towards (WASH): 3. Good health and well-being, 6. Clean Water and Sanitation and 10. Reduced Inequalities (Griggs D. et al., 2013).

Inadequate WASH standards in healthcare facilities is a major cause of infection transmission in Low- and Middle-Income Countries (LMICs) such as India (Watson et al., 2019). While the global burden of Hospital-acquired infections (HAIs) is unknown, the WHO estimates that in high-income countries at least 7% of all patients admitted to hospital will acquire a HAI (Watson et al., 2019). The risk of acquiring a HAI in LMICs is estimated to be much greater, with some estimates suggesting that 15.5% of all patients will develop a HAI during their stay at the hospital (Watson et al., 2019). In some developing countries, the WHO reports that 4000 children die of HAIs related to poor hygiene every day (WHO, 2019-A). Because of the importance of WASH in reducing life-threatening infections in both the public health space and in healthcare facilities, the WHO and UNICEF are now leading the implementation of a global roadmap to improve WASH services in healthcare facilities, particularly in LMICs (Watson et al., 2019; WHO, 2019-B).

Despite being a middle income country, the healthcare spending of India is more similar to a low-income country with only 1.4% of the GDP dedicated towards healthcare (Doshi V., 2018) This has often resulted in extremely limited WASH resources and consequently, low quality of healthcare that impacts care seeking behavior (Bouzid M., Cumming, O., & Hunter P.R., 2018). A combination of low healthcare expenditure leading to limited WASH resources and consequently increased incidences of HAIs has negative spillover effects within the hospital that especially affect the most immunocompromised groups within this space such as patients within labor wards , intensive care units (ICUs), pediatrics and surgical wards (Malhotra S., Sharma S., & Hans C., 2014). India also carries a disturbingly high global burden of maternal and neonatal deaths due to HAIs leading to sepsis (Figure 1).

Appreciating the literature evidence that points towards an intimate link between WASH and public health that has deleterious effects for reinforcing the global disease burden due to HAIs, the team strongly believes that an intervention that helps to creatively improve sanitation and hygiene within hospitals becomes an extremely promising intervention for the Indian public health space. Also, since the inception of the Swachh Bharat Mission (SBM) in 2014, the Indian government at both the provincial and state level has been extremely receptive to new innovative ideas in the field of sanitation (evidence detailed in the field work section of the report). Resonating with literature and on-ground evidence, this report is the

team's effort to present a unique intervention aimed at improving sanitation and hygiene within district level public hospitals in India through crowd management, incentivization and education strategies.

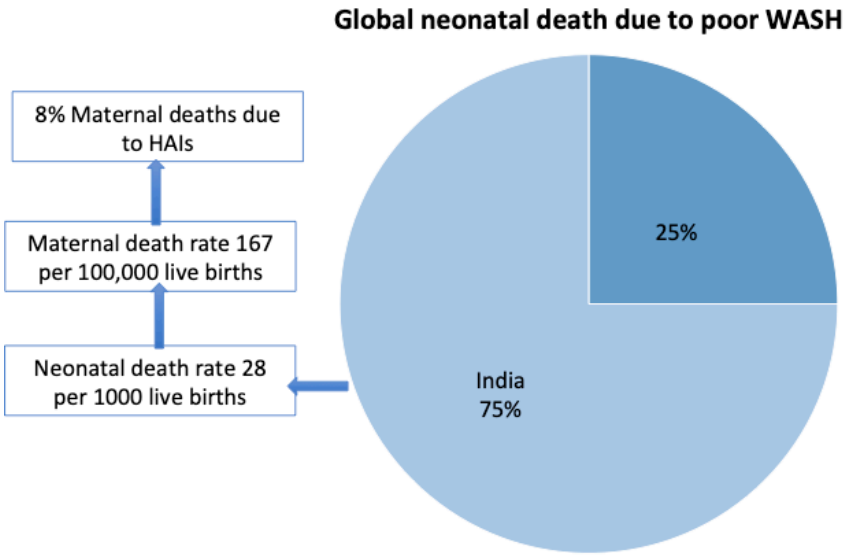

Figure 1: Neonatal and Maternal death rates in India as affected by poor WASH (adapted from Sample Registration Report Data, Ministry of Home Affairs, Government of India, 2016)

1.2 WASH, Overcrowding and Hospital Acquired Infections

Poor hygiene compliance in health care institutions in India is further exacerbated by overcrowding (Anand C., 2017). India is set to surpass China as the most populous country in 2022 (UN-DESA, 2015) and this will only exacerbate the pressure on the pre-existing, insufficient WASH resources in public hospitals with the potential to cause epidemics. On-ground evidence for overcrowding related hygiene challenges in India is presented later in the report (section 2.1). Since the proposed intervention uses crowd management strategies to innovatively address hygiene challenges in Indian public hospitals, it is crucial to discuss the key theory in public health that links overcrowding with WASH and more specifically HAIs. This theory is based on a parameter called **the basic reproductive number, often denoted as R_o. The three main parts to calculating the R_o are as follows:**

$$\mathbf{R_o = D \times C \times B} \qquad \text{(Equation 1)}$$

Where, D = duration of infectiousness,
C = contact number per unit time, and
B = infectiousness per contact.

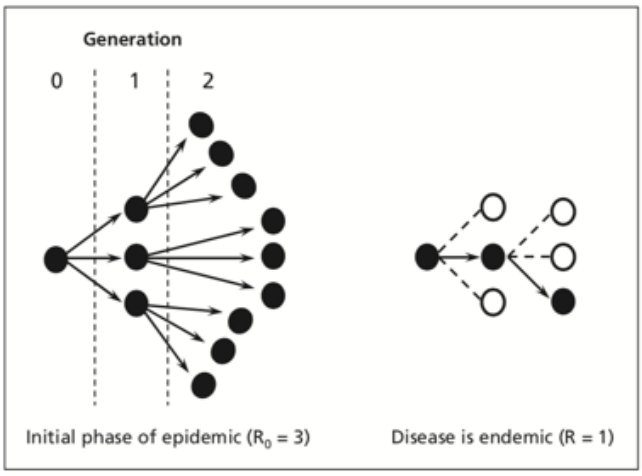

Figure 2: The left shows the propagation of a pathogen in a susceptible population with a basic reproductive number of 3 over three generations, with infected people denoted by black circles. This is an epidemic as the R_o is greater than 1 (R_o=3, so three new cases per infectious person) The right of the figure depicts a disease that is endemic, with black circles representing someone infected with the pathogen while clear circles represent someone not infected over three generation times of the pathogen. (Pan-InfORM, 2009).

R_o is the number of new secondary infections created by a single primary infectious case introduced into a susceptible population. A good example is a population of people in Delhi waiting for family members on a hospital campus. A R_o greater than 1 indicates that there is the potential for a new pathogen to cause an epidemic (Figure 2), and the basic reproductive number can estimate the size of the epidemic (Pan-InfORM, 2009; Gaube et al., 2018).

However, given the effect of high population density on R_o (seen through its dependence on factor C), targeting factor C provides unique avenues for innovative solutions to reduce HAIs in an overcrowded setting. In the intervention proposed in this study (detailed in section 3), low cost hand hygiene solutions for safeguarding against increased contacts and their infectiousness, or factors C and B, have been suggested along with a unique approach to separation of crowd by activity.

