

Emerging Problems in Infectious Diseases

Hand hygiene practices and perceptions among healthcare workers in Ghana: A WASH intervention study

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Abstract

Introduction: We aimed to investigate whether the provision of water, sanitation, and hand hygiene (WASH) interventions were associated with changes in hand hygiene compliance and perceptions of healthcare workers towards infection control.

Methodology: The study was conducted from June 2017 through February 2018 among healthcare workers in two Northern districts of Ghana. Using a pretest-posttest design, we performed hand hygiene observations and perception surveys at baseline (before the start of WASH interventions) and post-intervention (midline and endline). We assessed adherence to hand hygiene practice using the WHO direct observation tool. The perception study was conducted using the WHO perception survey for healthcare workers. Study outcomes were compared between baseline, midline and endline assessments.

Results: The hand hygiene compliance significantly improved from 28.8% at baseline through 51.7% at midline (n = 726/1404; 95% CI: 49.1-54.2%) to 67.9% at endline (n = 1000/1471; 95% CI: 65.6-70.3%). The highest increase in compliance was to the WHO hand hygiene moment 5 after touching patients surrounding (relative increase, 205%; relative rate, 3.05; 95% CI: 2.23-4.04; p < 0.0001). Post-intervention, the top three policies deemed most effective at improving hand hygiene practice were: provision of water source (rated mean score, n = 6.1 ± 1.4), participation in educational activities (rated mean score 6.0 ± 1.5); and hand hygiene promotional campaign (6.0 ± 1.3).

Conclusion: Hand hygiene compliance significantly improved post-intervention. Sustaining good hand hygiene practices in low resource settings should include education, the provision of essential supplies, and regular hand hygiene audits and feedback.

Key words: hand hygiene; infection control; perception survey.

J Infect Dev Ctries 2019; 13(12):1076-1085. doi:10.3855/jidc.11045

(Received 21 November 2018 – Accepted 03 August 2019)

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Introduction

Globally, healthcare-associated infections (HCIs) in hospitalized patients are a major patient safety concern. It is associated with increased healthcare costs, prolonged hospitalization and poor clinical outcomes especially among neonates [1,2]. The burden of these infections is higher in low-resource countries where it is associated with high case fatality rates [3]. Organisms responsible for HCIs are frequently carried by the hands of healthcare workers [4]; thus global efforts to reduce the burden of HCIs among hospitalized patients have focused on hand hygiene. This includes

the World Health Organization (WHO) campaign “clean care is safe care” and “fight antibiotic resistance, it’s in your hands” [5,6]. These campaigns are mainly based on improving hand hygiene practices in healthcare facilities through the implementation of the WHO multimodal hand hygiene strategy [5,7]. The success of this strategy is hinged on the availability of infection prevention and control infrastructure.

Previous studies of health facilities in Ghana have shown inadequate infrastructure for infection prevention and control [8,9]. In a recent report by United Nations Children’s Fund (UNICEF) Ghana [10],

