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Healthcare worker and family caregiver hand hygiene in Bangladeshi healthcare facilities: results from the Bangladesh National Hygiene Baseline Survey

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SUMMARY

Background—Healthcare facility hand hygiene impacts patient care, healthcare worker safety, and infection control, but low-income countries have few data to guide interventions.

Aim—To conduct a nationally representative survey of hand hygiene infrastructure and behaviour in Bangladeshi healthcare facilities to establish baseline data to aid policy.

Methods—The 2013 Bangladesh National Hygiene Baseline Survey examined water, sanitation, and hand hygiene across households, schools, restaurants and food vendors, traditional birth attendants, and healthcare facilities. We used probability proportional to size sampling to select 100 rural and urban population clusters, and then surveyed hand hygiene infrastructure in 875 inpatient healthcare facilities, observing behaviour in 100 facilities.

Findings—More than 96% of facilities had ‘improved’ water sources, but environmental contamination occurred frequently around water sources. Soap was available at 78–92% of handwashing locations for doctors and nurses, but just 4–30% for patients and family. Only 2% of 4676 hand hygiene opportunities resulted in recommended actions: using alcohol sanitizer or washing both hands with soap, then drying by air or clean cloth. Healthcare workers performed recommended hand hygiene in 9% of 919 opportunities: more after patient contact (26%) than before (11%). Family caregivers frequently washed hands with only water (48% of 2751 opportunities), but with little soap (3%).

Conclusion—Healthcare workers had more access to hand hygiene materials and performed better hand hygiene than family, but still had low adherence. Increasing hand hygiene materials and behaviour could improve infection control in Bangladeshi health-care facilities.

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Conflict of interest statement

None declared.

Keywords

Hand hygiene; Healthcare facility; Healthcare worker; Family caregiver; Bangladesh

Introduction

Healthcare facility hand hygiene impacts patient care, infection control, and safety of patients, healthcare workers (HCWs), and communities.^{1,2} High-income countries have evidence-based infection control guidelines, but many low–mid income countries (LMICs) lack rigorous data to aid policy.³ A World Health Organization (WHO) report found that 38% of 66,101 healthcare facilities in 54 LMICs lacked rudimentary water, sanitation, and hygiene resources.³ Moreover, LMICs have healthcare-associated infection rates (HCAIs) three times higher than high-income countries: 15.5 versus 4.5 per 100 patients.² WHO recommends a five-component hand hygiene improvement strategy encompassing infrastructure, training, monitoring, reminders, and institutional culture.¹ Experimental studies demonstrated this strategy's feasibility in Costa Rica, Pakistan, Saudi Arabia, Italy, and Mali.^{4,5} The Mali study was the first successful WHO hand hygiene strategy implementation in a low-income country and showed a trend towards fewer HCAIs: 18.7 per 100 patients pre intervention versus 15.3 post intervention, although not statistically significant.⁵ HCW hand hygiene, however, was low: 8% pre intervention and 22% post intervention [odds ratio (OR): 2.40; 95% confidence interval (CI): 1.62–3.55], and the study was funded externally.⁵ By contrast, interventions in wealthier Costa Rica, Pakistan, Saudi Arabia, and Italy had higher hand hygiene: 38–55% pre intervention and 59–69% post intervention.⁴ LMICs have fewer resources and more HCAIs than high-income settings. Moreover, LMICs have to achieve even larger changes to reach global patient care standards.

Bangladesh is an important study country because high population density, emerging diseases, and poor infection control contribute to vulnerability to pandemics.^{6,7} Qualitative studies found that hospital wards were often contaminated with live animals and human excrement, cleansing materials were rarely available, family provided most patient care, and handwashing with soap occurred in 1% of hand hygiene opportunities.^{7,8} In national facility surveys, the only hand hygiene measures were presence of water, soap, or alcohol sanitizer.⁹ Our Bangladesh National Hygiene Baseline Survey explored hand hygiene across a nationally representative sample of schools, households, food vendors and restaurants, traditional birth attendants, and healthcare facilities. In healthcare facilities, we examined hand hygiene infrastructure and observed HCW, patient, and family behaviour pertaining to patient care, food, and general hand hygiene.