Alternate, conventional approaches to tackling this problem could be done by capital and resource-intensive interventions such as building more hospitals. However, this is not feasible to urgently address the challenges of inadequate hygiene resulting from overcrowding on the hospital campus. Moreover, interventions solely focused on infrastructure miss the cultural nuances to the problem. It was found that in India it is not considered appropriate to physically leave the ill person alone in a hospital and acceptable that family remain around them (as learned through interviews with local community health experts in India, Appendix table A1). Therefore, we consider crowd management a key piece of the proposed multi-pronged intervention. Currently, there is also a disturbing reprimanding based correction system in place as suggested by official benchmarking documents (Swacchta guidelines for Public Health Facilities section E4.3, 2015) to enforce hygiene upkeep on visitors to hospitals

that creates apathy and mistrust in turn, making visitors and family all the more reluctant to leave the hospital premises. As observed on field, the messaging around hygiene is also quite descriptive which makes it difficult for outreach to majority of the visitor demographics in these hospitals who are unable to read.

Therefore, the proposed intervention also focuses on the positive reinforcement of hygiene behavior for the visitors using visual and verbal messaging and incentivization. In the long-term this aspect of the project should also sustainably incorporate hygiene education in the community beyond their visit to the hospital.

1.3 Hypotheses and Problem Statement

The team developed the following key hypotheses which were used to formulate the problem statement based on an extensive literature review (including research articles and review of public health and hygiene standard documents from the Indian Government) and in consultation with subject matter experts:

1. For public hospitals: lack of physical infrastructure (running water, sanitizing and janitorial equipment and constrained space) to support WASH compliance
2. For health workers: general apathy towards upholding and promoting a good hygiene culture resulting in part from resource and manpower limitations
3. For public health policy: Inadequate administrative and funding support for sanitation and hygiene
4. For incentivization: The Kaya Kalp program seems (Kaya Kalp, 2015) to be the only link between the Swacch Bharat Mission (SBM) and public health space and within the program the award funds seem to be inequitably funneling towards larger and better equipped public hospitals

Following the field trip, several hypotheses around the sanitation and hygiene culture in the public healthcare space were found to not be universally applicable. The on-ground performance of the Kaya Kalp program, while being primarily incentivization-based, had also succeeded in picking up on resource-endowed laggards and provided much needed mechanisms for training of staff on better hygiene practices and initiated monitoring of hygiene compliance. The hospital sites visited became positive deviants with respect to the initial assumptions as the quality of their WASH facilities met and even exceeded the National standards despite an extremely high daily intake (also known as footfall). **What emerged as the single biggest roadblock to these sites achieving excellent hygiene compliance was the management of unhygienic behavior by existing crowds.** Some additional factors specific to the crowds that contribute to the problem that the proposed intervention systematically addresses are:

- Lack of cost-effective accommodation resources for visitors travelling from afar
- Disconnect between SBM messaging and specific unhygienic behaviors at the hospitals

Building on these observations and hypotheses, the problem statement for the intervention has been formulated as follows with a focus on metropolitan Delhi, (referred to interchangeably as the field site or field henceforth in the report) and the field observations detailed in the next section.

Problem statement

"Unhygienic behavior by existing crowds in public hospitals in Delhi leads to decreased compliance with sanitation and hygiene standards and increases the incidence of hospital acquired infections."

Figure 3: Map of the District of Delhi (Source: Map of India)

2. Needs assessment and gap analysis

The needs assessment and problem identification, following gap and opportunities analysis, was done using a combination of literature review and informational interviews with subject matter experts and key stakeholders of the proposed intervention. The interviews were done both on field as well as off field with public health and global engineering experts in Toronto, Canada. Due to the sensitive nature of the information contained in this document, and in order to maintain anonymity, the authors refrain from identifying the public hospitals in Delhi subject of the field visits. These will be referred to as "Hospital A, B and C", in the present study.

2.1 Field work summary, project rationale and motivation

The field work for the intervention was done in Delhi from 11.01.2019 – 25.01.2019 and the main methodology used was informational interviews and site visits. The purpose of the interviews were to both test the formulated hypotheses as well as understand the real-world context of the problem. The scope of the field work is presented in figure 4 and the team was able to cover diverse perspectives from different actors and stakeholders central to the intervention.

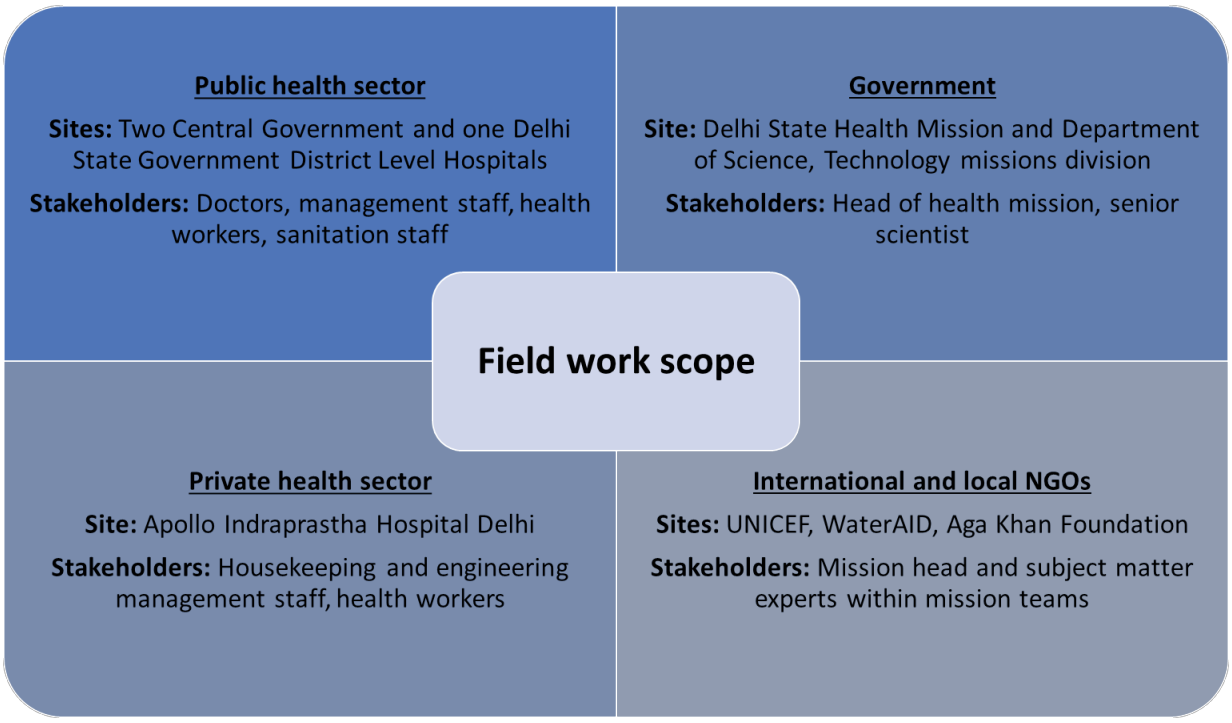

Figure 4: Scope of field work done in Delhi identifying different key actors interviewed and sites visited (due permission has been obtained for the identified stakeholders in the figure)