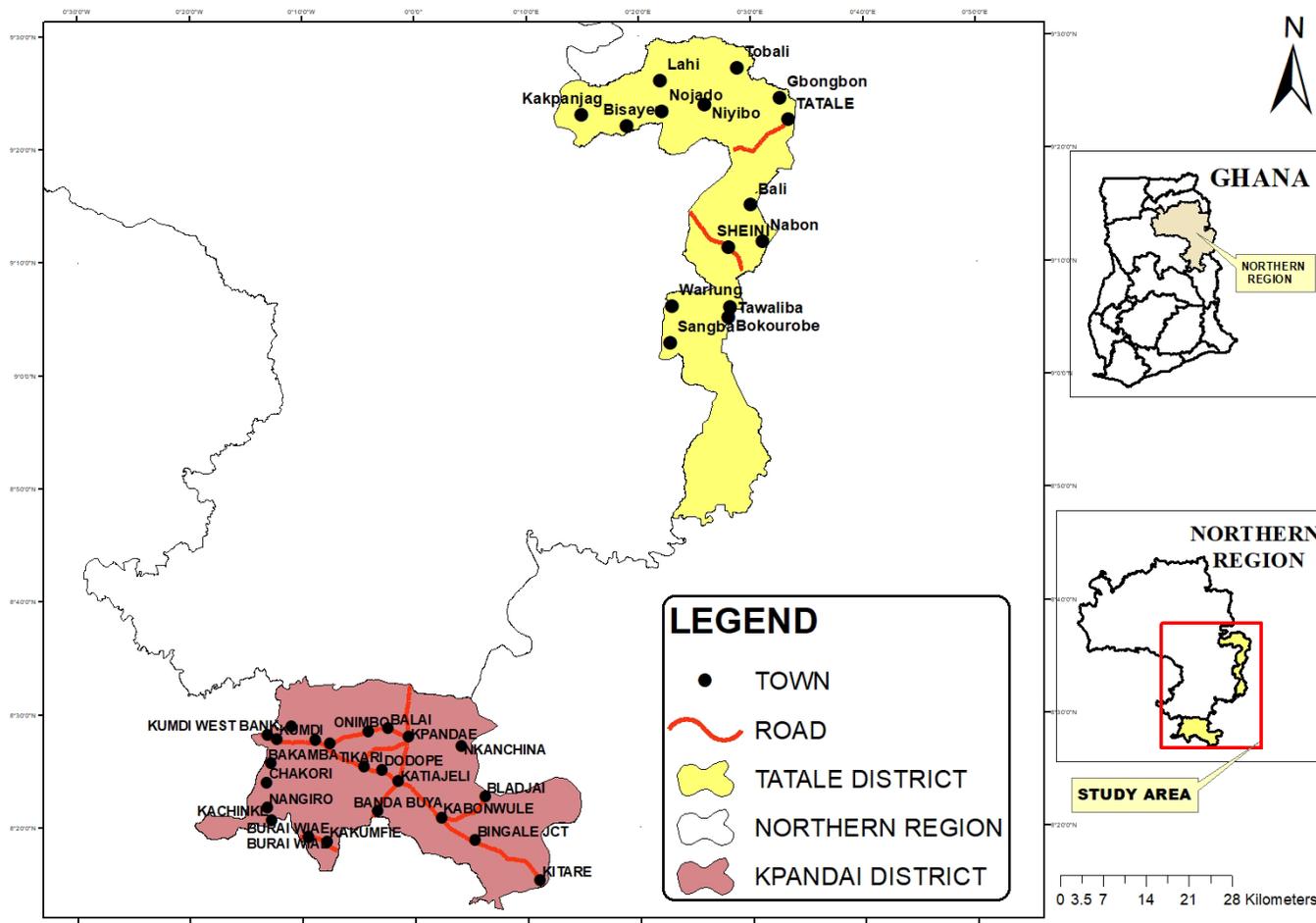
most healthcare facilities of the Northern Region of Ghana had inadequate water, sanitation, and hygiene (WASH) infrastructure. Inadequate WASH facilities combined with poor infection prevention practices threatens the health security of a nation [11]. Addressing this challenge requires the provision of adequate infrastructure for infection prevention as well as understanding factors influencing hand hygiene practices among healthcare workers. As part of efforts to improve health outcomes in two Districts (Tatale-Sanguli and Kpandai) of the Northern Region of Ghana, UNICEF Ghana implemented interventions, including the provision of water and toilet facilities, as well as education of healthcare workers on hand hygiene and healthcare-associated infections. This study sought to determine whether hand hygiene compliance and perceptions of healthcare workers towards infection control improved after the implementation of WASH interventions.

Methods

Setting

The study was conducted in 15 healthcare facilities consisting of 2 district hospitals and 13 health centers in two districts (Kpandai and Tatale-Sanguli) in the Northern Region of Ghana (Figure 1). The Kpandai district has an estimated population of 110,000 [12]. This population is served by 2 hospitals, 9 health centers, and 9 Community-based Health Planning & Services (CHPS) compounds. The total deliveries conducted in the district in the year 2016 were 2,693. Tatale-Sanguli district has an estimated population of 60,000 [12]. The population is served by a district hospital, 4 health centers, and 4 (CHPS) compounds. The total deliveries conducted in the district in the year 2016 were 1,160. The study participants comprised of healthcare professionals. All clinical staff directly involved in patient care on a daily basis and employed at the study site were eligible for inclusion. This study received ethical clearance from the Ethics Review

Figure 1. Map of Ghana showing Kpandai and Tatale-Sanguli Districts in the Northern region of Ghana. (The diagram is modified from the designation provided from Ghana Statistical Service [12]).



Committee of the Ghana Health Service, Protocol No. GHS-ERC: 08/04/17.

Study design

We conducted a one-group quasi-experimental study using pre-test and double post-test observations. This study design does not involve randomization. Instead, a variable is measured for the same group before, during, and after an intervention is implemented. The study was conducted over a total duration of 36 weeks from June 2017 through February 2018. There were three sampling phases: pre-intervention period (baseline, June to August 2017, 12 weeks); intervention period (midline, September to November 2017, 12 weeks) during which the UNICEF provided WASH amenities and capacity building of health staff; and post-intervention phase (endline: December 2017 to February 2018, 12 weeks).

