How much does it cost to meet the standards for making healthcare facilities water, sanitation, and hygiene (WASH) compliant?: analysis from Assam, India

Article *in* Journal of Water, Sanitation and Hygiene for Development · March 2022

DOI: 10.2166/washdev.2022.124

CITATIONS
0

READS
84

7 authors, including:

Priya Bhavsar
Indian Institute of Public Health, Gandhinagar
17 PUBLICATIONS **29** CITATIONS
SEE PROFILE

Pachillu Kalpana
University of Bonn
13 PUBLICATIONS **49** CITATIONS
SEE PROFILE

Deepak Saxena
Public Health Foundation of India
245 PUBLICATIONS **2,990** CITATIONS
SEE PROFILE

Journal of
Water, Sanitation & Hygiene for Development

IWA PUBLISHING

 Journal of Water, Sanitation and Hygiene for Development Vol 00 No 0, 1 doi: 10.2166/washdev.2022.124

Research Paper

How much does it cost to meet the standards for making healthcare facilities water, sanitation, and hygiene (WASH) compliant?: analysis from Assam, India

Priya Bhavsar[a], Pachillu Kalpana[a], Annapurna Kaul[b], Sweta Patnaik[b], Sridhar Ryavanki[b], Somen Saha[a] and Deepak Saxena[a,*]

[a] Indian Institute of Public Health Gandhinagar (IIPHG), Gandhinagar, Gujarat, India
[b] United Nations Children's Fund (UNICEF), Guwahati, Assam, India
*Corresponding author. E-mail: ddeepak72@iiphg.org

PK, 0000-0002-3847-221X; SS, 0000-0002-8043-3388; DS, 0000-0003-0563-4259

ABSTRACT

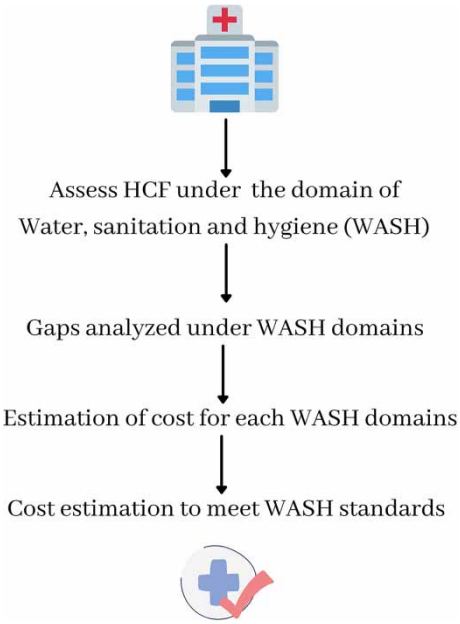
Inadequate water, sanitation, and hygiene (WASH) standards in healthcare facilities (HCFs) pose a severe risk to those who seek treatment. In India, more than one in every four HCFs lack basic water services and only 55% of facilities have access to improved sanitation. The study aims to estimate the cost to meet the standards for making WASH compliant HCFs. This cross-sectional study was centered on assessing 60 selected HCFs of Assam. The assessment comprises four steps: in the first step, domains and sub-domains were identified; in the second step, gaps were analyzed for the selected domains; in the third step, the cost was estimated for the domains and sub-domains, and in the final step, costs were estimated to meet the standards. The findings show that the cost required for the improvement varied for different types of facilities. The total annual cost to make all the selected facilities WASH compliant was found to be USD 13,73,741. The majority (93.3%) of the cost is required for human resources. District hospitals would require significant investment, followed by the sub-divisional hospitals and first referral units. The least cost is required to improve the state dispensary.

Key words: Assam, cost estimation, healthcare facilities, necessitate, quality improvement, WASH compliant

HIGHLIGHT

- This study focuses on estimating the cost to meet the standards of WASH compliant in HCFs in one of the states in India.
- There are many studies and tools focusing on the assessment; however, in the case of India, infrastructure development is needed to make the healthcare facilities WASH compliant.
- In India, even with funding, the health facility managers are not aware of where and how to utilize it for optimizing WASH.
- This study provides evidence on how to find the gaps and improve the health facilities for WASH compliance.

GRAPHICAL ABSTRACT



INTRODUCTION

Water, sanitation, and hygiene (WASH) are essential components of providing quality healthcare services. The term WASH in healthcare facilities (HCFs) refers to the provision of water, sanitation, healthcare waste management, hygiene and environmental cleaning infrastructure, and services across all parts of a facility (WHO 2020). Maintaining WASH standards at HCFs helps explicitly to ensure the quality of services and health of surrounding communities (UNICEF 2019). It also upholds the dignity of vulnerable populations, including pregnant women and disabled people.