Three public district-level hospitals, one private hospital (the biggest in Metropolitan Delhi) and three NGOs working at the intersection of WASH and public health in Delhi were visited and/or personnel interviewed. Along with this, the head of the Delhi State Health Mission was also interviewed, and a continued collaborative connection has been established to formally propose this intervention upon completion. Table A1 in the appendix below provides details of the main observations and needs assessment from interviews. Diversity in the stakeholders and their role in the public health value chain was commensurate with their perspectives on the biggest gaps when it comes to hygiene in the health space. These are illustrated in verbatim below:

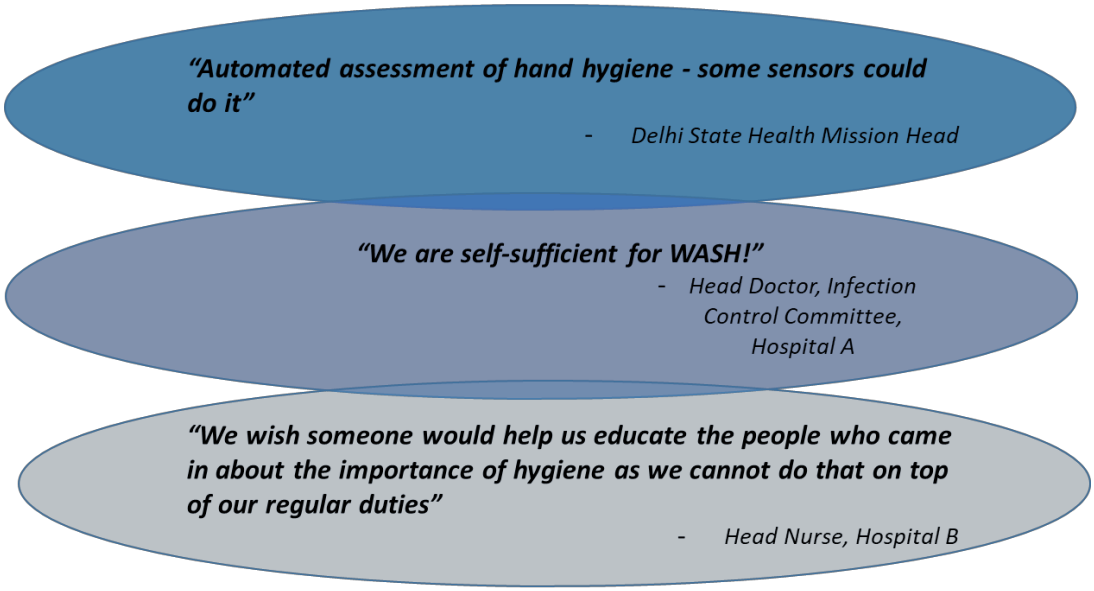

Figure 5: Excerpts from field informational interviews (hospital identities not revealed as requested by the personnel interviewed)

The interviews (and ongoing feedback for the intervention) (Table A1) also pointed towards an increasing emphasis on community driven initiatives for promoting hygiene and cleanliness and taking hygiene practices beyond the healthcare space to ensure sustainability of such practices. To the best of our knowledge, crowd hygiene management with regard to improving WASH performance is a very novel and unique approach in the public health space in India as the national guidelines for addressing this issue have been found to be lacking (National Health Mission Portal, 2005, 2015; Ministry of Drinking Water and Sanitation, 2017). As the SBM moves from being infrastructure-focused to more people-focused, it presents an opportune time to propose this intervention. The team recognizes that these conclusions hold true only in the context of the field covered in Delhi (the hospitals visited were definitely positive deviants from the original hypotheses) and there is still evidence for lack of hygiene and sanitation resources in public hospitals within and outside Delhi. Therefore, the scope of application of these interventions will be limited to public district level hospitals in Delhi, similar to the ones covered through the field work, with scope for reproducibility across India.

3. OUR INTERVENTION: "Welcome to the Hospital"

Modifying human health-related behavior in public hospitals in India is not only a complex task, but also a result of multiple influences of biology, education, environment and culture (WHO, 2009). Over the last few decades, studies have proven that adherence to any habit or norm is a function of social behavior; and social behavior is a function of people's perceptions (WHO, 2009). Behavioral interventions in hospitals are the most successful when they are designed to consider individual, institutional and community factors that create an organizational culture change and involve senior clinical as well as administrative staff in supporting and promoting the intervention (WHO, 2009).

Through our proposed multipronged intervention "Welcome to the Hospital", we are seeking to positively reinforce hygienic behavior, with longer-term goals to reduce the incidence of disease transmission despite the high daily footfall in public hospitals in India. The intervention addresses major gaps in hygiene compliance in our target public hospitals through its two components: A. Behavior Change around long-term hygiene compliance; and, B. Infrastructure upgrade for better crowd management.

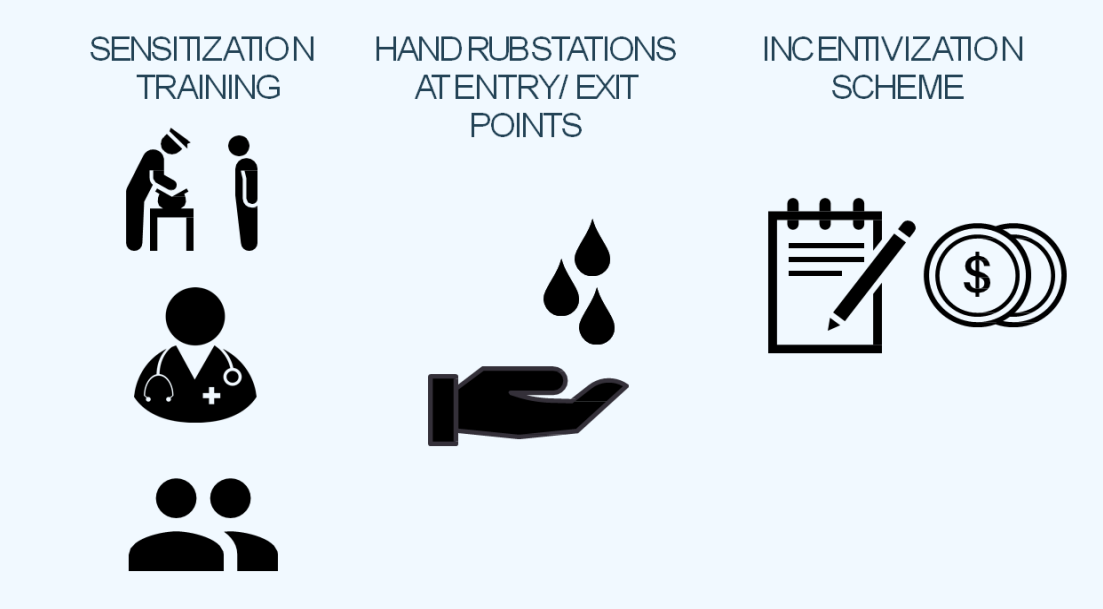

Figure 6: Pictorial depiction of key elements of intervention "Welcome to the Hospital"

