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Improving Knowledge, Attitude, and Compliance of Hand Hygiene Among Healthcare Workers of One Iranian Hospital: A Pilot Study Using Reminder Card

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Abstract

Background: Compliance rate of hand hygiene practice by healthcare workers has been observed to be universally low despite its importance, simplicity and cost-effectiveness in preventing the spread of infectious diseases in the healthcare settings. This study aimed to improve healthcare workers' knowledge, attitudes, and compliance with hand hygiene by using reminder cards displayed by patients.

Method: This before-after interventional study was carried out in 2019 among healthcare workers of a hospital in Tabriz, Iran. The intervention was a 'Reminder Card' showed by patients to remind healthcare workers to clean their hands. Participants' knowledge and attitude about hand hygiene and compliance to hand hygiene were assessed before and after the intervention. Descriptive statistics were presented and the inferential statistics were calculated using the paired *t*-test.

Results: Participants reported moderate knowledge (mean \pm SD: 17.47 \pm 3.03; *n* = 25) and attitude (mean \pm SD: 68.65 \pm 10.99; *n* = 96) at baseline. We observed improvements following the intervention for knowledge and attitude, respectively (mean \pm SD: 21.81 \pm 1.69; 79.23 \pm 7.83; *P* < 0.001). Overall, hand hygiene compliance was 25.7% at baseline. Compliance increased to 58.8% after the intervention. The moment 'after contact with body fluids' had the highest compliance rate before and after intervention (56.7% vs. 76.8%).

Conclusion: The use of a 'Reminder Card' was shown to improve hand hygiene compliance in this study. Patient participation in prompting staff to clean their hands may assist in achieving hand hygiene compliance among healthcare workers ensuring quality, safe care, and infection prevention in the hospital.

Keywords: Hand hygiene compliance, Handwashing, Alcohol-based hand rub, Patient safety

1. Introduction

Hospital infections are one of the most vital challenges of healthcare systems. They result in increased morbidity and mortality, and increase the duration of hospital stays and costs worldwide [1]. Many studies indicated that the transfer of

pathogens in the environment of the hospital via contaminated hands of the staff is a key issue [2].

Organisms are capable of surviving on healthcare workers' hands for at least several minutes following contamination. If hand hygiene practices are suboptimal, microbial colonization is more easily established through direct or indirect contact [2]. In the wake of the growing burden of hospital-acquired

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infections caused by multidrug-resistant pathogens, simple measures such as hand hygiene may significantly reduce the risk of cross-infections [3]. Since the start of the COVID-19 pandemic, keeping hand hygiene compliance has become even more important.

The novel 2019 coronavirus (SARS-CoV-2) is mostly transmitted by aerosol projection. However, it can also be spread through physical contact or contact with contaminated surfaces and materials [4]. According to the WHO, because hospitals are a major source of infections, appropriate hand hygiene practices must be adopted [5].

Improper hand hygiene by healthcare workers is responsible for about 40% of nosocomial infections which resulted in prolonged illnesses [2]. Despite its importance, simplicity, and cost-effectiveness in preventing the spread of infectious diseases in healthcare settings, its practice by healthcare workers is observed to be universally low [6].

Much of the previous research conducted on hand hygiene compliance used cross-sectional design. The exceptions are a few well-designed intervention studies [7]. A range of interventions have been confirmed to increase healthcare workers' awareness and improve their compliance with hand-washing practices [8]. Such interventions include reminders, posters, practical simulations in workshops, practical scenarios, videos and role playing [9]. It is useful to note that patient participation intervention results in improving patient safety, especially where patients remind the healthcare workers of hand hygiene before patient handling. It has been established previously that patients have an important role in ensuring safety while they are in hospital through engagement and participation in issues related to their health [10]. Studies of patient education and empowerment have suggested that several factors enhance patient engagement, including having a voice and being a part of the decision-making process, sharing information and possessing knowledge about their conditions [11]. A recent study has identified challenges facing patients' engagement, some of which include: patients' low levels of health literacy, inadequate education, patient unwillingness, and cultural barriers, the existence of negative attitudes towards engaging patients in matters relating to patient safety, ineffective communication, high workload and the reluctance on the part of physicians to engage with patients [12]. A paucity of such studies on patients' engagement and involvement in improving hand hygiene practices among healthcare workers in developing countries necessitate the need to conduct this study. This study aimed to investigate healthcare workers knowledge, attitudes and compliance with hand

hygiene after being shown a Reminder Card by patients in a selected hospital in Iran.