The World Health Organization (WHO) reports that almost one-tenth of the global disease burden could be prevented by improving water supply, sanitation, hygiene, and management of water resources (UNW-DPAC 2015).

WHO's report on WASH in HCFs status in low- and middle-income countries indicates that 38% lack access to even rudimentary water levels, 19% lack sanitation, 35% do not have water and soap for handwashing (WHO 2015), while 39% HCFs lack proper medical waste management services (Cronk & Bartram 2018). In India, more than one in every four HCFs lack basic water service (WHO 2015), and only 55% of facilities have access to improved sanitation (WHO 2019). Public facilities are often overburdened, understaffed, and lacking basic infrastructure and resources to deliver quality services (Tseng *et al.* 2020). However, even in facilities where required WASH infrastructure is available, the quality and functionality of services are often inadequate or inappropriate (WaterAid 2018) and hence pose a difficulty in maintaining quality at HCFs.

Along with the availability of infrastructure, maintaining hygiene and following cleaning procedures are also important. Visually clean hospital surfaces like beds, labor tables, and mops reported pathogenic microorganisms present in 18% when validated with the microbiological samples (Trivedi *et al.* 2020). Hence, it is equally important to focus on cleaning activities and the required resources for cleaning at HCFs.

Evidence cites that poor WASH and infection control practices in facilities are responsible for 56% of all neonatal deaths among hospital-born babies in developing countries, with three quarters occurring in south-east Asia and sub-Saharan Africa (UNICEF, WHO & Water Aid 2015). Poor WASH at HCFs increases the risk of healthcare-associated infections (HAIs) to mothers, babies, and indeed healthcare providers and has an impact on patient satisfaction (Bouzid *et al.* 2018). Thus, inadequate WASH standards in HCFs in many low- and middle-income countries are a major concern presenting serious health risks to those seeking treatment.

A poor understanding of the cost of delivering essential services hinders the progress toward the adequate provision of the services (Anderson *et al.* 2020). Establishing a costing or financing plan for improving WASH in HCFs is essential for achieving the Sustainable Development Goal (SDG) of universal health coverage for everyone by 2030 (WaterAid 2019). There is a

lack of literature on the cost of improving the WASH status in HCFs. A better understanding of the cost required for the WASH improvement in HCFs can help facility managers with budget allocation and decision-making in resource-limited settings. This study aims to estimate the cost required to meet the standards for improving WASH in the public HCFs of Assam, a north-eastern state of India. The estimated costs will help the facility head or manager to prioritize the area for making HCFs WASH compliant using the available budget under the *Swachh Swasth Sarvatra* (SSS) or the *Rogi Kalyan Samiti* (RKS) or the *kayakalp* (NHM 2016; MoHFW 2015).

METHODS

About study site

Assam is the most populous state of the north-eastern region of India. Almost 70% of the population of the entire region lives in Assam (Health and Family Welfare, Assam 2020). The state is divided into 33 administrative districts under five regional divisions (Government of Assam 2020). According to the Census of India 2011, nearly 86% of the population resides in rural areas and 89.2% of the rural population uses public hospitals. Assam's infant mortality rate is 48 against the national average of 40 (Health and Family Welfare, Assam 2020). The maternal mortality rate stands at 215, the highest in the country with the national average of 113 in 2016–2018 (NITI Ayog 2018).

About healthcare infrastructure of India and Assam

India's public healthcare infrastructure is a three-tier system based on the population norms, i.e., primary, secondary, and tertiary levels. Various types of facilities are available across three levels based on the Indian Public Health Standards (IPHS). At the primary level, there are sub-centers and primary health centers (PHCs); at the secondary level, there are community health centers (CHCs) and sub-district hospitals; and at the tertiary level, there are district hospitals or medical colleges (Chokshi *et al.* 2016). Assam's public healthcare infrastructure is more or less similar to the national health infrastructure. In addition to the facilities mentioned above, model hospitals (MHs) and block PHCs are also available at Assam, equivalent to CHCs of the secondary level.

In India, health is a state subject; all the programs are developed at the national level and decentralized at the state level. At present, there are two national initiatives for WASH in HCFs. First is the *Kayakalp* program launched in 2015, and another is the SSS, launched in 2016 under the Swachh Bharat Mission (SBM). *Kayakalp* is a Ministry of Health and Family Welfare (MoHFW) initiative under the National Health Mission. The SSS is a joint initiative of the MoHFW and the Ministry of Drinking Water and Sanitation (MDWS) (NHM 2015).

A cross-sectional study was conducted in 60 purposively selected HCFs of seven districts of Assam. The seven districts and 60 HCFs were selected based on the recommendation of the state officials of the Government of Assam. For the selection of HCFs, the government had applied the following four specific criteria:

- High-priority districts
- The mortality rate of the HCFs
- Patient load and
- Access to the facility (hard to reach areas).