3.1 Behavior Change for Long-Term Hygiene Compliance

This intervention uses a unique combination of education, motivation, system change and infrastructural components to complement and reinforce positive behavior. With support from our field data, we highlight three complementary elements to this intervention:

3.1.1 Sensitization Training

Through a sensitization training module, the aim is to target the main actors who interface the most with patients and visitors and change how they interact with and educate the visitors about hygiene upkeep. These include security guards, nurses and receptionists. The existing attitude of these people-facing actors often involves reprimanding and derogatory schooling, yielding little to no improvement in WASH compliance by crowds. Through a sensitization module, the program would encourage these actors to alter their interactions and contrive positive reinforcement, inclusion and a collective sentiment of commitment. Through the "Welcome to the Hospital" program, these key actors would be encouraged to pay it forward. By politely educating and constantly reminding visitors about what constitutes hygiene and emphasizing the implications of non-compliance on the lives of family members/patients. In line with our positive reinforcement model, guards can monitor hand sanitization at these entry-and-exit points and use the time to persuade people for a minute about WASH compliance. Similarly, receptionists can welcome patients and visitors to the hospital by encouraging them to participate in the hospital's collective mission of 100% WASH compliance. These initiatives will help get the message out to crowds that may not be able to read descriptive signages, while still making them feel welcome to the hospital and involved in this collective movement. These proactive engagements and interactions between the staff, patients and visitors will build an atmosphere of trust and collective accountability towards hygiene and sanitation. This module is also easily implemented within the existing routine mandatory training program for the hospital staff as required by the Indian government to ensure that existing hygiene, health care and administrative are dynamically updated.

In addition, there will be a ramp up in signages and cues to action such as cartoons, interactive posters and digital suggestion boxes throughout the public hospital premises in Delhi to target more people and their attention (examples provided in Appendix 3). Overall, the Sensitization module would harbour efforts through improved communication patterns to promote WASH compliance among crowds.

3.1.2 Motivation: Incentivization Scheme

The incentivization scheme would include a financial reward system to incentivize appropriate and accountable WASH behavior among all those inside the hospital campus including visiting families. The financial reward would be a bonus for maintaining hygiene while in the hospital premises. Each incoming patient file would be supplemented with a check list and a good hygiene behavior paper or electronic card that would identify hygienic behaviors

such as using garbage cans, washing/sanitizing hands, using washrooms, limiting food consumption to designated areas etc. Hospital staff deployed near these utilities would be asked to check or scan these rewards for beneficiaries. The points gained through the cards would then be used by patients and visitors to claim rebates on medicines, food, special medical treatments, etc. These rebates will not be used as a selection mechanism to treat patients, but in fact, will be a fixed monetary rebate on expenses alone, and will be actively monitored to reward behaviors that are sustainable in a judicious manner.

We propose two different types of reward card systems in order to create better incentives for appropriate WASH behavior. The first is a paper card system in which each patient file is supplemented with a paper card that would be stamped by compliance officers at the different aforementioned stations. The second would be a plastic recyclable card that would be similarly given to each patient file entering the hospital campus and returned upon leaving the campus. The plastic recyclable cards would be scanned for rewards, and the individual rewards information stored on a computer database, so the plastic cards could be used by an unlimited number of visitors in this recycled card option. It is also possible that a smartphone application could function similar to this plastic rewards card. However, a smartphone application might exclude individuals from participating for economic reasons.

Appendix 2 details a financial and general comparison of the two reward schemes. The e-card system emerges a lower cost option, due to higher resource intensive nature of paper cards. It is also promising in terms of ability to track data as an additional means to measure success of intervention but suffers from higher-end technological implementation which could take a longer time to implement. Over time, variable labor-related costs arising from increased shifts of the health workers to monitor the reward scheme are also expected to decrease as the intervention becomes more organically assimilated in the hospital ecosystem.

Currently, private sector companies in India such as Unilever and ITC Limited have successfully implemented unique and innovative behavior change models in the public institutions and school space. For example, ITC Savlon's #SwasthaIndiaMission has facilitated behavioral change among primary school children by promoting hand hygiene through the unique "Healthy Hands Chalk Sticks" campaign (AdAge India Bureau, 2019). Similarly, Hindustan Unilever has multiple successful programs underway in India such as Lifebuoy's "Help a Child reach 5" by encouraging children to wash hands at intervals and encouraging parents to be accountable for the same (AdAge India Bureau, 2019). The proposed incentivization model is unique in this space and building on the success of these creative analogous schemes fosters confidence in its success.

3.2 Infrastructure Upgrade for Better Crowd Management

The district level multi speciality hospitals in Delhi suffer from extreme overcrowding as they attract referred patients from afar who are often accompanied by family members (Dutt A., 2019). Since nudging the public to influence behavior is a key component of our intervention, we are proposing the following infrastructural changes in the hospital campus grounds to complement and reinforce the other aspects of our intervention. During our field visits, we encountered that district level hospitals in Delhi faced a complex challenge of serving the patients and monitoring large numbers of accompanying family members. In tackling this issue, the team thought of three elements:

3.2.1 Compartmentalizing the campus area

The compartmentalization of the campus area will be done using large tent-like structures, whose objective will be to separate people into three areas by activity type. The tents can be procured from the military or from INGOs who typically work with these structures (see figure 8). For example, these tents would serve the purpose of segregating individuals according to activities: food and drink zone, sleeping zone and waiting zone (see figure 7). Appendix 2 has the CAPEX calculations for setting up shelter tents to create these compartments and associated costs. Even though it is a high initial investment, the team has identified local NGOs who provide similar tents for free or marginal costs to serve the public good and we can create partnerships with them. Also, if the identified pilot site hospital administration has appetite for permanent construction, these spaces can be made more permanent. However, this is a less desirable option due to disruption of hospital activities.

3.2.2 Adding hand sanitation stations and rubbish bins near the tents

The starting point of the intervention targets reducing existing barriers and increasing the ease of access for hand hygiene options in hospitals through the installation of hand-rub or hand sanitizing stations at all major entry/exit points in the hospital premises. Corporate Social Responsibility (CSR) activities are mandated in India and promoted under the SBM (SBM, 2017). Currently, private sector organizations in India such as Unilever and ITC Limited (Savlon) have demonstrated interest to partner and implement innovative methods to incentivize WASH practices across schools and other public institutions. Public health space presents a new and impactful area to capitalize on opportunities for partnerships with the private sector in installing hand sanitizing stations. The hand sanitation stations would be strategically located in all areas that attract thoroughfare, most importantly: 1) at the entry/exit of each of the tents, and 2) at the main entrance to the hospital building. These would have to be monitored and replenished continuously (costs in Appendix 2). Additionally, rubbish bins would be placed strategically near the tents to encourage individuals to put away food waste and plastic containers, among others. These would have to be emptied frequently in order to comply with

sanitation standards (see figure 7). Finally, pictorial signage inside and outside the tents would remind individuals to use both hand sanitation stations and rubbish bins (Example of signages in Appendix 3).

3.2.3 Encouragement for hygienic behaviors

As part of the nudging strategy of our intervention, following the sensitization training, staff members such as security guards at the entrance of the hospital, nurses on their rounds and sanitation workers, would encourage accompanying family members who remain on campus to use the toilets inside the hospital to urinate and defecate. As they do so, they would be reminded to use the hand sanitation stations at these points.