Interventions

The interventions comprised of two modules. The skills acquisition module equipped healthcare workers with competences in inter-personal communication WASH and infection prevention control practices. Healthcare workers were taken through practical sessions on hand washing steps with emphasis on the WHO five hand hygiene moments, equipment decontamination processes as well as health care waste management. They were also made aware of the different types of hand washing: social/routine hand washing, clean hand washing, alcohol hand rub, and surgical hand washing. The infrastructure module was designed to improve WASH practices in health care facilities. The module involved the provision of toilet amenities and water supply (boreholes and veronica buckets) to participating healthcare facilities.

Assessment of hand hygiene compliance

Individual healthcare workers that routinely cared for patients at each ward were directly observed anonymously by a survey nurse. Informed consent was not obtained, because the study involved little risk of harm to participants and the study was regarded as an infection control program. The nurses noted all potential opportunities for hand hygiene and assessed hand hygiene compliance using the WHO hand hygiene observation tool [5] (Supplementary material 1). The survey nurses were recruited within each healthcare facility and trained on the WHO hand hygiene instrument. The hand, hygiene observation tool, is based on the WHO five moment of hand hygiene, which defines opportunities for hand hygiene as: before

patient contact, before the performance of an aseptic procedure, after contact with bodily fluids, after touching a patient and after leaving a patient's surroundings. The training was designed to introduce survey nurses to the objectives of the study, the purpose of each item on the data collection tool such as the definition of terms and indicator codes, methods for assessment of individual patient data, and the roles and responsibilities of each survey personnel. Each training session was concluded with a pilot survey of hand hygiene practices of a selected hospital ward. When the healthcare workers were providing patient care in the wards, the trained survey nurse anonymously observed and recorded their hand hygiene compliance. Observations were conducted daily over a ten-day period with three observation sessions in the morning, afternoon, and evening, each lasting a period of 30 minutes.

Perception surveys

The perception study was conducted using the WHO perception survey for healthcare workers [5] with minor modifications (Supplementary material 2). Self-administered anonymous questionnaires were distributed and retrieved from all healthcare workers in participating in healthcare facilities by nurse managers. Individual consent forms were signed by participants before completion of the questionnaires. The instrument comprised single item questions and covered demographic and professional characteristics, previous training in hand hygiene (yes/no) and frequency of use of alcohol-based hand rub (yes/no), perceptions on hand hygiene, patient safety and HCAI (3 questions with a 4-Likert-items scale), perceptions on strategies needed to improve institutional hand hygiene (8 questions with a 4-7-Likert-items scale), importance of hand hygiene by management and other healthcare workers (4 questions with a 7-Likert-items scale), perceptions on effectiveness of implemented hand hygiene activities (8 questions with 7-Likert-items scale). There were 3 open-ended questions concerning respondent's perception of the average percentage of hospitalised patients who will develop HCAs, the percentage of the perception situations requiring hand hygiene that healthcare workers actually perform hand hygiene, and self-reporting of hand hygiene compliance level.

Statistical analysis

Data were keyed into an access database and exported into STATA version 12 for analysis.

The observation outcomes for each WHO hand hygiene moment was reported as percentage compliance representing the proportion of the number of times hand hygiene was performed to the number of opportunities when hand hygiene should have been performed. The hand hygiene compliance with confidence intervals (95% CI) was calculated using the standard normal distribution. The Pearson Chi-Square statistic or the Fisher's exact test (where applicable) followed by the Marascuilo post hoc statistic was computed to assess differences in compliance between pre-(midline) and post-intervention (midline, endline) data. We used rated mean score to evaluate participant responses in the survey with Likert-items scale. Rated mean score represented the numerical average of a set of responses. Each scale represented 1 score. Low scores (below half of n-Likert-items scale) referred to negative responses and high scores (above half of n-Likert-items scale) to positive responses. The higher the mean score the better the response being assessed. The analysis of variance (ANOVA) with Bonferroni post hoc analysis was used to determine differences in healthcare worker perceptions at pre-(baseline) and post-intervention (midline, endline) data. Test of significance between parameters was two-sided and set at p -value of < 0.05 .

Results

Our primary study outcome was to determine hand hygiene compliance levels among healthcare workers at post in all participating facilities and their perceptions regarding HAIs and hand hygiene at baseline compared to the post-intervention phases. There was a total of 574 healthcare workers included in the study at baseline ($n = 155$, response rate 88.6%), midline ($n = 197$, response rate 84.9%) and endline ($n = 222$, response rate 96.9%) phases. The post-intervention assessments captured all baseline respondents. Nurses accounted for the majority of participants ($n = 397$), followed by midwives ($n =$

37), and doctors ($n = 5$). Other healthcare professionals such as technicians made up 22.9% ($n = 132$) of participants. The median age of the participants was 25 years. This varied from day 18 to 53 years (IQR: 20-32 years). Males constituted the majority ($n = 359$, 62.5%) of the respondents.