Methods

Two-stage stratified cluster sampling was used to select a nationally representative sample of population clusters.¹⁰ Bangladesh was divided into rural and urban strata and probability proportional to size sampling was then used to randomly select 50 out of 86,925 rural villages from the 2011 Bangladesh Census and 50 out of 10,552 urban sub-wards from the 2006 Urban Health Survey.^{11,12} It was calculated that 864 facilities were required to detect a

10% difference between rural and urban availability of soap and water at handwashing locations, assuming 50% prevalence in rural facilities, 80% power, 0.05 alpha, design effect 5, and intra-cluster correlation coefficient 0.45. A total of 875 healthcare facilities were sampled, nine from 75 clusters and eight from 25 clusters, including facilities with overnight services and at least one inpatient on survey day. Field researchers conducted infrastructure spot checks and interviews with doctors, nurses, ward attendants, patients, and family about hand hygiene. One facility was chosen closest to each cluster's geographic centre for structured hand hygiene behaviour observations of HCWs, patients, and family caregivers for 5 h on inpatient paediatric wards or, if paediatric wards were unavailable, adult female wards. Paediatric wards were chosen first because our overall Bangladesh National Hygiene Baseline Survey focused on child caregiver hand hygiene and its direct impacts on child health. Healthcare facilities without dedicated paediatric wards usually admitted sick children to adult female wards. Data were collected July–October 2013.

Medians and interquartile ranges were calculated for skewed variables of number of beds and daily admissions. For water, sanitation, and hygiene indicators, percentages and prevalence ratios (PRs) with 95% CIs using Poisson regression were calculated, adjusting for geographic cluster and weighting for the proportion of government versus independent, private, and non-governmental organization (NGO) facilities in our sample versus national estimates. We defined 'improved' water source per the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation: 'by the nature of its construction and when properly used, adequately protects the source from outside contamination, particularly faecal matter' and included piped, public tap, standpipe, tube well, borehole, protected dug well, protected spring, or collected rain-water.¹³ We compared rural versus urban facilities and available resources across HCWs, patients, and family. Hand hygiene actions were classified as using water only, soap, alcohol sanitizer, and/or 'recommended' hand hygiene defined as using sanitizer or washing both hands with soap, then drying by air or with clean cloth.¹ We calculated hand hygiene PRs using generalized estimating equations, adjusting for multiple observations per facility and weighting for the proportion of government versus independent, private, and NGO facilities in our sample versus national estimates. We analysed behaviour across facility types, persons observed, and actions surrounding patient care, food, and general hygiene.

The International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b) Ethical Review Committee approved our protocol. Written informed consent was obtained from administrators, HCWs, patients, and family.

Results

A total of 875 healthcare facilities were surveyed: 443 in urban and 432 in rural clusters (Table I). Most frequently occurring types were sub-district (66% of government) and small private hospitals (94% of independent, private, and NGO). Our sample included 136 government and 739 independent, private, and NGO facilities out of 593 government and 2983 private and NGO facilities registered nationally in 2013.¹⁴ Among interview respondents, 11% of doctors, 97% of nurses, and 63–73% of ward attendants, patients, and family were female.

More than 96% of facilities had improved water sources based on the WHO/UNICEF JMP definition (Table II). Sources were located inside in 64% of government and 81–90% of independent, private, and NGO facilities. Environmental contamination was frequent around improved sources, but contamination varied more by facility characteristics than specific type of water source (Supplementary Table I). Paper/food waste was seen around 51–76% of government and 30–38% of independent, private, and NGO sources. Human/animal faeces were seen around 2–6% of government and 1–4% of independent, private, and NGO sources. Rural government sources had the most contamination: 76% paper/food waste and 6% faeces. Handwashing locations had water (96–99%), but variable hand hygiene materials. In most hospitals, doctors have private offices which include private handwashing stations and toilets; nurses have nurse stations or rooms with handwashing stations and toilets separate from patient wards.⁷ Ward attendants, cleaners, and other staff sometimes have separate facilities or use the same facilities as patients, family, and visitors.⁷ Any materials were available at 87–96% of handwashing locations for doctors, 94–99% for nurses, and 75–90% for ward attendants, but just 4–30% for patients/family. Bar soap was the most usual material for everyone. By contrast, alcohol sanitizer was available at 32–39% of hand-washing locations for doctors, 39–51% for nurses, 18–24% for ward attendants, but only 0–1% for patients/family. Government facilities had fewer materials, especially for patients/family: 4% in government versus 27–30% in independent, private, and NGO facilities.