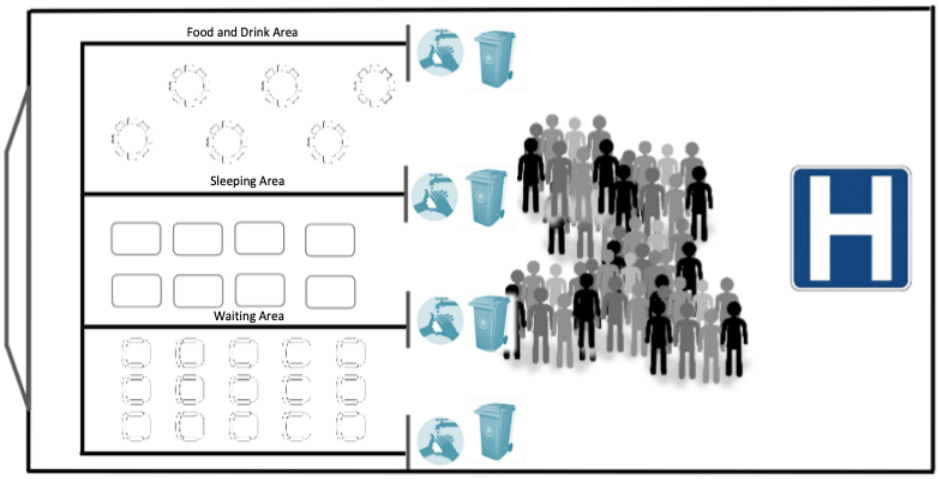

Figure 7: Proposed Floor plan. Hospital premises.

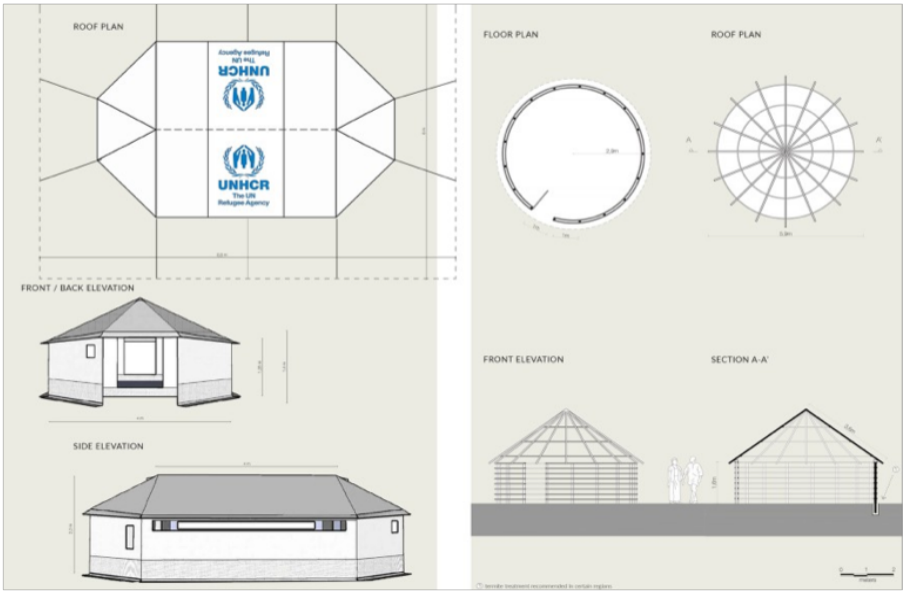

Figure 8: Proposed tent. Source: UNHCR.

The team has pitched the infrastructural redesign concept to community health program experts in India and received positive feedback. These areas will help to create physical spaces for a positive hygiene culture where hospital staff can have increased interactions with the visitors and can easily monitor positive and sustainable hygiene behavior for the reward scheme. The visitors will also be able to constantly interface with the positive pictorial messaging and campaigning. Moreover, these spaces will also help offset the burden on the sleeping shelters provided by the government.

4. Our Impact

Hospitals can be thought of as ecosystems. In accordance with this thought, we believe this intervention will benefit all the identified major stakeholders within the premises of a typical public hospital and positively affect the value chain of the hospital (see figure 9), as the following benefits are anticipated:

- Health workers will experience improved workspace due to cleaner premises and less accumulated dirt and waste
- Sanitation workers will benefit from a reduced risk of infection due to the multiple hand sanitation stations and the compartmentalization of large crowds
- Financial incentives previously described will support the nudging to which patients and accompanying members are subject. Such financial mechanism is particularly relevant considering the users of public district level hospitals.

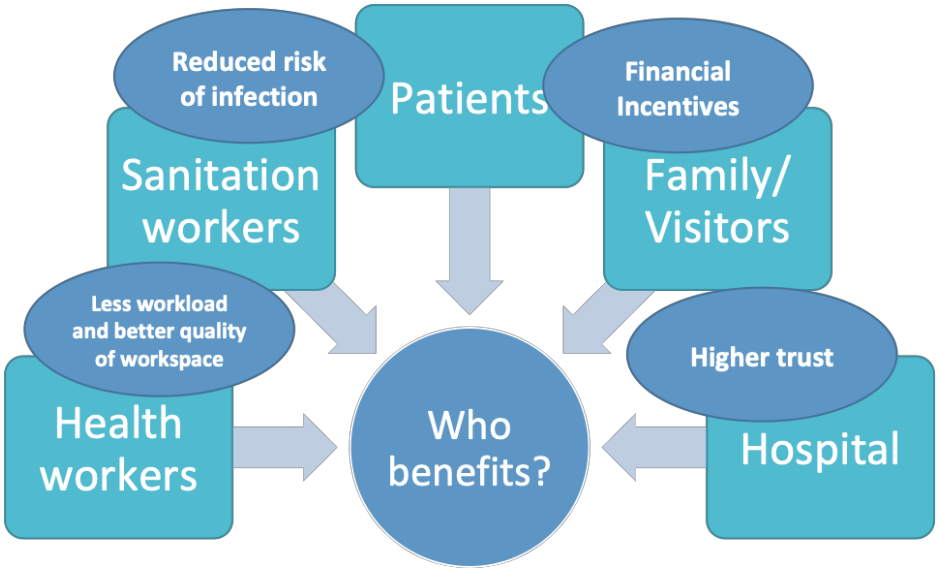

Figure 9: Stakeholders' map within a typical public hospital in India

5. Project evaluation

5.1 Measures of success

As a result of implementation of "Welcome to the Hospital" we anticipate that overall, there could be a higher level of trust amongst all stakeholders which will positively affect the hospital ecosystem. The measure of success of this intervention could be done by monitoring the reduction of hospital acquired infections (HAIs). This measurement is retrofittable with the existing monitoring mechanisms in the hospital that routinely test for infection causing pathogens in different areas of the hospital premises to account for the incidence of HAIs. While conventionally this is done in areas that are sterilized, the team will propose for the expansion of the area of coverage of HAIs testing to the campus of the hospital, in order to support reduction of HAIs. The ultimate goal is to create aspirational hygienic hospital models at our pilot site to have a positive snowball effect on other hospitals in the country.