A total of 1,204 (excluding sub-centers) HCFs were available in Assam, of which 5% were selected for the assessment based on the specific criteria. The 60 HCFs were selected from the seven districts. The selected HCFs ranged from PHCs to district hospitals (DHs).

Based on the assessment (including microbiological surveillance) of the current status of WASH in the selected HCFs, the cost was estimated for making facilities WASH compliant. Two water samples were collected from each facility and tested for fecal contamination to validate water quality.

A four-step model was developed for coming up with the cost to meet the standards for WASH compliant HCFs :

- Identification of domains
- Gap analysis
- Cost estimation for the domains and
- Estimation of required cost (to meet the standards).

The four steps followed for cost estimation to meet the standards are described below in detail.

Identification of the domains

Domains that need improvement for making HCFs WASH compliant were identified based on the WASH assessment Tool Box (WASH & CLEAN 2014). After domains were identified, all the sub-domains were extracted, which are essential and should be available to maintain optimal cleanliness and hygiene and directly contribute to the WASH. A total of five such domains were identified, namely (1) availability of human resources (cleaners) at HCFs; (2) infrastructure of the HCFs; (3) cleaning material supplies; (4) infection prevention and control (IPC) equipment; and (5) bio-medical waste (BMW) management.

In the infrastructure domain, the toilets and the handwashing facilities of the various departments were mainly considered. Cleaning material includes various essential materials for maintaining cleanliness and hygiene like mops, brushes, dustpans, floor cleaner, bleach, disinfectant, and gloves.

Various types of equipment are available at the hospital for sterilization and disinfection of instruments used during medical care and major or minor surgeries. At HCFs for sterilization and disinfection electric/non-electric autoclave, electric dry heat sterilizer, electric/non-electric boiler, fumigation machine, and chemical high-level disinfection (HLD) are available.

The approach for the gap analysis

WASH assessment of 60 selected HCFs was carried out using a set of a pre-developed assessment tools, Tool Box (WASH & CLEAN 2014). This tool was developed for the labor room, so the extended version of a tool for beyond labor room validated in India was used. The Tool Box mainly encompasses four assessment tools together with microbiological surveillance. These four assessment tools contain (1) facility-need assessment; (2) document availability; (3) walkthrough; and (4) in-depth interviews of key informants. Based on the information (both reported and observed) gathered during the WASH assessment of the selected HCFs, gaps were identified for the selected domains.

The gap analysis was carried out for the three domains, i.e., availability of human resources (cleaners) at HCFs, infrastructure of the HCFs, and IPC equipment.

For the gap analysis under each sub-domain, criteria were decided for classification using IPHS and *kayakalp* guidelines, e.g., availability of toilets and handwashing points identified under the infrastructure of HCFs. Identified gaps were further classified in three main categories: not available or major repair required (0), partially available or minor repair required (5), and available or no repair (10).

Human resource gap (cleaner)

Requirement: One sanitary attendant/cleaner for two hospital beds to ensure appropriate 24-h coverage in all hospital areas (MOHFW 2015).

Gap=Required cleaners–Cleaners available.

Infrastructure gap

Toilets

- Major repair: 0 (neither available nor functional)
  Major repair of the toilet includes full construction of the toilet (if the toilet is not available) or some major renovations or construction required like commode and flush mechanism change or commode change.
- Minor repair: 5 (available but not functional)
  Minor repair of the toilet includes establishing a new flush mechanism or change in the existing flush mechanism and minor plumbing costs such as water tap and pipe issues or blocked toilets.
- No repair/ maintenance: 10 (available and functional)
  This category includes those toilets where no construction is required; however, some indirect cost is required for the maintenance of the toilet. For example, optimum level of cleanliness, training for cleaning techniques. It mainly includes the human resource, cleaning material, and training cost of the human resources.

Hand washing point

- Major repair: 0
  Major repair of handwashing facility includes complete construction of the handwashing point (if hand washing point is not available) or some major renovations or construction required like sink change.

- Minor repair: 5
  Minor repair of handwashing facility includes tap changes and some minor plumbing costs.
- No repair/maintenance: 10
  This category includes those hand washing facilities where no construction is required; however, some indirect cost is required to maintain the handwashing facilities. For example, optimum level of cleanliness, training for cleaning techniques. It mainly includes the human resource, cleaning material, and training cost of the human resources.

IPC-related instruments (autoclave, boiler, and chemical HLD accounted for the plan)

- Instrument not available: 0
- Instrument available but non-functional: 5
- Instrument available and functional: 10

Cleaning supplies

Cleaning supplies cost includes some capital cost and some recurrent cost.