2. Methods

2.1. Design

This before-after intervention study was performed in a hospital in Tabriz, Iran over the course of six months (July to December 2019). The hospital has a capacity of 510 beds and has a specialist burns unit. The study setting included three medical–surgical departments, which were selected as descriptive of general inpatient wards in Iran. Moreover, healthcare workers in these wards were willing to participate in the intervention. The study targeted all healthcare workers in selected departments ($n = 80$; including nurses, physicians, auxiliaries, and paramedics) who had direct contact with patients using consecutive sampling.

2.2. Procedures

At the beginning of the study, we obtained the hospital management's consent and steps were taken to enroll participants. We also checked that ethanol-based hand rub and handwashing agents were readily available at the patient (POC) point of care. Ethanol-based hand rub products and hand wash agents consumed per patient-day was the primary outcome variables. The other outcome variables were the healthcare workers' knowledge and attitude about handwashing. The study had three stages: 1) a baseline assessment before the intervention, 2) a preoperational and educational stage, and 3) hand hygiene compliance monitoring and knowledge/attitude assessment after the intervention.

At the baseline assessment stage, compliance with hand hygiene was monitored for two months. The “WHO Guidelines on Hand Hygiene in Health Care” was used to observe the handwashing behavior in the three departments [13]. Two observers associated with clinical care were selected. They received intensive training by using a WHO-recommended training video clip under the supervision of a senior researcher. These two unobtrusive observers openly watched staff and recorded opportunities and actions for hand hygiene.

The observers were then given trial evaluations and assessments to ensure that their findings were compatible and consistent. Healthcare workers (physicians, nursing staff, paramedics, and auxiliary nurses) were monitored during routine normal work for eight 20-min episodes at various times during the daytime morning and evening shifts.

Observers were placed in such a way that they aimed not interfere with patient care nor with patient privacy. In this stage, hand hygiene knowledge and attitude were also surveyed using valid tools.

At the preoperational and educational stage in the three departments, a nurse was appointed to act as the supervisor and patient educator. All patients admitted to these wards from the surgical waiting list or the emergency rooms were included in the study, if they agreed to participate. On admission, patients were taught about the concept of patient safety and their role in improving safety. The consequence of hand hygiene and the content of the card was explained to patients. Patients were asked to show a “Reminder Card” to the staff when the staff came to care for them or undertake any procedure. All staff of the participating units were informed about the study and the prompt card to be used by patients. The researcher assumed that using the “Reminder Card” might increase staff willingness to improve their hand hygiene knowledge or change their attitude. Additionally, if they had any questions regarding hand hygiene, healthcare workers were offered an educational short video in which the infection control expert of the hospital demonstrated handwashing and hand rubbing technique. This stage lasted for two months.

At the third stage, at the end of the study, in order to measure any changes in hand hygiene practices from baseline, we recorded hand hygiene measurements in each department to measure the impact of health care workers receiving the intervention “Reminder Card.” Hand hygiene opportunities are described as the point during health care delivery when hand hygiene is required to prevent microorganism transfer by hands. In compliance yielding measurements, hand hygiene opportunities serve as the denominator, while the completed hand washing actions are the numerator [13]. The opportunities for hand hygiene were assessed based on the observers' encounters with health care workers interacting with patients. The number of completed actions divided by the number of opportunities is the ratio of hand hygiene compliance. The hand hygiene knowledge and attitude of healthcare workers were surveyed again in this stage. The types of hand hygiene materials required (alcohol dispenser, soap and water, or both) and the observed staff's hand hygiene behavior (handwashing, hand rubbing, or nothing) were documented with each opportunity. The type of opportunity, as described by the principle of five moments for hand hygiene, as well as the time of

day when the observation was made, was also documented.