A total of 5071 hand hygiene opportunities were observed in 100 facilities. Gloves were used in 1% of opportunities, but hand hygiene before putting gloves on and after removing gloves was incompletely examined and therefore excluded. Of 4676 complete observations, 41% used only water, 4% soap, 1% alcohol sanitizer, and 2% recommended hand hygiene (Table III). Independent, private, and NGO facilities had higher soap use than government facilities (7% versus 2%; PR: 2.81; 95% CI: 1.64–4.81). Family caregivers often washed hands with only water (48% of 2751 opportunities), but rarely used soap (3%), alcohol sanitizer (0%), or recommended hand hygiene (1%). By contrast, HCWs infrequently washed hands with only water (10% of 919 opportunities) and seldom used soap (7%), alcohol sanitizer (6%), or recommended hand hygiene (9%; PR: 10.22; 95% CI: 4.87–21.44). Female HCWs washed hands with only water more than male HCWs (11% vs 6%), but female HCWs performed less recommended hand hygiene than male HCWs (8% vs 12%). Nurses had the most opportunities (49%), but infrequently performed recommended hand hygiene (11% of 452 opportunities). Laboratory technicians had the highest recommended hand hygiene (22% of 98 opportunities). Alcohol sanitizer was used in 65% of HCWs' recommended hand hygiene actions ($N = 80$).

Hand hygiene was categorized by WHO's 'five moments for hand hygiene' – before touching patients, before clean/aseptic procedures, after body fluid exposure risk, after touching patients, and after touching patient surroundings – and by key times around food and general hygiene (Table IV).¹ HCWs had more patient care hand hygiene opportunities than family (55% versus 33% of 1383 opportunities), except that HCWs handled body fluids much less than family (8% versus 67% of 636 opportunities). HCWs performed recommended hand hygiene more after touching patients (26%) or body fluids (13%) than before touching patients (11%) or clean/aseptic procedures (8%). Overall, family had more

hand hygiene opportunities (59% of 4676 complete observations) than HCWs (20%). After touching others' faeces, family often washed hands with only water (36% of 234 opportunities) or soap (24%), but rarely performed recommended hand hygiene (3%). Only 1% of family considered hand hygiene important before a clean/aseptic procedure. Concerning food and general hygiene, more opportunities involved family (70% of 3293 opportunities) than HCWs (5%). Family washed hands often with water after eating/feeding others (87% of 565 opportunities), but rarely used soap (1%) and never recommended hand hygiene.

Of the total 4676 observations, 921 were from district, maternal child welfare, and specialized healthcare facilities with resources for dedicated paediatric wards (Supplementary Tables II and III). Overall, recommended hand hygiene was similarly low on paediatric and adult female wards, 2%. Before clean/aseptic procedures, recommended hand hygiene was higher on paediatric wards (15% of 66 opportunities) than on adult female wards (6% of 317 opportunities). Conversely, after body fluid exposure risk, soap use and recommended hand hygiene were lower on paediatric wards (10% soap and 0% recommended out of 107 opportunities) than on adult female wards (14% soap and 3% recommended out of 529 opportunities).

Discussion

One reason widely touted for poor LMIC infection control is lack of resources, but we found that resources were available although not well-maintained in Bangladeshi healthcare facilities. We found improved water sources in almost all facilities and soap at >80% of healthcare workers' handwashing stations, similar to 70% in another national survey.⁹ On the other hand, we found few hand hygiene materials for patients and family, poor environmental hygiene, and worse conditions in government facilities. Contamination in the form of visible paper, food, and faeces surrounding water sources defined as 'improved' by global metrics highlights the importance of careful examination of actual conditions and interpretation of what constitutes safe or adequate water for hygiene.¹⁵ Better resource management may improve use of existing infrastructure.

Another frequent explanation for poor infection control in LMICs is lack of knowledge, but we found that behaviour reflects differences in motivation and priorities. We found that knowledge was higher than observed behaviour – similar to other studies.^{1,5} We observed HCWs performing more hand hygiene after patient contact than before, a frequent pattern regardless of resources.^{1,4} Individual, group, and institutional factors influence behaviour.^{1,16,17} One theory to explain individual behaviour divides behaviours into 'inherent' versus 'elective': 'inherent' ones are instilled at a young age to instinctively respond with disgust to visible/perceived dirt, whereas 'elective' ones are learned later to conform to occupational standards.¹⁷ Individual factors also include gender, education, and position: being male, having lower education, and being a doctor are associated with poor hand hygiene.^{1,16} The gender distribution in our study was similar to another national survey in Bangladesh which found 23% of 2715 physicians were female, 19% of 1987 consultants were female, 94% of 6167 nurses were female, and 46% of 2070 cleaners were female.¹⁸ Isolating the effect of gender on hand hygiene, however, is difficult because of the