Hand hygiene compliance

During the study period, 4296 hand hygiene opportunities were observed among study participants. The hand hygiene actions observed were 2135. Overall, compliance with hand hygiene as recommended by the WHO was 49.6% (95% CI: 48.21-51.9%). Table 1 shows hand hygiene compliance at baseline and post-intervention (midline and endline). At baseline, 1421 opportunities were observed for all WHO five moments of hand hygiene. Compliance to hand hygiene was 28.8% ($n = 409/1421$; 95% CI: 26.5-31.9). There were significant differences in compliance within the WHO five moments of hand hygiene ($\chi^2, 137.0$; df, 4; $p < 0.001$). The best compliance was noted to moment 3 after blood fluid exposure (57.5%) and moment 4 after touching patient (43.6%). The worst adherence to hand hygiene was to moment 2 before performing aseptic procedures (13.6%) and moment 1 before touching patients (17.3%). When adding phase (pre-and post-intervention) as a limiting factor, the overall hand hygiene compliance increased from 28.8% at baseline through 51.7% at midline ($n = 726/1404$; 95% CI: 49.1-54.2%) to 67.9% at endline ($n = 1000/1471$; 95% CI: 65.6-70.3%) with significant differences in compliance between all three assessments. Similarly, we observed considerable improvement in compliance with each WHO moment of hand hygiene at midline through endline. The greatest improvement in adherence was noted for moment 5 after touching patients' surroundings. Compliance increased from 27.8% at baseline through 86.1% at midline to 84.9% at endline (relative increase, 205%; relative rate, 3.05; 95% CI:

Table 1. Compliance to five moments of hand hygiene.

Description	Bef Pat			Bef Asept			Aft Exp			Aft Pat			Aft Pat Sur		
	OPP	ACT	%COM	OPP	ACT	%COM	OPP	ACT	%COM	OPP	ACT	%COM	OPP	ACT	%COM
Total period	1272	369	29.0 ₄	614	145	23.6 ₄	452	363	80.3 ₁	1266	716	56.5 ₃	853	542	63.5 ₂
Study phase															
Baseline	429	73	17.3 ^b	206	28	13.6 ^b	120	69	57.5 ^b	342	149	43.6 ^b	324	90	27.8 ^b
Midline	386	126	32.6 ^a	200	42	21.1 ^b	154	138	89.6 ^a	440	227	51.6 ^b	224	193	86.1 ^a
Endline	457	170	37.2 ^a	208	75	36.1 ^a	178	156	87.6 ^a	484	340	70.2 ^a	305	259	84.9 ^a
	Relative increase, 118% (relative rate, 2.18; 95% CI, 1.23-3.32; $p < 0.0001$)			Relative increase, 165% (relative rate, 2.65; 95% CI, 1.43-3.52; $p < 0.0001$)			Relative increase, 52.3% (relative rate, 1.52; 95% CI, 1.12-2.21; $p < 0.0001$)			Relative increase, 61.0% (relative rate, 1.61; 95% CI, 1.33-2.53; $p < 0.0001$)			Relative increase, 205% (relative rate, 3.05; 95% CI, 2.23-4.04; $p < 0.0001$)		

* Different superscripts within column signify significant differences at $p < 0.05$, where $b > a$; different subscripts within rows signify significant differences at $p < 0.05$, where $1 > 2 > 3 > 4$; Bef Pat, before touching patient; Bef Asept, before performing aseptic procedure, Aft Exp, after bodily fluid exposure; Aft Pat, after touching patient; Aft Pat Sur, after touching patients surroundings; OPP, opportunity; ACT, action; %COM, percentage compliance; Paeds, pediatric wards; Maternity, maternity wards.

2.23-4.04; $p < 0.0001$). The change in compliance was minimum for moment 3 after bodily fluid exposure showed the least change in hand hygiene compliance (relative increase, 52.3%; relative rate, 1.52; 95% CI:1.12-2.21; $p < 0.0001$) and moment 4 (relative increase, 61.0%; relative rate, 1.61; 95% CI: 1.33-2.53; $p < 0.0001$).