2.3. Intervention

Studies also show that direct and continuous observation and providing appropriate feedback on hygiene are effective ways to increase hand hygiene [9]. A ‘Reminder Card’ was designed for patients to use. A tent card inscribed with a brief sentence about cleaning hands of healthcare workers “*Thank you for cleaning your hands before coming into contact with me*” was reviewed and approved by clinical staff and patients. The reminder card addresses general explanations for non-compliance with hand hygiene, such as forgetting or having a high workload and low knowledge about/poor attitude with compliance to hand hygiene.

The size and font of the reminder message and the color of the card was reviewed and corrected after the pilot study involving five patients. Finally, the card was developed in a B-4 size (155 by 106 mm), yellow color background with a font of B bold 32 size, black color. The card was set on the table in the patients' room in a convenient location and the patients were requested to use the cards and show the card to the staff when the healthcare workers came to care for them or undertake any procedure. A registered nurse in charge of the patients' care was in charge of distributing new cards to new patients and randomly observing the use of delivered cards. Any problem during the intervention was reported to the research team, so that they could quickly come up with a solution. The patients were supported in any case in which they encountered a problem.

2.4. Instrumentation

Data was gathered using a validated three-part questionnaire. By using WHO's developed “hand hygiene knowledge questionnaire for healthcare workers,” *Knowledge* was assessed [13]. This questionnaire with 25 items contained questions with yes/no, multiple choice, true/false formats. *Attitude* towards hand hygiene practices was measured using the ‘questionnaire for perception survey for healthcare workers’ with 11 questions, which was originally developed by the WHO. It measures the effectiveness of the intervention on participants' attitudes towards hand hygiene practices. The items are on 7-point scale ranging from 1 = ‘not effective/very low’ to 7 = ‘very effective/very high.’

These questionnaires were anonymously completed at baseline, prior to, and after the intervention. Using methods identical to those mentioned previously, we measured these attributes using an aggregate ranking. One point was given for each correct answer to knowledge and positive attitudes in a scoring system. Negative attitudes and incorrect knowledge were given zero points. The cutoff values used to classify levels as good (scores >75%), moderate (scores between 50% and 74%), or poor (scores <50%) knowledge/attitude was based on a previously published study.

For the assessment of *compliance* of hand hygiene, the WHO's observation tool for hand hygiene compliance was used [13]. Hand hygiene should be practiced 'before touching a patient,' 'before clean or aseptic treatments,' 'after the possibility of exposure to body fluids,' 'after touching a patient,' and 'after touching patient surroundings,' according to WHO guidelines. Hand hygiene compliance was assumed to be accurate whether the healthcare worker washed or used hand sanitizer on his or her hands before and after each patient touch. If the hands became soiled, hand washing has been recommended; however, since we did not check the hands directly, we considered either technique as accurate.

2.5. Data analysis

Data collected were analyzed with Statistical Product and Service Solution (SPSS) version 22 (SPSS Inc., Chicago, IL, USA). Descriptive statistics were used to describe the characteristics of the study participants and the study variables. To compare the main variable before and after the intervention, we utilized the paired *t*-test with a *p*-value of 0.05 for the level of significance.

2.6. Ethical issues

This study was approved by the Ethical Committee of Tabriz University of Medical Science (ethical code: IR.TBZMED.REC.1397.617).

3. Results

3.1. Participants

Eighty staff participated in this study with the average age of 26.30 (SD = 5.20) years and average work experience of 9.15 (SD = 6.58) years. The characteristics of the participants and workload are summarized in Table 1.

Table 1. Characteristics of participants in study of hospital health care workers and hand hygiene in Iran (n = 80).

Variables	n (%)
Gender	
Male	55 (68.75)
Female	25 (31.25)
Education status	
Associate degree	6 (7.5)
Bachelor's degree	60 (75)
Postgraduate	14 (17.5)
Profession group	
Nurse	43 (53.75)
Physician	10 (12.5)
Auxiliary nurse	15 (18.75)
Paramedic	12 (15)
Work experience (in years)	
1–5	12 (15)
6–10	36 (45)
11–15	24 (30)
>15	8 (10)

3.2. Knowledge and attitude of hand hygiene

In Table 2, the overall knowledge score improved from 17.47 (SD = 3.03) at baseline to 21.81 (SD = 1.69) after the intervention (*p* < 0.001). Of the four professional groups, nurses had the highest mean knowledge score at baseline (mean = 21). The mean knowledge score for nurses improved to a mean of 22.16 after the intervention. The lowest mean score at baseline was among paramedics (mean = 12.50). The mean score for paramedics improved to 21.10 after the intervention.