5.2 Assessment of "Welcome to the Hospital"

Similar to how hospitals are assessed for hygiene compliance in the Kaya Kalp guidelines (Kaya Kalp, 2015), we have conducted an assessment of our project based on six key criteria (Figure 10). The assessment found that it would be difficult to quantify the impact of the commitment form component due to the confounding effects of ethical implications and diverse perceptions around the requirement of having the family/companions of admitted patients being asked to sign a commitment form (albeit not legally binding) upon entering the hospital campus. However, this was a tougher assessment, as it could be considered ethical to promote commitments to hygiene for all people on the hospital campus and this could have positive spillover effects for hygiene in the society at large. The verbal interactions component was strong, but its scalability would be based on the manpower available for these interactions and the quantifiable impact would be, like the commitment form, difficult to attribute solely to the verbal interactions. The hand sanitizing stations and campus separation are strong components based on the criteria, despite not being innovative, as this had been done before in different settings. Assessing the different components of our intervention can help identify which parts of this intervention might be more suitable for uptake given different contexts or hospital settings (Wong et al., 2014).

Project component	Innovation	Technologically Feasible	Sustainable	Scalable	Quantifiable impact	Ethical
Pictorial Signages	✓	✓	✓	✓	✓	✓
Commitment form	✓	✓	✓	✓		
Verbal interactions	✓	✓	✓			✓
Hand sanitizing stations		✓	✓	✓	✓	✓
Campus separation		✓	✓		✓	✓

Figure 10: Different components of the "Welcome to the Hospital" intervention assessed on criteria of six factors, outlined as the column headings. Checkmarks represent project components that fulfilled the criteria of the column heading based on the discussion with the intervention planners.

5.3 Risk analysis

Despite the novelty and promise of this project towards improving hygiene and consequently reducing the risk of hospital acquired infections, there are certain risks associated with project pilot and scale-up that the team hopes to address.

Risks/Roadblocks	Potential mitigation strategies
Buy-in from stakeholders: The success of this project depends crucially on the involvement of multiple stakeholders, the Delhi State Health Department must provide the necessary approvals for e.g. the pilot site for implementation, establishing a committee to be the on-site project contact point including doctors, health workers and security guards; the hospital administration itself would need to provide resource allocation and select the reward card scheme model for implementation; establish training resources for actors on-site, local NGOs and private companies	During the field visit to India, direct contacts have been established with these different stakeholders. Initial feedback has also been obtained on the idea from prominent local NGOs like WaterAid and Aga Khan Foundation and the results have been positive with an interest in collaboration. The Delhi state health mission head was also interviewed and has asked for the submission of the project in the form of an "Expression of Interest Statement" (a standard format required by the Indian government) that will be evaluated for feasibility analysis. Private

are also identified for creating IEC materials, procuring tents/temporary shelters and providing support for hand sanitation stations	partner identification is ongoing.
Reward system abuse and target population apathy: The reward card systems, both paper or electronic can be prone to abuse, for e.g. self-collection of points or expensive electronic equipment can be prone to theft or vandalism and create security issues (this was reported by health workers during the field interview, for other electronic equipment installed in the hospital). Post the Swacch Bharat Mission, the population in India has been inundated with several kinds of messaging around hygiene and within the public health space, the IEC materials have to be really creative, unique and inspiring to capture the attention of the visitors.	During their regular rounds of the hospital premises, security guards can monitor the point collection sites. During the initial phase of implementation, health workers will rotate through the visitor/family assembly areas and along with campaigning for hygiene, will also take turns to be present at the hygiene points collection site for awarding the stamps/e-points. This is based on the assumption that the workers will be suitably compensated for their extra hours or new workers will be hired to ensure that the primary duties of staff are not hindered by the intervention. There is also a possibility to recruit community-based volunteers as hygiene champions on-site who would be exclusively monitoring the reward system while simultaneously campaigning for hygiene to avoid health labour workforce issues altogether. The IEC materials will be developed with local NGOs and audio/video delivery and pictorial representation will be stressed to overcome issues with highly descriptive messaging that cannot reach people who are unable to read.

Scale-up and reproducibility: India is a big and very diverse country, health is a state government mandate but is also supported by the central government (within Delhi itself there are four types of hospital authorities; central, state, municipalities and private), the challenges faced by public hospitals vary from one region to another depending on their size/scale, geographic location, local socio-political influences and demography of the populace they cater to.	This project model is intended for hospitals with big enough premises to accommodate the temporary shelter set-up and resources to implement a reward based incentivization system. The pilot scale implementation and data analysis to evaluate the intervention success is projected to take at least 3-4 years (as depicted in the timeline), but since the implementation is dependent on government approval, the government buy-in support can be counted upon. This will ensure reproducing the project first at similar sites, and following more resource allocation, tailoring the intervention for other public hospital sites depending on their characteristics and collaborating with other local actors.
Geographical Proximity and Project sustainability: The team is based in Toronto, Canada while the intended site of implementation is in Delhi, India. Also, the project is heavily dependent on financial support from the Delhi State Health Department, logistical support from the pilot site coordinating team and initial support from local NGO's. Continued progress is contingent on government support since it is not a self-revenue generating model.	The team has a local member on-site in Delhi who is affiliated with the Public health foundation of India. There is a strong on-ground supported collaborative framework and the team at Toronto are familiar with most of the local contacts in India. The project is in good shape to be successful at pilot scale and is very well aligned with national and state public health and sanitation goals to ensure continued support from the government.

6. Timeline of the Intervention

A 5-year timeline has been created to reflect the official plan for evaluating the "Welcome to the Hospital" intervention over time. This 5-year plan would be starting in 2019 and end in 2024, with key activity periods and milestones outlined, starting with this proposal and reaching out to collaborators, infrastructure development, which would be developed alongside the sensitization training and verbal and pictorial campaigning, a monitoring and evaluation phase (between 2021 and 2024), and finally, if successful upon evaluation, a scale-up and economic expansion of the reward scheme in 2024 (Appendix 1).

7. Partners to Support the Intervention

There are a number of partners who have been identified to help with this intervention moving forwards. This intervention has already been developed using the feedback provided by UNICEF and WaterAid NGOs currently operating in India, and so we will approach these NGOs for infection control education materials moving forward with the intervention implementation. Our intervention has also been informed by the information collected at three hospital sites in India. This intervention can partner with all levels of central, state as well as municipal governments in India to identify the pilot hospitals for the intervention. Finally, partners to aid in the success of this intervention include NGOs working within the WASH space in India, such as Sulabh and Unilever, as previously mentioned, who could provide resources towards the success of this intervention and the improvement of health in New Delhi hospitals. The team will be working with these partners in a consulting role to facilitate implementation intervention.

Figure 11: Different identified project partners, several of whom the team has established contacts with during the field trip.

8. Conclusion

In order to maintain low HAIs and improve the hygiene compliance across the entire hospital campus, we have proposed an intervention with a broad scope that aims to extend hygiene compliance throughout a hospital premises. The “Welcome to the Hospital” intervention includes a multi-pronged and multi-component approach to improve the WASH standards of large public hospitals in the New Delhi region of India. This approach aims to sustain an environment and culture of prevention of HAIs within the hospital, targeting the wider hospital campus. Overcrowding among public hospital campuses is a current and potentially growing problem in India. This innovative and multi-pronged intervention, when implemented in a Delhi-specific context can make for a public health success story in the Indian WASH space. We believe that this intervention could be a part of a larger positive attitudinal shift around hygiene compliance in India. While we focus on large public hospitals in the Delhi-region for now, we hope that the solutions recommended here would be translated to different public hospitals across India, supported by different public as well as private stakeholders.