Perception survey

In all, none of the participating facilities had an infection control team, doctor or nurse. Although no hand hygiene campaign had been conducted in participating healthcare facilities until the present study started, 82% ($n = 478/574$) of baseline respondents had received formal training in hand hygiene in the last 3 years and the proportion did not change significantly across the study phases. Healthcare workers' perceptions of infections and hand hygiene practices are shown in Table 2. Overall, the perceived percentage of hospitalized patients who will develop healthcare-associated infections remained comparable at baseline (37.3 ± 27.6) through midline (39.7 ± 27.7) and endline (40.8 ± 28.9). Approximately half (48.1%) of the pre-intervention respondents indicated that healthcare-associated infections have low (38.2%, $n = 58/155$) to very low (9.9%, $n = 15/155$) impact on patient's clinical outcome; and no positive change in this opinion was

noted post-intervention. Most healthcare workers (85.5%) at baseline regarded hand hygiene as highly (47.7, $n = 71/155$) or very highly (41.6%, $n = 62/155$) effective in preventing healthcare-associated infection with little change in perception during midline and endline surveys. Similarly, most respondents (70%) assigned a high priority (36.5%, $n = 56/155$) and a very high priority (33.8%, $n = 51/155$) to the importance of institutional hand hygiene importance with little change in perception at midline and endline. Post-intervention (endline, 76.0 ± 17.4), we observed no improvement in respondent-perceived hand hygiene compliance in their healthcare facilities the perceived compliance remained unchanged from baseline (75.2 ± 18.6) to midline (74.3 ± 17.3). Self-reported percentage of the situation in which the participant actually performed hand hygiene significantly improved from 72.1 ± 14.0 at baseline through 77.1 ± 17 at midline to 80.4 ± 16 at endline.

Improving hand hygiene

Table 3 summarizes healthcare workers' opinions on activities to permanently improve hand hygiene in their institution. Independent of study phase, the highest ratings (with rated mean score > 5.0) for institutional

Table 2. Changes in perceptions regarding healthcare associated infections.

Perceptions	Number of respondents (%)			P-value
	Baseline (n = 155)	Midline (n = 197)	Endline (n = 222)	
Average percentage of hospitalized patients with hospital care associated infection, mean \pm SD	37.3 \pm 27.6	39.7 \pm 27.7	40.8 \pm 28.9	0.653
Impact of health care associated infection on patient's clinical outcome				
Very low	15 (9.9) ^a	31 (15.7) ^a	39 (17.6) ^a	0.111
Low	58 (38.2) ^a	61 (31.0) ^a	81 (36.5) ^a	0.318
High	61 (40.1) ^a	86 (43.7) ^a	74 (33.3) ^a	0.087
Very high	18 (11.8) ^a	19 (9.6) ^a	28 (12.6) ^a	0.0620
Effectiveness of hand hygiene in preventing health care associated infection				
Very low	2 (1.3) ^a	4 (2.0) ^a	6 (2.7) ^a	0.667
Low	14 (9.4) ^a	28 (14.2) ^a	19 (8.6) ^a	0.145
High	71 (47.7) ^a	90 (45.7) ^a	109 (49.1) ^a	0.783
Very high	62 (41.6) ^a	75 (38.1) ^a	88 (39.6) ^a	0.800
Importance of hand hygiene at institution				
Very low priority	7 (4.6) ^a	5 (2.5) ^a	6 (2.7) ^a	0.486
Low priority	38 (25.0) ^a	41 (20.8) ^a	37 (16.7) ^a	0.141
High priority	56 (36.8) ^a	91 (46.2) ^a	86 (38.7) ^a	0.153
Very high priority	51 (33.6) ^a	60 (30.5) ^a	93 (41.9) ^b	0.041
Percentage situation for which health care workers in institution actually perform hand hygiene, mean \pm SD	74.3 \pm 17.3 ^a	75.2 \pm 18.6 ^a	76.0 \pm 17.4 ^a	0.709
Percentage situation for which study participant actually perform hand hygiene, mean (\pm SD)	n = 139 72.1 \pm 14.0 ^a	n = 175 77.1 \pm 17.0 ^a	n = 222 80.4 \pm 16.1 ^b	< 0.001

*SD, standard deviation; P-value compares outcomes across baseline, midline and endline; Different superscripts within columns signify significant differences at $p < 0.05$, where $b > a$.

Table 3. Healthcare workers recommended activities to permanently improve hand hygiene in their institution.

Activity	Rated score mean (\pm SD)			P-value
	Not effective (1)		Very effective (7)	
	Baseline (n = 155)	Midline (n = 197)	Endline (222)	
Leaders and senior managers support and openly promote hand hygiene	5.5 \pm 1.8 ^a	5.5 \pm 1.8 ^a	5.8 \pm 1.6 ^a	0.219
Health institution makes alcohol-based hand-rub always available at each point of care	4.2 \pm 2.5 ^a	4.5 \pm 2.3 ^a	4.6 \pm 2.3 ^a	0.256
Hand hygiene posters displayed at point of care as reminders	5.3 \pm 2.1 ^a	6.1 \pm 1.5 ^b	6.0 \pm 1.7 ^b	< 0.001
Each health care worker receives education on hand hygiene	5.9 \pm 1.6 ^a	5.9 \pm 1.7 ^a	6.1 \pm 1.4 ^a	0.328
Clear and simple instructions on hand hygiene are visible for every health care worker	5.6 \pm 1.8 ^a	6.1 \pm 1.3 ^b	6.0 \pm 1.5 ^b	0.007
Health care workers regularly receive feedback on hand hygiene performance	4.0 \pm 2.3 ^a	4.6 \pm 2.2 ^b	4.7 \pm 2.1 ^b	0.006
Always perform hand hygiene as recommended (good example to colleagues)	5.6 \pm 1.6 ^a	6.0 \pm 1.3 ^b	6.0 \pm 1.4 ^b	0.012
Patients are invited to remind health care workers to perform hand hygiene	3.3 \pm 2.4 ^a	3.6 \pm 2.4 ^a	3.4 \pm 2.3 ^a	0.470