multitude of other factors involved. Group factors include peer behaviours, understaffing, duration of patient contact, and workload; institutional factors include infrastructure, monitoring, and leadership.^{16,17} Group and institutional factors shape elective behaviours. Laboratory technicians, for example, could have better hand hygiene due to peer pressure or monitoring. In addition, patient cohort can influence hand hygiene. We found that hand hygiene on paediatric wards before patient contact was higher than after body fluid exposure risk, which is the opposite behaviour observed on adult female wards. Studies show that paediatric patients are often regarded as ‘clean’, unlikely to transmit infectious diseases, and thus not needing the same infection control or hand hygiene practices as adult patients.^{1,19} Understanding how group and institutional factors modify behaviour would enable more targeted interventions.

Workload and convenience influence hand hygiene prioritization, and alcohol sanitizer could be promoted because of convenience.¹ In Bangladesh and other Muslim countries with alcohol prohibition, presence of alcohol has not been a barrier to using sanitizer.¹ We found HCWs using sanitizer more than soap, but sanitizer was not always available. Alcohol is costly in Bangladesh because of heavy taxes; therefore reducing taxes or using non-alcohol alternatives such as chlorhexidine could increase sanitizer availability. Increasing supply could contribute to more use, but adding hand hygiene infrastructure does not necessarily change behaviour.²⁰

Exclusively focusing on HCWs in LMICs overlooks family caregivers who provide most patient care and generate most hand hygiene opportunities.^{8,21} We found that family caregivers usually washed hands with only water, but water alone removes fewer pathogens than soap and alcohol; and washing hands with water alone is less effective in preventing diarrhoea than washing hands with soap.^{1,22,23} Family caregiver hand hygiene in healthcare facilities is similar to that in the community: one study in rural Bangladesh observed 13,026 hand-washing opportunities of which 48% resulted in no handwashing, 50% water alone, 1% ash/soil, and 2% soap.²⁴ Reasons for family caregivers washing hands with only water in healthcare facilities likely include: lack of soap availability, community practices of handwashing, common attitudes that soap is expensive and should be limited for high priority use, and perceptions that soap is needed only for visible dirt or contact with faeces.^{24,25} Burden of infections spread by family is difficult to calculate: family members have no infection control training and may be more likely to transmit infections, but they usually care for a single patient and are less likely to contact several patients compared to HCWs. One Bangladeshi study with families of patients with shigellosis found that increasing family handwashing with soap after defecation and before meals decreased secondary shigellosis rates from 32% in control to 10% in intervention families.²⁶ Moreover, caregivers in the Ebola epidemic with no formal medical training maintained infection control in community care centers and decreased Ebola transmission.²⁷ Improving family hand hygiene can improve patient care and infection control.

Changing healthcare hand hygiene in Bangladesh requires committed leadership. A recent meta-analysis of 41 hand hygiene intervention trials found that the greatest change resulted from WHO five-component intervention plus additional goal setting, incentives, and/or accountability (OR: 11.8; 95% CI: 2.7–53.8).²⁸ Many LMICs including Bangladesh are

weak states, plagued by inefficiencies and corruption.²⁹ Anti-corruption interventions such as tracking HCW absences or charging official fees have often failed, but successful programmes involved staff participation, effective supervision, committed stakeholders, and accountability.²⁹ In 2014, only 14% of Bangladeshi hospitals had quality assurance programmes and 24% had infection control guidelines.⁹ In 2007, the Bangladesh government and WHO created a hand hygiene intervention in Chittagong Medical College Hospital including an infection control committee, staff training, two tube wells, one sink per 15 beds, and alcohol sanitizer promotion.¹ HCW hand hygiene increased from 0% to 65%, but the programme was not sustained.¹ Future interventions should consider accountability and sustainability.