List of abbreviations

CSR - Corporate Social Responsibility
HAIs- Hospital Acquired infections
IEC - Information, Education and Communication
IPHS - Indian Public Health Standards
LMICs – Low- and Middle-Income Countries
NHM - National Health Mission
PHCs - Primary Health Care Centres
SBM - Swacch Bharat Mission
SSS - Swacch, Swasth and Sarvtra guidelines
WASH – Water, Sanitation and Hygiene

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Appendix 1: Project Timeline and Field data

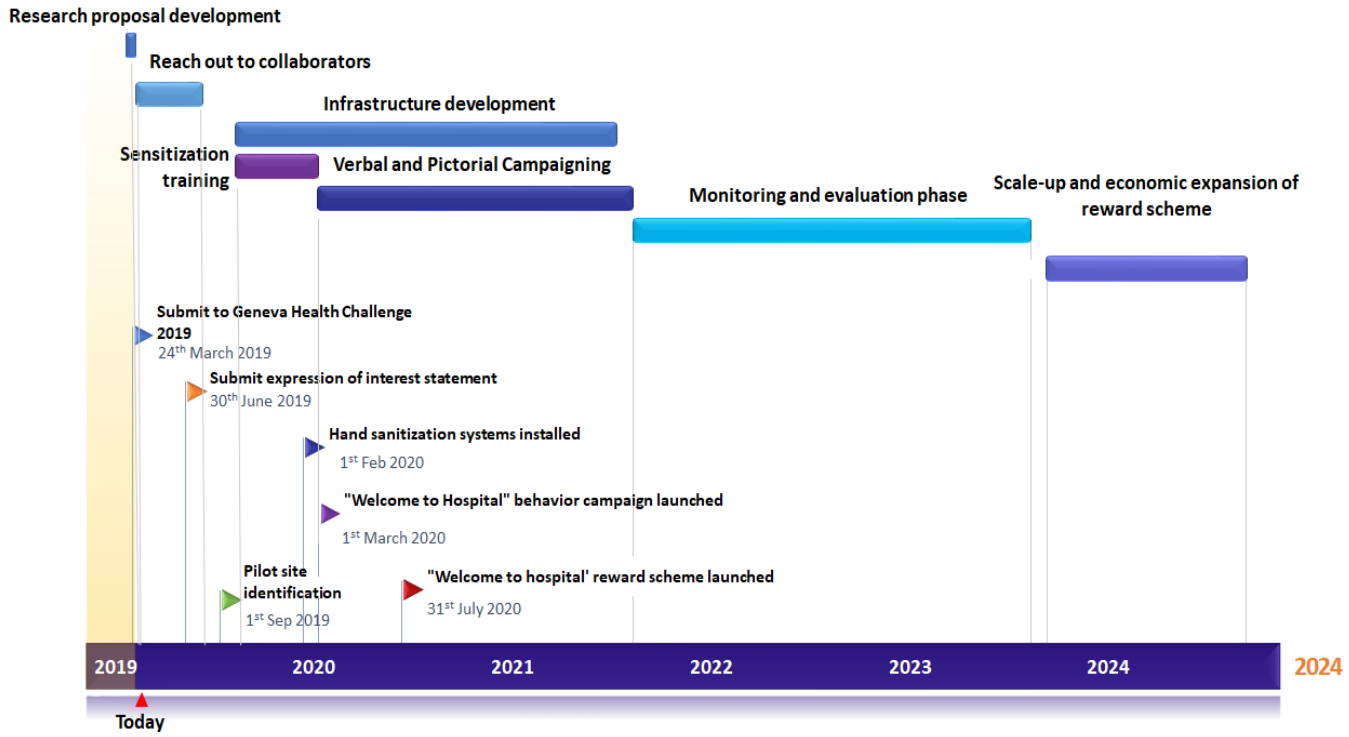

Figure A1: The 5-year plan for the "Welcome to the Hospital" intervention would last from 2019 to 2024. Key periods for different stages of the timeline are outlined in the coloured bars, and key benchmarks are outlined in the coloured flags to ensure intervention success.

Table A1: Field data: observations and feedback

Organization	Description	Interviewees	Key observations/findings	Needs assessment/Feedback
Hospital A	District level hospital under the Delhi State Government (footfall 2000 patients/day)	Senior doctor responsible for Kaya Kalp program implementation and training	Administrative, policy and financial support and participation of doctors as hygiene champions has created a culture of good hygiene compliance predating the SBM, incentives program in place for health and sanitation workers	High-technology solutions - elbow/foot/sensor operated hand wash stations; automated solutions for hand hygiene monitoring, creative messaging to patients and visitors for hygiene
Hospital B	District level hospital under the Central Government (footfall 9000-10000 patients/day)	Head of housekeeping facilities, sanitation workers and nursing staff	Private contracting of sanitation workers and high investment in training has ensured good hygiene compliance despite extremely high footfall	Health workers struggle the most with managing the unhygienic behavior of visitors; shortage of manpower and increased pressure on WASH resources
Hospital C	District level hospital under the Central Government (6000-7000 patients/day)	Site visit only	Recent construction of an expanded emergency section on site has led to great improvements in hygiene compliance; evidence of good biomedical waste segregation	Extensive overcrowding observed in the hospital campus, squatting and loitering by visitors creates more litter and encourages a higher thoroughfare
Apollo Indraprastha Hospital	Private hospital (footfall comparable to Hospital C)	Deputy General Manager housekeeping, Head of Engineering operations	The first hospital in Asia to get accredited with JCI health standards , extremely rigorous standards hygiene compliance are followed	N/A
Delhi State Health Mission	State government body overseeing hospitals and other public health facilities	Head of State Mission	Insights about the Kaya Kalp program: currently incentivizing and monitoring focused and in the next phase will be focused on pulling up on underperforming hospitals	Automated audit of hand hygiene; interactive IEC materials focused on public messaging for change in hygiene behavior

UNICEF	International body engaged in cross-sectoral development in India	WASH Institutions specialist and public health expert Delhi region	Directed interview for assessment of validity of the overcrowding problem in hospital space and current state-of-the-art	Problem area for intervention was validated and potential for collaboration for developing training modules has been established
Aga Khan Foundation	International NGO engaged in cross-sectoral development with a focus on rural India	Programme officers and Director, Community Health Services and Research (Aga Khan Health Services)	Program officers on site Delhi: Insights about the monitoring and assessment of hygiene culture in rural PHC's; Director Community: Public health context within Maharashtra and validation of overcrowding issue	Insights about a focus on community driven hygiene messaging in rural India to offset burden on health workers (start in the house approach); validation of the geographical scope of the overcrowding issue and the underlying considerations of a culture of mistrust between family and health care providers
WaterAid	International non-profit engaged in improving water accessibility and security across India	Manager-Policy (WASH in health, nutrition and schools)	Feedback on preliminary approach to formulated intervention idea	Intervention area validated and feedback on using a "campaign-type" rather than "training-oriented" positive hygiene messaging with the target population (visitors)

Appendix 2: Project Finances

This section describes an initial cost assessment of three key physical aspects of the intervention Welcome to the Hospital.