The overall mean score for attitude improved from 68.65 at baseline to 79.23 after the intervention

Table 2. Scores for knowledge and attitude of hand hygiene among different medical professions.

Profession	Before	After	p-value ^a
	Mean (SD)	Mean (SD)	
Knowledge score (Min = 0, Max = 25)			
Physicians	17.23 (1.41)	21.53 (1.13)	<0.001
Nurses	21 (1.88)	22.16 (1.47)	0.343
Auxiliary nurses	17.40 (3.45)	21.50 (1.67)	<0.001
Paramedics	12.50 (4.94)	21.10 (1.79)	0.001
Total	17.47 (3.03)	21.81 (1.69)	<0.001
Judgment ^b	69.88% (moderate)	87.24% (good)	–
Attitude (Min = 15, Max = 96)			
Physicians	70.16 (12.75)	78.75 (9.81)	<0.001
Nurses	71.33 (14.33)	80.34 (6.19)	<0.001
Auxiliary nurses	69.79 (8.49)	79.13 (10.23)	<0.001
Paramedics	57.90 (7.47)	75.20 (7.37)	0.004
Total	68.65 (10.99)	79.23 (7.83)	<0.001
Judgment ^b	71.5% (moderate)	82.5% (good)	–

^a Paired *t*-test.

^b % of correct responses; Scores were categorized as good (>75%), moderate (50%–74%), or poor (<50%).

($p < 0.001$). Of the four professional groups, the highest mean score was among nurses (mean = 71.33). Their score improved to 80.34 after the intervention. The lowest mean score was among paramedics (mean = 57.90). Their score improved to 75.20 after the intervention. Overall, participants had moderate scores for the knowledge and attitude questionnaires at baseline (69.88%, 71.5%, respectively). Their scores for knowledge and attitude improved to a good level after the intervention (87.24%, 82.5%, respectively) (Fig. 1).

3.3. Compliance with hand hygiene

For all four professional groups, we recorded 498 hand-hygiene opportunities during 33 sessions before the intervention and 508 opportunities during 36 sessions after the intervention. Overall, compliance was found to be 25.7% before the intervention, and improved to 58.8% after the intervention. We noted increases in hand hygiene compliance for all categories of health professionals and for all hand-hygiene indications (Table 3). With the patients' involvement in the use of 'Reminder

Card,' healthcare workers became more conscious and committed to hand hygiene practices as prescribed by the WHO guidelines (5 steps of hand hygiene).

We recorded a significant increase in the use of hand rubbing. Hand rubbing became the preferred method of hand hygiene action after intervention. Higher compliance rates were observed among nurses, which improved from 31.7% compliance before the intervention to 62.4% compliance after the intervention. Regarding five moments indicating hand washing, the highest compliance was related to indication "after contact with body fluids." Compliance after contact with body fluids improved from 56.7% before intervention to 76.8% after the intervention. The lowest compliance rate was related to indication "before touching a patient." Compliance for this indication was relatively low both before (15.6%) and after the intervention (42.2%) (Fig. 2).

Error bars show 95% confidence intervals for mean compliance rate. Observation periods before and after implementation lasted 3 months each. The moments indicating hand-hygiene were: 1 = before