- Non-compliant: 0
- Partial compliant: 5
- Full compliant: 10

Bio-medical waste

- Non-compliant: 0, e.g., no bins available.
- Partial compliant: 5, e.g., bins available but all four bins for waste segregation were not available as per the BMW guidelines.
- Fully compliant: 10, e.g., all four bins were available as per the BMW guidelines for the waste segregation. The only training cost is required for the proper segregation.

The gap analysis also considered the number of the particular observed infrastructure, e.g., if there were two sinks available in the labor room at the time of assessment and both required minor repair, then both were taken into account. While considering the cost, the minor repair cost multiplied accordingly.

Cost estimation for the domains

Guidelines of the SSS (NHM), the National Quality Assurance Standards (MoFHW 2021), and the *Kayakalp* (MoHFW) were reviewed for human resources, including the requirement of cleaners.

For the cost estimation of various categories, the team discussed this with the government and private sectors, such as project implementation units and public and private hospitals. Cost from the project implementation unit of the health system was taken into consideration and based on that, the cost was estimated for three main sub-categories and all five domains. The estimated cost of the various domains can be adjusted or changed according to the government norms or state norms.

While estimating the cost of cleaning supplies, it was calculated based on the number of departments available in the particular HCF. However, the requirement of disinfectant and bleach was calculated based on the average usage. The cost was considered double the average for DHs as the number of beds in DHs is quite high compared to other facilities.

Total cost was divided into two, i.e., capital cost and recurrent cost. Capital cost includes the cost of infrastructure, major repairs, boiler, autoclave, and cost of the three-bucket system. In contrast, recurrent cost includes the cost of human resources, cleaning supplies, chemical HLD, and BMW.

Estimation of required cost (to meet the standards)

The final required cost was estimated based on the gap identified and the estimated cost for the particular domains to fulfill the gap. WASH compliant means availability of the required infrastructure, instrument, and other material in functional condition according to the *kayakalp* and IPHS. Improvement in the WASH status means improving the existing facility to make the HCF WASH compliant. While developing the model, an upper limit of the estimated cost was considered and based on that total annual cost was estimated for the HCFs. The annual cost includes the capital and recurrent cost required for 1 year. Annualized capital cost was estimated considering 5-year lifespan of the improved facilities, and a 3% discount rate was applied to adjust future costs to its present value as per standard costing guidelines.

While estimating the required cost, two different plans were prepared; one considers the upper limit of the estimated cost, while in the second one average of the estimated cost was considered. Despite significant differences in the upper limit and

average cost, the minimal difference was identified in the final required cost for the improvement. After discussion and detailed observation, it was found that there was a maximum gap in the human resource domain in all the HCFs, and for the same already, the minimum wage was considered. Hence, the minimal difference was identified, and it was decided to focus on the upper limit of the estimated cost.

This model is suitable for various HCFs or even for a single department within the HCFs. Requirements of the various department may vary, but the overall standards remain the same for the WASH. This evidence will help the facility manager or the higher authority to decide where they need to invest and how much it would cost to improve the WASH status in the HCFs.

RESULTS

A total of 60 HCFs (Figure 1) were assessed for the WASH status of the public health facilities of Assam. The selected facilities include three PHCs, 18 CHCs, three first referral units (FRUs), two sub-divisional hospitals (SDHs), six DHs, 11 MHs, eight block PHCs (BPHCs), five mini PHCs (MPHCs), three state dispensaries (SDs), and one subsidiary health center (SHC). Of the total 60 HCFs, the majority were CHCs (18), followed by BPHCs (8) and DHs (6) (Table 1). Detailed information regarding the type of facility is described in the supplementary material, Annexure 2.

Gap analysis findings

As indicated in Table 2, the maximum gaps were identified for the human resource domain. Among all the facilities, maximum human resource gap was identified in the DHs. The gap analysis findings show that some major and minor repairs in the infrastructure were required to improve the WASH status in the selected HCFs. In most of the observed toilets, the minor repair was required. While in the majority of the handwashing facilities, major repairs and in few minor repairs were required. Of all the selected 60 HCFs, the autoclave was not available in four facilities, whereas in nine facilities it

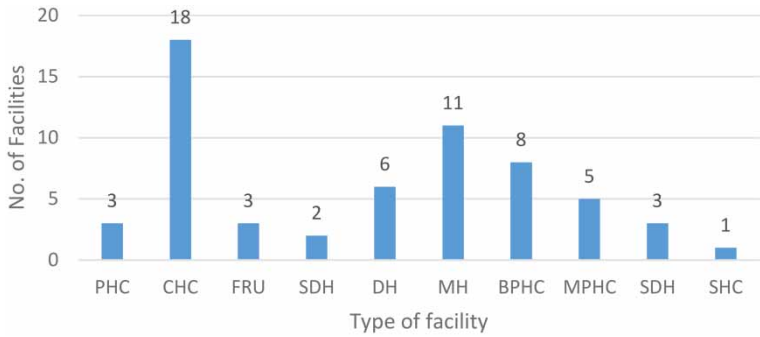


Figure 1 | Types of the 60 selected HCFs.