Study limitations relate to sampling and hand hygiene measurement. Geographic sampling resulted in selecting mostly small private hospitals. We did not study many large government facilities in which pandemics would be most difficult to control, thus our findings might underestimate infection control risk across Bangladesh. We did not investigate handwashing station placement relative to beds and could not infer much about access and convenience. Regarding measurement, HCWs often examined patients consecutively and observers may have missed hand hygiene between patients and recorded more ‘after patient contact’ opportunities. However, the pattern we observed of more hand hygiene after patient contact than before has been shown in other studies.^{1,4} We did not observe HCWs inside private offices, resulting in more incomplete observations of HCWs (15%) than patients/family (7%) which could underestimate HCW behaviour. All observation studies are limited by the Hawthorne effect where desired behaviour increases under observation.¹ Our findings thus probably overestimate actual behaviour. Ultimately, our hand hygiene rate of <10% is comparable to other LMIC studies.^{2,4}

Hand hygiene is critical to preventing HCAs and controlling pandemics, and Bangladesh is unprepared in this regard. Reliable measurements are crucial to designing and monitoring practical interventions.³ Our nationally representative survey adds key insights by characterizing hand hygiene infrastructure and behaviour in 875 healthcare facilities. We found that water and soap were available but unevenly distributed, that family performed most patient care but with poor hand hygiene knowledge and behaviour, that HCWs had better knowledge but poor corresponding behaviour, and that HCWs preferred sanitizer over soap. Our findings suggest that simply increasing infrastructure or knowledge will have little impact on behaviour. Research exploring impacts of family caregiver versus HCW hand hygiene and comparing soap versus sanitizer will be useful for future interventions. Improving hand hygiene in Bangladeshi healthcare facilities will necessitate an integrated approach of improving resource management and changing behaviour.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.jhin.2016.08.016>.

Table 1
 Characteristics of healthcare facilities with surveys, spot checks, and structured observations

Healthcare facilities	Total	Urban	Rural	No. of beds Median (Q1–Q3)	No. of daily admissions Median (Q1–Q3)
Facilities with surveys and spot checks	875	443	432	20 (12–32)	8 (4–19)
Government facilities	136	47	89	49 (31–57)	33 (18–52)
Medical college/specialized	3	3	0	86 (16–123)	18 (2–90)
Maternal child welfare	15	8	7	20 (16–26)	6 (4–10)
District	26	12	14	108 (100–138)	133 (96–172)
Sub-district	90	23	67	43 (31–50)	30 (19–40)
Union sub-centres	2	1	1	15 (10–19)	3 (1–5)
Independent, private, and NGO facilities	739	396	343	17 (11–27)	7 (3–13)
Medical college/specialized	7	5	2	350 (111–586)	107 (66–239)
Private	698	367	331	17 (11–26)	7 (3–13)
NGO	34	24	10	14 (10–20)	5 (3–9)
Facilities with structured observations	100	50	50	41 (28–58)	28 (10–44)
Government facilities	53	16	37	50 (31–58)	38 (25–66)
Medical college/specialized	0	–	–	–	–
Maternal child welfare	1	1	0	173–	146–
District	12	6	6	132 (100–151)	138 (94–185)
Sub-district	40	9	31	43 (31–50)	30 (20–41)
Union sub-centres	0	–	–	–	–
Independent, private, and NGO facilities	47	34	13	28 (12–57)	13 (6–33)
Medical college/specialized	2	1	1	61 (11–111)	55 (2–107)
Private	40	29	11	30 (13–60)	17 (7–36)
NGO	5	4	1	16 (11–22)	7 (5–8)

Q1–Q3, first quartile to third quartile; NGO, non-governmental organization.