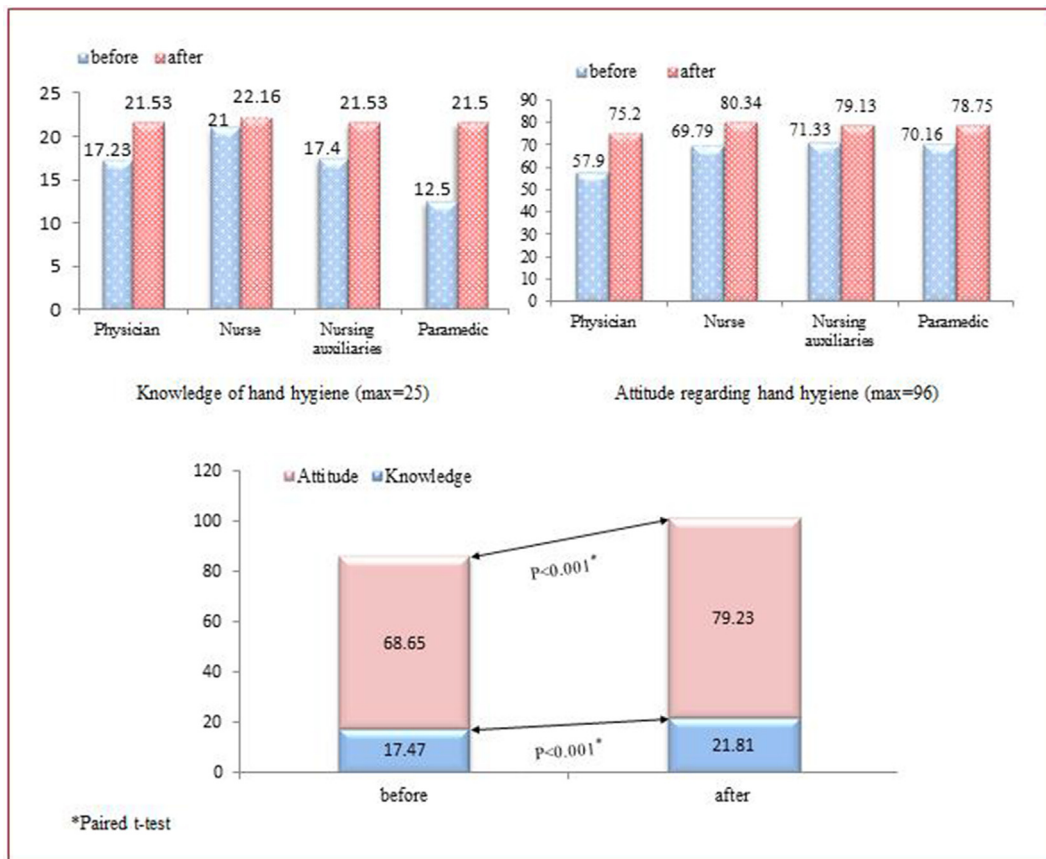


Fig. 1. Knowledge and attitude of hand hygiene before and after intervention overall and among different health care workers professional groups.

Table 3. Effects of the intervention on hand-hygiene compliance by health care professionals and hand hygiene indications.

	Before				After			
	HW	HR	OPP	Compliance (%)	HW	HR	OPP	Compliance (%)
Professional categories								
Physicians	27	22	198	24.7	30	23	96	55.2
Nurses	21	13	107	31.7	40	88	205	62.4
Nursing auxiliaries	21	16	158	23.4	34	66	164	60.9
Paramedics	5	3	35	22.8	10	8	43	41.8
Total	74	54	498	25.7	114	185	508	58.8
Indications								
Before touching a patient	8	11	87	21.8	17	25	90	46.7
Before aseptic tasks	4	8	52	23.1	11	19	55	54.5
After contact with body fluids	36	15	90	56.7	108	186	35	76.8
After contact with a patient	8	13	79	26.5	24	54	122	63.9
After contact with the patient's closest surroundings	11	14	160	15.6	13	44	135	42.2

HW: Hand wash, HR: Hand rub, Indic: Indications, OPP: opportunity.

patient contact, 2 = before an aseptic task, 3 = after risk of exposure to body fluid, 4 = after patient contact, 5 = after contact with patient surroundings.

3.4. Consumption of hand disinfectant

Consumption of soap during the pre-intervention period was 55 litres (l) and after intervention 93.5 L. Similarly, consumption of alcohol-based hand rub during the pre-intervention period was 89 L and after intervention 203 L. During the pre-intervention period, 607 patient-days were produced on the ward equaling a consumption of 12.94 and 20.95 mL (ml)/patient-days of soap and hand rub respectively. During the post-intervention period, 643 patient-days were produced on the ward equaling a consumption of 20.77 and 45.10 ml/patient-days of soap

and hand rub respectively (Table 4). This means that the total consumption of soap and hand rub rose by 8% and 25%, respectively, from the pre-intervention baseline (Fig. 3).