Table 1 | Types of the 60 selected HCFs (district wise)

	Type of facility										
District	PHC	CHC	FRU	SDH	DH	MH	BPHC	MPHC	SD	SHC	Total facilities
Dhubri	0	5	0	1	1	2	2	0	0	1	12
Dibrugarh	0	3	0	0	0	0	2	0	0	0	5
Goalpara	1	1	1	0	1	3	2	1	0	0	10
Barpeta	0	3	1	1	1	1	2	1	1	0	11
Baksa	1	2	0	0	1	2	0	2	1	0	9
Udalguri	0	3	0	0	1	2	0	0	0	0	6
Darrang	1	1	1	0	1	1	0	1	1	0	7
Total Facility	3	18	3	2	6	11	8	5	3	1	60

Table 2 | Findings of the gap analysis of the 60 selected HCFs

			Infrastructure				IPC equipment				
			Number of toilet facilities		Number of handwashing facilities		Number of autoclave		Number of boiler		Chemical HLD (facility number)
Type of facility	Number of facility	HR (cleaner) gap against standard	Major repair	Minor repair	Major repair	Minor repair	Not available	Available but non-functional	Not available	Available but non-functional	Not available
PHC	3	10	1	8	10	1	0	0	0	1	2
CHC	18	222	9	31	53	8	0	5	10	0	16
FRU	3	53	2	7	7	2	0	0	2	0	1
SDH	2	39	1	4	7	3	1	0	1	0	2
DH	6	334	3	14	18	7	0	0	2	0	3
MH	11	68	3	14	35	4	0	0	3	0	10
BPHC	8	68	2	9	25	2	1	2	2	1	5
MPHC	5	25	1	8	15	0	1	1	1	0	4
SD	3	7	1	5	12	1	1	1	0	0	2
SHC	1	3	0	0	3	0	0	0	1	0	1
Total Gaps		829	23	100	185	28	4	9	22	2	46

Cleaners required to ensure appropriate 24-h coverage.

Table 3 | Annual cost required for various domains

Various domains	Cost required (USD[a])	% of total cost
Human resource	12,81,384	93.3
Infrastructure	10,623	0.8
Cleaning supplies	64,024	4.7
IPC equipment	2,634	0.2
Bio-medical waste management	15,076	1.1
Total cost	13,73,741	

[a]INR 74.62 exchange rate used as dated on 25 August 2020.

was available but was not functional at the time of assessment. It was observed that the boiler was not available in more than one-third (22) of the facilities and chemical HLD was not available in most (46) of the facilities.

Estimated required cost

The estimated required cost for improving the WASH status in HCF varied facility to facility depending on the current status of WASH, the type of facility, services provided at that facility, and the number of departments available. The total annual cost to make all the selected facilities WASH compliant was USD 13,73,741; the majority being for posting required cleaners at HCFs (Table 3). In line with the gap identified, a major cost (USD 88,471 annually) would be required to make one DH WASH compliant, followed by the SDHs and FRUs. The least cost is required to improve one SD (Table 4). Of the total cost required, the majority (more than 95%) was required for the recurrent cost (Table 5). Minor upgrades should be taken first rather than major renovations, which require a considerable cost.

DISCUSSION

In this study, a shortage of cleaning staff, contractual cleaners who lack training (related to storage of cleaning materials and procedures for cleaning), poor WASH infrastructure, and less provision of supplies required for the cleaning procedure

Table 4 | Annual cost required to improve the WASH status of one facility (USD[a])

	Type of facility											
District	**PHC (3)**	**CHC (18)**	**FRU (3)**	**SDH (2)**	**DH (6)**	**MH (11)**	**BPHC (8)**	**MPHC (5)**	**SD (3)**	**SHC (1)**	**Total cost**	**Average cost**
Dhubri (12)	NA	99,125	NA	19,675	37,440	18,932	30,118	NA	NA	5,835	2,11,125	17,594
Dibrugarh (5)	NA	73,471	NA	NA	NA	NA	27,401	NA	NA	NA	1,00,871	20,174
Goalpara (10)	10,729	36,952	25,128	NA	1,65,094	51,518	39,400	7,680	NA	NA	3,36,500	33,650
Barpeta (11)	NA	48,098	26,179	43,573	87,575	10,558	17,614	4,057	4,218	NA	2,41,870	21,988
Baksa (9)	2,599	16,849	NA	NA	57,478	15,652	NA	27,670	6,510	NA	1,26,757	14,084
Udalguri (6)	NA	78,298	NA	NA	93,140	12,650	NA	NA	NA	NA	1,84,088	30,681
Darrang (7)	5,571	18,477	35,862	NA	90,100	12,881	NA	5,644	3,993	NA	1,72,529	24,647
Total Cost	18,899	3,71,269	87,168	63,247	5,30,826	1,22,191	1,14,533	45,051	14,721	5,835	13,73,741	22,896
Average Cost	6,300	20,626	29,056	31,624	88,471	11,108	14,317	9,010	4,907	5,835	22,896	

[a]INR 74.62 exchange rate used as dated on 25 August 2020.