Table II

Healthcare facility hand hygiene infrastructure from surveys and spot checks

Healthcare facility hand hygiene infrastructure	Total		Urban		Rural		PR ^a	95% CI ^a
	N = 875	%	N = 443	%	N = 432	%		
Government facilities								
N = 136								
N = 89								
General water sources:								
No water source	0	0	0	0	0	0	–	–
Improved water source ^b	132	97	47	100	85	96	1.05	(1.00, 1.10)
Water source located inside	87	64	30	64	57	64	1.00	(0.79, 1.25)
No drain, broken drain, or soak pit	45	33	9	19	36	40	0.47	(0.26, 0.86)
Visible paper or food waste	92	68	24	51	68	76	0.67	(0.48, 0.94)
Visible animal or human faeces	6	4	1	2	5	6	0.38	(0.04, 3.27)
Hand hygiene materials:								
For doctors:								
Any hand hygiene materials	122	90	45	96	77	87	1.11	(0.98, 1.24)
Any bar soap	111	82	42	89	69	78	1.15	(0.99, 1.34)
Any liquid soap	34	25	14	30	20	22	1.33	(0.69, 2.55)
Any powder/detergent	10	7	4	9	6	7	1.26	(0.37, 4.26)
Any alcohol hand sanitizer	45	33	15	32	30	34	0.95	(0.54, 1.65)
For nurses:								
Any hand hygiene materials	133	98	45	96	88	99	0.97	(0.91, 1.03)
Any bar soap	118	87	40	85	78	88	0.97	(0.83, 1.13)
Any liquid soap	26	19	7	15	19	21	0.70	(0.30, 1.66)
Any powder/detergent	18	13	5	11	13	15	0.73	(0.30, 1.76)
Any alcohol hand sanitizer	59	43	23	51	35	39	1.30	(0.85, 1.97)
For ward attendants:								
Any hand hygiene materials	102	75	34	76	68	76	0.95	(0.76, 1.18)
Any bar soap	93	68	29	62	64	72	0.86	(0.65, 1.13)
Any liquid soap	16	12	4	9	12	13	0.63	(0.23, 1.74)
Any powder/detergent	24	18	8	17	16	18	0.95	(0.45, 1.98)
Any alcohol hand sanitizer	25	18	9	19	16	18	1.07	(0.55, 2.07)

Healthcare facility hand hygiene infrastructure	Total		Urban		Rural		PR ^a	95% CI ^a
	N = 875	%	N = 443	%	N = 432	%		
For patients/family caregivers:								
Any hand hygiene materials	6	4	2	4	4	4	0.95	(0.21, 4.24)
Any bar soap	6	4	2	4	4	4	0.95	(0.21, 4.24)
Any liquid soap	1	1	0	0	1	1	-	-
Any powder/detergent	1	1	1	2	0	0	-	-
Any alcohol hand sanitizer	0	0	0	0	0	0	-	-
Independent, private, and NGO facilities	N = 739		N = 396		N = 343			
General water sources:								
No water source	2	0	0	0	2	1	-	-
Improved water source ^b	722	98	387	98	335	98	1.00	(0.97, 1.03)
Water source located inside	634	86	356	90	278	81	1.11	(1.03, 1.19)
No drain, broken drain, or soak pit	196	27	102	26	94	27	0.94	(0.64, 1.37)
Visible paper or food waste	247	33	117	30	130	38	0.78	(0.61, 1.00)
Visible animal or human faeces	18	2	5	1	13	4	0.33	(0.10, 1.07)
Hand hygiene materials:								
For doctors:								
Any hand hygiene materials	706	96	382	96	324	94	1.02	(0.99, 1.06)
Any bar soap	647	88	353	89	294	86	1.04	(0.98, 1.10)
Any liquid soap	233	32	125	32	108	31	1.00	(0.81, 1.24)
Any powder/detergent	101	14	55	14	46	13	1.04	(0.68, 1.58)
Any alcohol hand sanitizer	285	39	150	38	135	39	0.96	(0.79, 1.17)
For nurses:								
Any hand hygiene materials	705	95	372	94	333	97	0.97	(0.94, 1.00)
Any bar soap	671	91	356	90	315	92	0.98	(0.94, 1.02)
Any liquid soap	172	23	91	23	81	24	0.97	(0.74, 1.27)
Any powder/detergent	126	17	63	16	63	18	0.87	(0.59, 1.28)
Any alcohol hand sanitizer	363	49	194	49	169	49	0.99	(0.84, 1.18)
For ward attendants:								
Any hand hygiene materials	649	88	342	86	307	90	0.96	(0.90, 1.03)
Any bar soap	626	85	327	83	299	87	0.95	(0.88, 1.02)

Healthcare facility hand hygiene infrastructure	Total		Urban		Rural		PR ^a	95% CI ^a
	N = 875	%	N = 443	%	N = 432	%		
Any liquid soap	83	11	45	11	38	11	1.03	(0.67, 1.58)
Any powder/detergent	240	32	125	32	115	34	0.94	(0.73, 1.22)
Any alcohol hand sanitizer	158	21	74	19	84	24	0.76	(0.57, 1.03)
For patients/family caregivers:								
Any hand hygiene materials	212	29	119	30	93	27	1.11	(0.85, 1.45)
Any bar soap	207	28	117	30	90	26	1.13	(0.86, 1.48)
Any liquid soap	10	1	8	2	2	1	3.46	(0.77, 15.67)
Any powder/detergent	14	2	7	2	7	2	0.87	(0.33, 2.28)
Any alcohol hand sanitizer	9	1	5	1	4	1	1.08	(0.31, 3.79)

PR, prevalence ratio; CI, confidence interval.