4. Discussion

The overall knowledge and attitude of healthcare workers improved from 'moderate' at baseline to 'good' after the intervention. The highest and lowest hand hygiene knowledge and attitude were among the nurses and paramedics, respectively. Most of this study' participants demonstrated good knowledge of hand hygiene following the intervention. This corroborates the findings of some studies including a study at the Dubti Referral Hospital in Ethiopia [14], and a multispecialty hospital in India [15], which reported 65.9% and 90.0% prevalence of

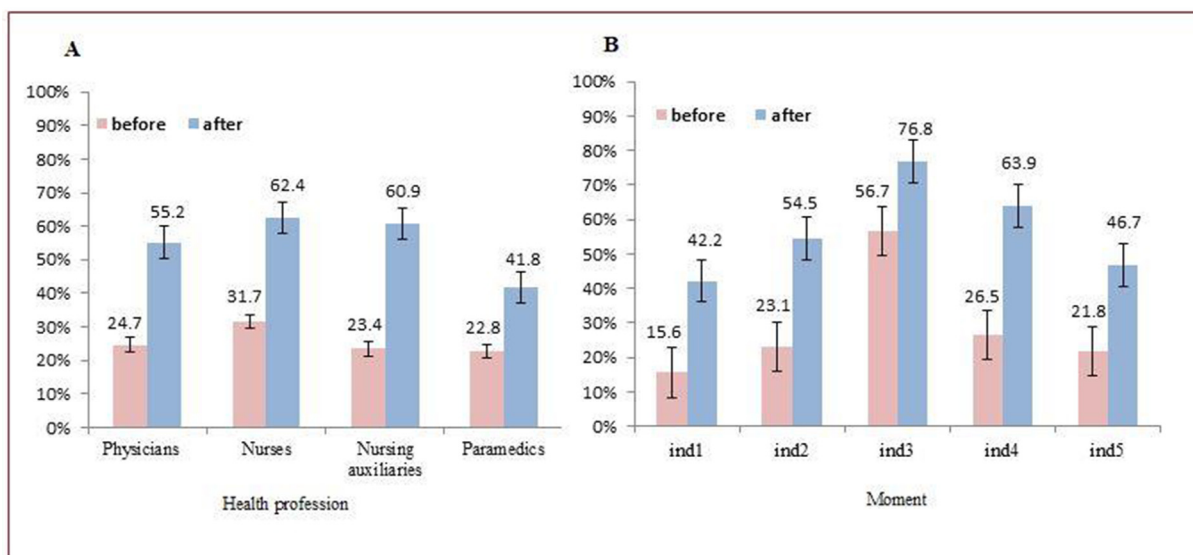


Fig. 2. Overall hand-hygiene compliance rate before and after implementation of intervention by: (A) category of health professional and (B) moments indicating hand-hygiene.

Table 4. Consumption of hand disinfectants before and after intervention.

Washing with soap and water	Before	After	P-value
Total consumption (litres)	55	93.5	0.01 ^a
Consumption per patient-day (milliliters)	12.94	20.77	0.01 ^a
Alcohol-based hand rub solution	Before	After	P-value
Total consumption (litres)	89	203	0.01 ^a
Consumption per patient-day (milliliters)	20.95	45.10	0.01 ^a

^a Indicates statistical significance (P < 0.05).

good knowledge about hand hygiene, respectively. This could be due to the global hand hygiene awareness campaign and sensitization carried out to reduce the spread of infections from person-to-person, especially in hospital environments.

Furthermore, the present study reveals a remarkable improvement in participants' knowledge following the intervention. This contradicts the findings of a descriptive cross-sectional study in South Africa where participants had poor knowledge regarding hand hygiene as a basic measure of infection control [16]. Meanwhile, the highest mean score was found among the nurses before and after intervention. Our results differ from the findings reported in a study conducted at a super-specialty hospital in India where knowledge and awareness were found to be excellent (>80%) among doctors [17]. Our findings could be as a result of nurses' level of access to hand hygiene resources, and their closeness to patients when compared to other professional groups. It may also be attributed to their perceived risks of contracting and transferring infections during patient handling.

An appreciable increase in knowledge level was also found among our participants, except for the nurses. We concluded that the intervention had a significant positive effect on participants' knowledge level, except among the nurses. These results corroborate with conclusions in a study which found that the intervention improved hand hygiene compliance and knowledge among healthcare workers in two out of three intervention departments in a limited-resource hospital in Indonesia [18].