Table 5 | Cost required to improve the WASH status of one facility (USD[a])

	Type of facility																					
	PHC (3)		CHC (18)		FRU (3)		SDH (2)		DH (6)		MH (11)		BPHC (8)		MPHC (5)		SD (3)		SHC (1)		Total required cost	
	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R	C	R
Dhubri (12)	NA	NA	1,126	97,999	NA	NA	338	19,337	198	37,242	385	18,548	426	29,692	NA	NA	NA	NA	117	5,718	2,589	2,08,535
Dibrugarh (5)	NA	NA	705	72,766	NA	NA	NA	NA	NA	NA	NA	NA	686	26,714	NA	NA	NA	NA	NA	NA	1,391	99,481
Goalpara (10)	374	10,355	174	36,778	309	24,818	NA	NA	260	1,64,834	590	50,928	320	39,080	125	7,556	NA	NA	NA	NA	2,153	3,34,348
Barpeta (11)	NA	NA	866	47,232	221	25,958	320	43,253	286	87,289	203	10,355	174	17,440	177	3,880	338	3,880	NA	NA	2,584	2,39,286
Baksa (9)	151	2,448	569	16,280	NA	NA	NA	NA	320	57,158	541	15,111	NA	NA	517	27,153	354	6,156	NA	NA	2,452	1,24,306
Udalguri (6)	NA	NA	424	77,874	NA	NA	NA	NA	224	92,916	192	12,458	NA	NA	NA	NA	NA	NA	NA	NA	840	1,83,248
Darrang (7)	146	5,426	333	18,144	224	35,638	NA	NA	159	89,942	104	12,777	NA	NA	218	5,426	146	3,848	NA	NA	1,329	1,71,200
Total Required Cost	671	18,229	4,196	367,073	754	86,414	658	62,590	1,446	5,29,380	2,015	1,20,176	1,607	1,12,926	1,037	44,014	837	13,884	117	5,718	13,337	13,60,403

C, capital cost; R, recurrent cost.

[a]INR 74.62 exchange rate used as dated on 25 August 2020.

emerged as the key gaps through our assessment. These gaps in the HCFs need to be addressed to improve the quality of services at HCFs.

Investment in WASH can prevent almost a tenth of the global burden of disease and help in reducing HAIs. Despite investment in improving the quality of healthcare institutions over time, systematic investment in WASH in HCFs is lacking.

Findings from our study highlight the urgent need to invest in human resources, especially the cleaners who play an essential role in maintaining cleanliness and hygiene. In most of the facilities, it was observed that cleaners were hired through a third party or on a contract basis and were provided with the less wages compared to permanent staff, which ultimately leads to a high staff turnover rate and more vacant positions. At the facility level, more efforts should be made to hire more staff and retain the existing staff by motivating them by appreciating their work and providing fixed wages. Interrupted water supply, non-availability and non-functionality of water points for hand washing in different departments, and the water points for staff in maternity wards and inpatient department (IPD) that were not located near the point of care emerged as a major concern in Assam. The quality of water was also poor, as validated by microbiological testing. Of the 117 samples, 68 (58%) samples were positive for fecal contamination, which may be due to unimproved water sources or the lack of sanitation facilities.

A study carried out by Water Aid in India reported that WASH facilities are not available in many facilities. Their functionality, accessibility, adequacy, and quality are often questionable even if available. Hence, for achieving national standards, WASH infrastructure, governance, monitoring, financing for updating WASH infrastructure, capacity building, and resources need attention (WaterAid 2019).

The study reported that the DHs would require a significant investment compared to other facilities. During the estimation of the required cost for WASH improvement and maintenance, the number of departments were also taken into consideration. Therefore, DHs require more considerable cost investment out of all other facility types due to the availability of more beds and the complexity of the provided services.

Our assessment further suggests that gaps vary by type of facility and individual requirements. Costs required at the facility level depended on the type of improvements made. Therefore, a separate untied fund within the existing RKS or patient welfare society at the healthcare facility must be provided to enhance the facility capacity to create a tailored plan of action.