*Different superscripts within column signify significant differences at $p < 0.05$, where $b > a$.

Table 4. Perceived institutional and personal efforts towards hand hygiene.

Activity	Rated score mean (\pm SD)			P-value
	Not effective (1)		Very effective (7)	
	Baseline (n = 155)	Midline (n = 197)	Endline (222)	
Leaders and senior managers support and openly promote hand hygiene	5.5 \pm 1.8 ^a	5.5 \pm 1.8	5.8 \pm 1.6	0.219
Health institution makes alcohol-based hand-rub always available at each point of care	4.2 \pm 2.5 ^a	4.5 \pm 2.3 ^a	4.6 \pm 2.3 ^a	0.256
Hand hygiene posters displayed at point of care as reminders	5.3 \pm 2.1 ^a	6.1 \pm 1.5 ^b	6.0 \pm 1.7 ^b	< 0.001
Each health care worker receives education on hand hygiene	5.9 \pm 1.6 ^a	5.9 \pm 1.7 ^a	6.1 \pm 1.4 ^a	0.328
Clear and simple instructions on hand hygiene are visible for every health care worker	5.6 \pm 1.8 ^a	6.1 \pm 1.3 ^b	6.0 \pm 1.5 ^b	0.007
Health care workers regularly receive feedback on hand hygiene performance	4.0 \pm 2.3 ^a	4.6 \pm 2.2 ^b	4.7 \pm 2.1 ^b	0.006
Always perform hand hygiene as recommended (good example to colleagues)	5.6 \pm 1.6 ^a	6.0 \pm 1.3 ^b	6.0 \pm 1.4 ^b	0.012
Patients are invited to remind health care workers to perform hand hygiene	3.3 \pm 2.4 ^a	3.6 \pm 2.4 ^a	3.4 \pm 2.3 ^a	0.470
Importance	Rated score mean (\pm SD)			P-value
	No importance (1)		Very much importance (7)	
Importance Head of Department attaches to optimal hand hygiene	5.1 \pm 1.9 ^a	5 \pm 1.8 ^a	6.2 \pm 1.4 ^b	< 0.001
Importance colleagues attaches to optimal hand hygiene	5.1 \pm 1.8 ^a	5.6 \pm 1.7 ^a	6.1 \pm 1.2 ^b	< 0.001
Importance patients attaches to optimal hand hygiene	4.0 \pm 2.2 ^a	4.5 \pm 2.2 ^a	4.8 \pm 2.1 ^b	0.002

* Different superscripts within column signify significant differences at $p < 0.05$, where $b > a$; SD, standard deviation.

hand hygiene promotion were to education on hand hygiene (rated mean score, 5.9 ± 1.6), visible clear hand hygiene instructions (rated mean score, 5.6 ± 1.8), positive role modelling (rated mean score, 5.6 ± 1.6), managers' support and promotion of hand hygiene (rated mean score, 5.5 ± 1.8), and displays of hand hygiene posters (rated mean score, 5.3 ± 2.1). When adding phase as a confounding factor, the following recommendations received a significant rise in ratings during follow-ups at midline and endline: displays of hand hygiene posters, visible clear hand hygiene instructions, and positive role modeling, regular feedback on hand hygiene performance. Suffice it to say though that baseline, midline, and endline ratings for regular feedback on hand hygiene performance were low level (rated mean score < 5.0). Table 4 summarizes perceived institutional and personal efforts towards hand hygiene. The healthcare workers indicated that their heads of department, colleagues, and patients attached very high importance to performing optimal hand hygiene during the care process. The respondents noted that the highest expectation came from their heads of department (rated mean score, 5.1 ± 1.9) and then colleagues (rated mean score, 5.1 ± 1.9). Respondents perceived patients to harbour the least expectation (rated mean score 4.0 ± 2.2) of them to perform hand hygiene during a care process. Post interventions, participants reported that the expectations from their heads of department, colleagues, and patients to perform hand hygiene had significantly increased (Table 4). Most participants considered it a big effort to perform good hand hygiene when caring for patients (rated mean score, 5.9 ± 1.7) even after ($p < 0.133$) the implementation of interventions (rated mean score: midline, 6.0 ± 1.5 ; endline, 6.2 ± 1.3).