^aPoisson regression model was used to compare urban versus rural facilities.

^bWHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation definition for 'improved sources' includes: piped water into dwelling or yard/plot, public tap or standpipe, tube well or borehole, protected dug well, protected spring, rainwater.¹³

Table III

Hand hygiene behaviour on inpatient paediatric or adult female wards from structured observations in 100 facilities

	Handwashing with water only		Handwashing with any soap		Alcohol hand sanitizer		Recommended hand hygiene ^d	
	n/N	%	n/N	%	n/N	%	n/N	%
Total hand hygiene actions observed	1921/4676	41	174/4676	4	56/4676	1	100/4676	2
Urban facilities	918/2283	40	121/2283	5	41/2283	2	68/2283	3
Rural facilities	1003/2393	42	53/2393	2 ^c	15/2393	1	32/2393	1
Government facilities	1278/2890	44	56/2890	2	16/2890	1	34/2890	1
Medical college/specialized	0	-	0	-	0	-	0	-
Maternal child welfare	9/25	36	0/25	0	0/25	0	0/25	0
District	373/780	48 ^b	16/780	2	12/780	2	15/780	2
Sub-district	896/2085	43 ^b	40/2085	2	4/2085	0 ^c	19/2085	1
Independent, private, and NGO facilities	643/1786	36 ^c	118/1786	7 ^c	40/1786	2	66/1786	4 ^b
Medical college/specialized	58/116	50 ^c	4/116	3	0/116	0	0/25	0
Private	532/1500	35	92/1500	6 ^c	40/1500	3	62/1500	4
NGO	53/170	31	22/170	13 ^c	0/170	0	4/170	2
All persons observed								
Female	1680/3950	43	157/3950	4	41/3950	1	76/3950	2
Male	241/726	33 ^c	17/726	2	15/726	2	24/726	3
Patients	509/1006	51 ^c	14/1006	1 ^c	0/1006	0	4/1006	0 ^c
Female	479/900	53	14/900	2	0/900	0	4/900	0
Male	30/106	28 ^c	0/106	0	0/106	0	0/106	0
Family caregivers	1323/2751	48 ^c	93/2751	3	4/2751	0 ^c	16/2751	1 ^c
Female	1124/2337	48	90/2337	4	4/2337	0	16/2337	1
Male	199/414	48	3/414	1 ^c	0/414	0	0/414	0
Healthcare workers	89/919	10 ^c	67/919	7 ^c	52/919	6 ^c	80/919	9 ^c
Female	77/713	11	53/713	7	37/713	5	56/713	8
Male	12/206	6	14/206	7	15/206	7	24/206	12

	Handwashing with water only		Handwashing with any soap		Alcohol hand sanitizer		Recommended hand hygiene ^d	
	n/N	%	n/N	%	n/N	%	n/N	%
Doctors	0/96	0	4/96	4 ^{ref}	6/96	6 ^{ref}	7/96	7 ^{ref}
Nurses	12/452	3 ^{ref}	29/452	6	30/452	7	48/452	11
Lab technicians	5/98	5	8/98	8	14/98	14	22/98	22 ^b
Ward attendants	14/100	14 ^c	7/100	7	2/100	2	3/100	3
Cleaners	58/173	34 ^c	19/173	11	0/173	0	0/173	0

^{ref}Reference value.

^aRecommended hand hygiene was defined as: (1) using alcohol hand sanitizer, (2) washing both hands with soap then air drying, or (3) washing both hands with soap, then drying with a clean cloth.

^bP < 0.05 and

^cP < 0.01 were calculated with generalized estimating equations.

Table IV

Hand hygiene behaviour regarding World Health Organization (WHO) ‘five moments’ and other key times from structured observations