Funding without delegation of authority in fund utilization, training on BMW management, and adequate cleaning of departments such as labor room and operating theater will have limited meaning. Thus, a proper system of regular capacity building, supportive supervision, monitoring and routine microbiological surveillance will go a long way in preventing HAIs and disease transmission during public health emergencies. Along with improving infrastructure and resources, the staff's capacity building (in terms of knowledge and skill) should also be focused on. Once improvement is made at the facility level, a robust mechanism for periodic supervision and monitoring needs to be established for maintenance.

In this study, we could not access minimum wages for Assam, and hence the rates of Gujarat were used as a proxy. However, minimum wages are standardized by the Ministry of Labour and Employment and do not vary widely across India.

One of the limitations of this study is that we have only included the cost of the color-coded bins for BMW management. As per the new BMW amendment of the Government of India, the BMW collection process has been streamlined; however, the management, including disposal, varies at the grass-root level. Thus, we have not accounted for the disposal patterns and cost for the disposal in this research.

CONCLUSION

Although maintaining WASH standards at the facility level is necessary for providing quality services and reducing mortality and HAIs, limited attention is given at the facility level. Investment towards WASH compliant HCF can aid in the prevention of HAIs and improving overall health. The four-step model used in this study can serve as grounds to understand the cost required for meeting the WASH standards at the facility level. This model also informs the need-based resource allocation, which may help facility managers make decisions in facilities with limited resources. This model can be used for any healthcare facility from primary to tertiary level across India as this study includes representative samples from all three major divisions of HCFs. The model can be adopted, and local costs can be estimated for more precise cost estimation. The cost required for the improvement varied based on the types of facilities. DHs would require significant investment, followed by the SDHs and FRUs. Least cost is required to improve SD. The majority of the costs are toward meeting minimum human resource norms and the other recurrent costs required. Thus, adequate provision of the recurrent cost is critical in

achieving WASH compliant facilities. Without that, it may not be easy to sustain the improvement at HCFs and achieve the envisaged health outcomes.

ACKNOWLEDGEMENTS

We wish to thank the National Health Mission, Assam office for their kind support and liasioning to the field activities. We are thankful to the research team of the Indian Institute of Public Health Gandhinagar (IIPHG) for their support during the field activities. We are also thankful to the medical officers and allied staffs for the recruited healthcare facilities to provide the information for this particular study. We are thankful to Dr. Sandul Yasobant, IIPHG for the language edits.

FUNDING STATEMENT

This study is made possible by the generous support of the United Nations Children's Fund (UNICEF), Assam. The staff of the funding agency critically reviewed the draft and offered comments to improve the paper.

DATA SHARING STATEMENT

All relevant data that support the findings of this study are within the manuscript. For further data requirements, please reach out to the corresponding author (ddeepak72@iiphg.org).

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethics approval for this study was obtained from the Indian Institute of Public Health Gandhinagar – Institutional Ethics Committee.

AUTHOR CONTRIBUTIONS

All authors contributed equally to the development of this study. All authors contributed to data analysis, drafting or revising the article, have agreed on the journal to which the article will be submitted, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work.

DISCLOSURE

The authors report no conflicts of interest in this work.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

REFERENCES

Anderson, D. M., Cronk, R., Best, L., Radin, M., Schram, H., Tracy, J. W. & Bartram, J. 2020 Budgeting for environmental health services in healthcare facilities: a ten-step model for planning and costing. *International Journal of Environmental Research and Public Health* **17** (6), 2075. https://doi.org/10.3390/ijerph17062075.

Bouzid, M., Cumming, O. & Hunter, P. R. 2018 What is the impact of water sanitation and hygiene in healthcare facilities on care seeking behaviour and patient satisfaction? A systematic review of the evidence from low-income and middle-income countries. *BMJ Global Health* **3** (3). https://doi.org/10.1136/bmjgh-2017-000648.

Chokshi, M., Patil, B., Khanna, R., Neogi, S. B., Sharma, J., Paul, V. K. & Zodpey, S. 2016 Health systems in India. *Journal of Perinatology* S9–S12. https://doi.org/10.1038/jp.2016.18.

Cronk, R. & Bartram, J. 2018 Environmental conditions in health care facilities in low- and middle-income countries: coverage and inequalities. *International Journal of Hygiene and Environmental Health* **221** (3), 409–422. https://doi.org/10.1016/j.ijheh.2018.01.004.

Government of Assam 2020 *Official State Portal of Assam*. Government of Assam. Available from: https://assam.gov.in/en/main/Districts#:~:text=The%20State%20of%20Assam%20is,divisions%20of%20the%20earlier%20districts (accessed 26 August 2020).

Health and Family Welfare, Assam 2020 *Health Indicators of Assam*. Health and Family Welfare Government of Asssam. Available from: https://hfw.assam.gov.in/frontimpotentdata/health-indicators-of-assam (accessed 20 January 2021).