I. Reward card based incentivization system:

Each patient file is supplemented with a points card (either paper or plastic/electronic and one card per family) and points are collected around the hospital premises for a number of predefined hygiene behaviors

The team considered two possible modes of implementation based on general pros and cons:

1. **Paper based system:** Suitable for a low-resource setting, ease of implementation; Highly resource intensive, possibility of creating more litter, more labour hours due to physical stamping needed.
2. **Electronic card system (plastic cards):** Card recycling opportunities, easier to collect and evaluate usage data; requirements for higher-end technology, slower in implementation (in absence of e-readers).

There are certain **conservative assumptions** made listed below:

1. The site of implementation of the intervention is Hospital C with a daily patient footfall of 7000
2. All admitted patients are accompanied with at least one family member
3. To calculate electronic card turnover: Long term patients are defined as patients spending more than 6 months in the hospital and short-term patients who spend less than 6 months (patients discharged the same day not included and assumed to be 10% of the daily patient count), the average length of stay for short-term patient is 4 days and the annual figure for long-term patients is included. (https://www.statista.com/statistics/976534/alos-apollo-hospitals-india/, https://www.jemds.com/latest-articles.php?at_id=6382)

Table A2: Hospital data (including figures obtained from Hospital's website[1] or field data[2] and extrapolations based on these)

Total Patients Treated Annually[1]	1200000
Annual number of long term patients (=sum total of surgeries performed and assuming time for recovery > 6 months) [1]	49000
Percentage of long-term patients (%)	4
Daily patient count[2]	70000
Long-term patients (daily basis; using annual percentage)	280
Short-term patients	6720
Patients discharged daily (assumed to be 10% of daily admits)	700
Average length of stay (days) for short-term patients	4

$$Total\ e-cards\ needed = (Short\ term\ patients - Patients\ discharged\ daily) * (Average\ length\ of\ stay) + (Annual\ Number\ of\ long-term\ patients)$$

= (6720-280)*4 + 49000

= 74760

Table A3: E-card system (annual cost in 1st year of implementation in Indian National Rupees (INR))

	Unit cost (INR)	Units	Total	Notes
Plastic card	4	74760	299040	
Reader (= sites for collecting points)	3000	16	48000	Assuming 2 readers per four hygienic behavior rewards outlined in report (X2 for the whole hospital)
Card initialization readers	18000	10	180000	These readers present in OPD check-in counters where patient files are issued
System*	15813	1	15813	One reward card software system purchase (based on purchase cost in Canada since these systems are not yet as common in India)
Salary of technician	491439	1	491439	Based on average wage of database technician
* Exchanged from CAD			**1034292**	**Costing sources** [Creation Technics Indian Private Ltd.(cards and readers); Costowl Canada (reward system software) Glassdoor India (technician salary)]

Table A4: Paper card system (annual cost in 1st year of implementation in Indian National Rupees (INR))

	Unit cost (INR)	Units	Total	Notes
Paper	0.5	2555000	1277500	Assuming 7000 patients per day one card per family for 365 days
Stamp pads	19.5	16	312	Similar to number of readers at sites of hygienic behavior rewards
Stamps	50	16	800	
Daily Salary of nurse	650	15 (days of overtime) * 16 sites of deployment	156000	Based on average wage of nurse/health worker (assuming their physical presence at each stamping site adds an additional hour per day of overtime)
			1434612	**Costing sources** [India mart (cards and stamp pads); Glassdoor India (nurse salary)]

II. Cost of tents/temporary shelters for segregation of visitor activities:

These shelters are created in the premises of the hospital to create spaces for separating activities of the visitors to achieve two-fold goals:

1. Reduce risk of infection to immuno-compromised patients by activities that create more litter in the campus e.g. food consumption, squatting
2. Reduce burden on shelters provided by the government to accommodate families of patients travelling from afar (on a rotating basis)
3. Increase space for general waiting

Assumptions:

1. Average number of people accompanying patient (family or other) = 3
2. Daily visitor count = 18900 (based on daily patient count of 7000 - family of patients discharged daily)
3. Hospitals allow one person to be accommodated with patient in ward, therefore number of visitors in any shelter space on a given day = 12600
4. UN guidelines specify a square foot space of 3.5 m^2 (or 37 sq. foot) per person, total square foot space needed = 466200
5. Waiting area internal to the hospital (assumed to be 1% of total hospital area as given on website in square foot) = 12916.69
6. Area of hospital available for making external shelters (assumed to be 10% total hospital area as given on website in square foot) = 129177
7. Assuming 50% of visitors need shelter space (in addition to government shelters)

Total combined shelter space (sq. ft.) = 0.5(Total external space available for visitors - internal waiting area)

$$= 0.5(129177 - 12917) = 58130$$

Table A5: Initial CAPEX for temporary shelter set-up in hospital premises

	Unit cost (INR)	Units	Total	Notes
Medical tent material	350/sq foot	58130 sq foot	20345500	Total to cover square footage needed
Folding cots for sleeping area	1050	524	550200	To cover 1/3rd of total shelter area and assuming 37 sq. ft. space per person
Fans	700	500	350000	Can be rented during non-winter seasons, assuming one industrial-style fan per 100 sq. ft.
			21155700	Costing source : Indiamart 1, 2

This CAPEX can vary significantly if instead of temporary shelters, permanent shelters are constructed using building materials. The team recommends temporary shelters for faster set-up with minimal disruption of hospital activities and the potential to collaborate with local NGOs engaged in supplying shelter tents to avoid high CAPEX of tent material. Some local NGO suggestions are UDAY, mHS city lab, and billionbricks.

III. Cost of installing hand washing stations:

Unit price assumed = 1500 INR/unit (Costing source Indiamart)
Total units needed (at all major entry/exit points within and outside hospitals and temporary shelter areas; excluding area inside wards as they are already equipped with hand rub stations) = 20
CAPEX = 30000 INR

There will be associated OPEX of refilling the stations, a refill typically will cost 100 INR/0.5 L (Costing source Indiamart)

For this aspect of the project there is a possibility to collaborate with private sector engaged in similar projects through CSR requirements mandated by the Indian government.

Appendix 3: IEC material example

The IEC material used in this intervention will be based on creative messaging targeting audio-visual display of hygiene promotion, targeting behaviors typically observed by visitors in hospital areas (as per information obtained from health workers through on-site interviews). The signages will be more pictorial and stress will be on verbal communication to the visitors by health workers who will be making the rounds in the shelter areas. This is done to avoid apathy from visitors who are unable to read. The messaging will also revolve around emphasizing how their activities affect their family members who are patients to generate an empathetic response. The signs will also be in the local language.

Figure A2: Sample handwashing poster example (Source: UNICEF India)

आप और आपके बच्चे को स्वच्छ और स्वस्थ रखें"
(Keep yourself and your child clean and healthy)

"आपके थूंकने से आपके प्रियजन पीड़ित होंगे"
(Spitting in the open will harm your loved ones)

Figure A3: Figures depicting key unhygienic behaviors observed in hospital premises by visitors that will form the basis for messaging