Hand hygiene actions out of observed opportunities	Handwashing with water only		Handwashing with any soap		Recommended hand hygiene ^d	
	n/N	%	n/N	%	n/N	%
Total hand hygiene actions observed	1921/4676	41	174/4676	4	100/4676	2
WHO ‘five moments for hand hygiene’						
1. Before touching patients						
Healthcare workers	0/132	0	3/132	2	14/132	11
Patients	0/129	0	3/129	2	14/129	11
Family caregivers	0	–	0	–	0	–
2. Before clean/aseptic procedures						
Healthcare workers	4/383	1 ^c	9/383	2	30/383	8 ^b
Patients	4/378	1 ^c	8/378	2 ^b	30/378	8
Family caregivers	0/3	0	1/3	33 ^c	0/3	0
3. After body fluid exposure risk (blood, vomit, urine, faeces)						
Healthcare workers	0/2	0	0/2	0	0/2	0
Patients	290/636	46	85/636	13 ^c	18/636	3
Family caregivers	16/53	30 ^c	10/53	19	7/53	13
4. After defecation (self)						
Healthcare workers	90/159	57	7/159	4 ^b	2/159	1
Patients	184/424	43	68/424	16 ^c	9/424	2
Family caregivers	108/209	52	9/209	4	2/209	1
5. After defecation (others)						
Healthcare workers	6/13	46 ^c	1/13	8	0/13	0
Patients	48/97	49	3/97	3	1/97	1
Family caregivers	54/99	55	5/99	5	1/99	1
6. After exposure to faeces (others)						
Healthcare workers	59/71	83 ^c	10/71	14 ^c	1/71	1
Patients	0/1	0	1/1	100 ^c	0/1	0
Family caregivers	34/39	87 ^c	3/39	8 ^c	1/39	3
7. After exposure to faeces (self)						
Healthcare workers	25/31	81 ^c	6/31	19 ^c	0/31	0
Patients	91/251	36	58/251	23 ^c	7/251	3
Family caregivers	4/7	57 ^c	2/7	29	0/7	0

Hand hygiene actions out of observed opportunities	Handwashing with water only		Handwashing with any soap		Recommended hand hygiene ^d	
	n/N	%	n/N	%	n/N	%
Patients	3/10	30	1/10	10	0/10	0
Family caregivers	84/234	36 ^c	55/234	24 ^c	7/234	3 ^b
4. After touching patients or wounds	5/105	5 ^c	18/105	17 ^c	26/105	25 ^c
Healthcare workers	4/101	4	18/101	18 ^b	26/101	26 ^c
Patients	0	–	0	–	0	–
Family caregivers	1/4	25	0/4	0	0/4	0
5. After touching patient surroundings (clothes, bed, floors)	27/127	21 ^c	11/127	9	2/127	2
Healthcare workers	24/98	24 ^c	11/98	11	2/98	2
Patients	0/5	0	0/5	0	0/5	0
Family caregivers	3/24	13 ^b	0/24	0	0/24	0
Other key handwashing moments						
6. Before preparing/serving food or water	189/596	32	4/596	1 ^b	0/596	0
Healthcare workers	4/23	17	1/23	4	0/23	0
Patients	24/79	30	0/79	0	0/79	0
Family caregivers	161/494	33 ^c	3/494	1	0/494	0
7. Before food or medicine (self and others)	629/1673	38 ^b	10/1673	1 ^c	5/1673	0 ^b
Healthcare workers	5/61	8	4/61	7	1/61	2
Patients	184/496	37 ^c	1/496	0 ^b	0/496	0
Family caregivers	440/1116	39 ^c	5/1116	0 ^c	4/1116	0
8. After food or medicine (self and others)	707/827	85 ^c	14/827	2	4/827	0
Healthcare workers	9/15	60 ^c	3/15	20	0/15	0
Patients	208/247	84 ^c	3/247	1	2/247	1
Family caregivers	490/565	87 ^c	8/565	1	2/565	0
9. After sneezing/coughing (self and others)	1/64	2 ^b	2/64	3	0/64	0
Healthcare workers	0	–	0	–	0	–
Patients	0/13	0	1/13	8 ^c	0/13	0

Hand hygiene actions out of observed opportunities	Handwashing with water only		Handwashing with any soap		Recommended hand hygiene ^d	
	n/N	%	n/N	%	n/N	%
Family caregivers	1/51	2 ^b	1/51	2	0/51	0
10. After general cleaning (dishes, drums, pots, bins)	69/133	52	18/133	14 ^c	1/133	1 ^c
Healthcare workers	23/61	38 ^c	9/61	15 ^b	0/61	0
Patients	3/4	75	1/4	25 ^c	0/4	0
Family caregivers	43/68	63	8/68	12 ^b	1/68	1

^aRecommended hand hygiene was defined as: (1) using alcohol hand sanitizer, (2) washing both hands with soap then air drying, or (3) washing both hands with soap, then drying with a clean cloth.

^b $P < 0.05$ and

^c $P < 0.01$ were calculated with generalized estimating equations.