Assessment of intervention policies

Post-intervention, we summarized all interventional activities under four items and assessed healthcare workers' opinion on the effectiveness of implemented projects (Table 5). The highest ratings at midline for interventions that were perceived to very much improve hand hygiene practice went to "healthcare worker participation in educational activities" (rated mean score, 5.8 ± 1.5) and "hand hygiene promotional campaign" (rated mean score, 5.8 ± 1.5), followed by "improvement in safety climate" (rated mean score, 5.6 ± 1.6). Administrative support for hand hygiene was perceived as the least effective policy (rated mean score, 5.1 ± 2.2). At endline, we did not observe improvements in respondent's rankings for the top two interventions with the highest midline ratings. We, however, noted significant improvement ($p < 0.05$) at endline in respondents' ratings for the two least midline ranked policies: "administrative support for hand hygiene" and "improvement in safety climate". Regarding specific activities, participants indicated that the provision of water in veronica buckets improved very much (rated mean score, 6.1 ± 1.4) their hand hygiene practices. Their perception of the importance of veronica buckets remained unaffected ($p = 1.00$) even at endline survey (rated mean score, 6.1 ± 1.4). They also noted that "the knowledge of being observed" improved very much (rated mean score, 5.8 ± 1.6) their hand hygiene practices no change ($p = 0.509$) in the rating for this observation was noted during endline survey (rated mean score, 5.9 ± 1.5).

Discussion

This is the first survey assessing hand hygiene practices and perceptions on infection control from primary healthcare facilities in Ghana. This information is important for the successful implementation of

Table 5. Assessment of interventional policies on hand hygiene.

Interventional policy	Rated mean score		P-value
	Not at all (1)	Very much (7)	
	Midline	Endline	
Participation in educational activities important in improving hand hygiene practices	5.8 ± 1.5^a	6.0 ± 1.5^a	0.173
Administrators supportive of hand hygiene improvement	5.1 ± 2.2^a	5.7 ± 1.7^b	0.002
Improvement of safety climate helped to improve hand hygiene practices	5.6 ± 1.6^a	5.9 ± 1.3^b	0.035
Current hand hygiene promotional campaign increased awareness of good hand hygiene practices	5.8 ± 1.5^a	6.0 ± 1.3^a	0.145
Interventional policy	Rated mean score		P-value
	Not at all (1)	Very well (7)	
	Midline	Endline	
Provision of veronica buckets improved hand hygiene practice	6.1 ± 1.4^a	6.1 ± 1.4^a	1.000
Knowledge of being observed improved hand hygiene practices	5.8 ± 1.6^a	5.9 ± 1.5^a	0.509

* Different superscripts within column signify significant differences at $p < 0.05$, where $b > a$; SD, standard deviation.

programs to improve hand hygiene in health care facilities. In this study, a high percentage (82%, n = 478/574) of healthcare workers reported having received some training on hand hygiene within the past three years. This finding is however not unusual since healthcare workers nationwide received training on hand hygiene as part of infection prevention and control preparedness campaign during the recent Ebola outbreak in West Africa [13].

We observed a significant increase in the self-reported percentage of situations in which respondents performed hand hygiene from baseline through endline assessment (77.1-80.4%). Despite high self-reported hand hygiene compliance rates, it was not commensurate with the observed overall hand hygiene compliance rates of 28.8% and 67.9%. The disparity between perception and compliance may be due to socially acceptable response from participants. These findings agree with the suggestion that self-assessment questionnaires tend to overestimate hand hygiene compliance; and may point to the dichotomy between knowledge and practice as was documented by Seyed *et al.* [14]. The low hand hygiene compliance rates observed at the baseline period is comparable to findings from other studies in Ghana where low compliance has been observed among healthcare workers [8,9,15]. It is also comparable to 38.7% (range 5-89%) baseline compliance rates reported by WHO [16]. At the end of the study, compliance rates had significantly risen to 67.9%, meaning provision of WASH facilities with education can significantly improve hand hygiene compliance rates. It has also been observed that compliance with hand hygiene requires some minimal objective provisions, such as availability of essential infrastructure and supplies. The implemented method of hand hygiene also influences compliance, and the presence of a readily available source of water for hand hygiene has been associated with marked improvement of compliance [17–19].