MoFHW 2021 *Operational Guidelines for Improving Quality in Public Healthcare Facilities*. Available from: http://qi.nhsrcindia.org/sites/default/files/Operational%20Guidelines%20for%20Improving%20Quality_2021_0.pdf (accessed 26 August 2020).

MOHFW 2015 *National Guidelines for Clean Hospitals Kayakalp*. MOHFW, Government of India. Available from: https://main.mohfw.gov.in/sites/default/files/7660257301436254417_0.pdf. (accessed 28 March 2020).

MoHFW 2015 *Guidelines for Implimentation of 'Kayakalp' Initiative*. Available from: https://nhm.gov.in/images/pdf/in-focus/Implementation_Guidebook_for_Kayakalp.pdf (accessed 20 February 2021).

NHM 2015 *National Health Mission*. Ministry of Health & Family Welfare, Government of India. Available from: https://nhm.gov.in/ (accessed 24 November 2021).

NHM 2016 *Operational Guidelines Swachh Swasth Sarvatra*. Available from: https://nhm.gov.in/images/pdf/in-focus/swachh_swasth_sarvtra_09_02_2018.pdf (accessed 15 July 2020).

NITI Ayog 2018 *Government of India*. Available from: https://niti.gov.in/content/maternal-mortality-ratio-mmr-100000-live-births (accessed 26 August 2020).

Trivedi, P., Patel, K., Yasobant, S., Kalpana, P., Bhavsar, P., Raval, D. & Saxena, D. 2020 Visually clean is not necessarily microbiologically safe: learnings from WASH assessment of maternity units of Gujarat, India. *Journal of Family Medicine and Primary Care* 788–792. doi:10.4103/jfmpc.jfmpc_1066_19.

Tseng, K. K., Joshi, J., Shrivastava, S. & Klein, E. 2020 Estimating the cost of interventions to improve water, sanitation and hygiene in healthcare facilities across India. *BMJ Global Health*. http://dx.doi.org/10.1136/bmjgh-2020-003045

UNICEF 2019 *WASH in Healthcare Facilities 2019 UNICEF Scoping Study in Eastern and Southern Africa*. UNICEF, Eastern and Southren Africa. Available from: https://www.unicef.org/esa/media/4826/file/UNICEF-WASH-in-Health-Care-Facilities-2019.pdf (accessed 18 June 2020).

UNICEF, WHO & Water Aid 2015 *Water, Sanitation and Hygiene in Health Care Facilities in Asia and the Pacific, A Necessary Step to Achieving Universal Health Coverage and Improving Health Outcomes*. Available from: http://www.wateraid.org/what-we-do/our-approach/research-and-publications (accessed 26 August 2020).

UNW-DPAC, U. W. 2015 *Information Brief on Water and Health*. Available from: https://www.un.org/waterforlifedecade/pdf/04_2014_water_and_health_info_brief_eng.pdf. (accessed 19 June 2020).

WASH & CLEAN 2014 *WASH & CLEAN in the Labour Ward: A Situational Analysis in India & Bangladesh (2013–2015)*. Available from: https://www.lshtm.ac.uk/research/centres/march-centre/soapbox-collaborative/wash-clean (accessed 26 August 2020).

WaterAid 2018 *Water, Sanitation and Hygiene in Healthcare Facilities*. Available from: https://www.wateraidindia.in/sites/g/files/jkxoof336/files/water-sanitation-and-hygiene-in-health-care-facilities.pdf (accessed 16 July 2021).

WaterAid 2019 *'Doing the Maths':FInancing WASH in Healthcare Facilities in Ghana*. Water Aid. Available from: https://washmatters.wateraid.org/blog/doing-the-maths-financing-wash-in-health-care-facilities-in-ghana (accessed 19 June 2020).

WHO 2015 *Water Sanitation and Hygienein Healthcare Facilities-Status in low and Middle Income Countries and way Forward*. WHO. Available from: https://www.who.int/water_sanitation_health/publications/wash-health-care-facilities/en/#:~:text=Status%20in%20low-%20and%20middle-income%20countries%20and%20way%20forward&text=Drawing%20on%20data%20from%2054,water%20and%20soap%20for%20handwashing (accessed 16 August 2020).

WHO 2019 *WASH in Healthcare Facilities: Global Baseline Report*. Geneva, Switzerland. Available from: https://www.who.int/publications/i/item/9789241515504 (accessed 20 August 2020).

WHO 2020 *WASH in Healthcare Facilities*. World Health Organization. Available from: https://www.who.int/water_sanitation_health/facilities/healthcare/en/#:~:text=The%20term%20%E2%80%9CWASH%20in%20health,all%20parts%20of%20a%20facility (accessed 18 June 2020).

First received 19 July 2021; accepted in revised form 22 February 2022. Available online 14 March 2022