Hand hygiene compliance was highest after exposure to bodily fluids across all phases of the study. This finding has been attributed to the concept of self-preservation; where the main motivation of health workers to perform hand hygiene is to protect themselves from infection [20]. Low hand hygiene compliance observed before the performance of aseptic procedures is reportedly due to the use of gloves before performing these procedures [21]. This is however contrary to the recommendations which required hand hygiene to be performed before donning gloves [22].

Majority of respondents throughout the study believed that healthcare-associated infections had a low

impact on patient's clinical outcomes and that patients did not attach much importance to the performance of optimal hand hygiene. These findings may be detrimental to efforts to improve infection control in the participating facilities. Indeed, healthcare-associated infections unquestionably have substantial effects on morbidity and mortality. The management of healthcare-associated infections could be helped by the awareness that these infections are associated with inadequate antibiotic therapy and negative impact on hospital outcome. Previous studies have shown that patients with healthcare-associated infections have a higher rate of multi-drug resistant pathogens, increased morbidity and mortality, longer hospital stay, and higher hospital cost. Healthcare workers need to be aware of this impact in order to adopt appropriate infection prevention and control guidelines. Not many patients are cognizant of the need for hand hygiene in clinical care. Perhaps, a new idea for practice and research is to educate patients to insist on hand hygiene from care providers.

Hand hygiene is repetitive and could result in the formation of habits, and habits may influence behaviour[23,24].

In this study, we noted high expectations of healthcare workers for managerial support in the promotion of hand hygiene. Similarly, a positive opinion of the head of department toward hand hygiene practices was associated with intention to perform hand hygiene; and the finding is consistent with other studies [20]. The significant role of important referent others has been previously observed and used effectively as vital components of campaigns promoting hand hygiene in many hospital settings [25–26]. Other preferred strategies for improving hand hygiene among participants were education on hand hygiene, and the use of simple visual aids on hand hygiene. These are common strategies included in several international hand hygiene bundles [7,27]. Interestingly, most healthcare workers perceived patients to have the least expectation of them to perform hand hygiene; they also did not favour patients being invited to remind health workers to perform hand hygiene as a method of improving hand hygiene compliance. Similar findings have been recorded in studies from other countries [28].

The study has potential limitations. It is possible that some of the answers received in the questionnaire survey may represent socially acceptable answers. As with self-administered questionnaires not completed under supervision, we cannot exclude the possibility that respondents verified their answers with other personnel. However, to minimize this bias we insisted

on the independent effort from all study participants. The limited number of healthcare workers per facility made it difficult to conduct hand hygiene observation unobtrusively. The low numbers of doctors compared to nurses reflects the shortage of doctors in remote and rural areas. It is also noteworthy that our study outcomes were not compared across different professional groupings- such analysis is the focus of another paper to be published elsewhere. It is plausible that hand hygiene practices of health workers in the included facilities may have been influenced by our observational assessments (Hawthorne effect). However, steps were taken to minimize the Hawthorne effect. The survey nurses who observed hand hygiene practices were selected from among staff that worked in the same units as those being observed. They were encouraged to be as discreet as possible with regards to observations.

Conclusion

In this study, we found significant improvement in hand hygiene compliance in a low resource setting after improving WASH facilities and instituting educational programs on infection control and prevention. There was however little variation in the perceptions of healthcare workers on infection prevention throughout the study. Some of the perceptions revealed in this study may undermine efforts to ensure sustainable good hand hygiene practice in health facilities and require further consideration. Efforts to improve hand hygiene compliance in low resource settings should go beyond educational activities to include the provision of resources and periodic audits.

Acknowledgements

We thank Mr. Edmund Tetteh Nartey for the help with database development and analysis. We also thank the District directors of health and heads of all the participating health facilities for their assistance during the data collection.

Authors' contribution

AKL, NON, CEL, BN, SI, NFD, PB, DD, PW conceptualized the study; participated in its design, coordination, and questionnaire administration. NON and AKL performed statistical analysis. AKL, NON, CEL, BN, SI, NFD, PB, DD, PW drafted the manuscript and approved the final version.

Ethical considerations

The study received ethical clearance from the Ethics Review Committee of the Ghana Health Service, Protocol No. GHS-ERC: 08/04/17. Participants in the hand hygiene perception survey provided informed consent before completing the questionnaires. Data were treated with a high level of

confidentiality. Unique codes per questionnaire were employed for computer-based data entry. In all cases, questionnaire and documentations were kept securely locked. Computerized records of the survey were kept in electronic files. These documents were accessible to the lead investigator only.

Funding

This study was conducted with funding from UNICEF Ghana.

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Conflict of interests: The findings, interpretations and conclusions set out in this publication are those of the authors only, and do not in any way reflect the official opinion of UNICEF Ghana. Neither the UNICEF institutions and bodies nor any person acting on their behalf should be held responsible for any information contained here.