Most of the study participants showed moderate to good attitudes towards hand hygiene practices from pre-intervention to post-intervention phases. This is comparable the 93.1% prevalence of positive attitude towards hand hygiene among healthcare providers observed by Ango and colleagues [19] in northern Nigeria. This could be ascribed to their positive working conditions and administrative support through the provision of necessary hand hygiene materials for personnel use. Though there tended to

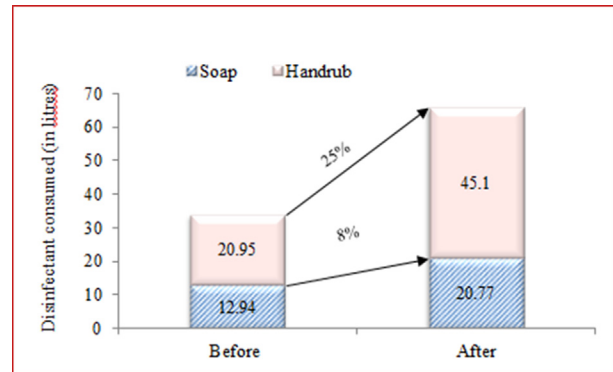


Fig. 3. Consumption of hand disinfectant before and after intervention (value in litres).

be a negative attitude towards hand hygiene among the paramedics when compared to others before the intervention, there was a significant positive change in their attitude following the intervention. This reveals the effectiveness of the intervention on their attitude towards hand hygiene practices. The positive attitude we observed after intervention is similar to positive attitude to hand hygiene among respondents in a Nigerian study [19], among Indian nurses compared to other healthcare workers [20], and among nurses and resident doctors in a cross-sectional study [17].

The negative attitude among the paramedics may be a result of lack of adequate training on hand hygiene importance and the steps involved, their personal indifferent attitudes, or their failure to recognize the risks of infection spread through improper hand hygiene. However, the opposite is the case in Egypt which satisfactory attitude has been found among nurses and technicians [17]. Therefore, it is crucial to ensure adequate and continuous training (formal or informal) of all healthcare workers, including those who do not provide direct patient care. Proper monitoring of hand hygiene practices may also be needed.

The overall compliance rate was improved following the intervention. Similar findings were reported in an observational study conducted among health providers in a tertiary hospital in Ghana with hand hygiene compliance rate improving from 9.2% to 57% for doctors and 9.6%–54% among nurses [7]. But our findings differ from poor compliance with hand hygiene found in a review conducted by Malliarou [21]. Such improvement could be credited to the effects of the use of reminder cards on hand hygiene before patients' handling and the awareness that patients are involved in ensuring proper hand hygiene practices. The variance in the findings can be due to individual differences and the level of exposure to hand hygiene education.

Furthermore, marked and significant improvement in compliance with hand hygiene practices was found among all categories of health professionals and for all hand hygiene indications. A high level of compliance was found mostly among nurses before and after the intervention. Meanwhile, many nurses preferred hand rubbing over other methods of hand hygiene. This result supports Nigerian study that an overwhelming majority of their respondents (96.5%) observed hand hygiene practices, yet only about two-thirds (69.8%) do so consistently [6]. These results are similar to the 67% prevalence of compliance with hand hygiene practices reported in another study conducted in Ghana [7]. This implies that the intervention promotes the rate of compliance towards hand hygiene among healthcare workers.

This study also revealed that the rate of compliance is high only when personnel has come in contact with blood and body fluids before and after intervention. Also, most healthcare workers use hand rubbing methods for hand hygiene. This is similar to the findings of a study in Germany [8] where the hand hygiene complaint rates varied with its indications ranging from 55% to 85%. The same could be found in an Ethiopian research study in which poor hand hygiene compliance rates were reported [14]. Poor compliance towards other indications for hand hygiene as stated in WHO regulations could be due to improper orientation and less importance attached to hand hygiene for all indication situations. Such indications include before coming in contact with patients, before and after each procedure, before the aseptic task, and when personnel come in contact with patients' surroundings. Similar findings were reported by Wetzker et al. [8] where the rates of hand hygiene performance for all types of healthcare worker were significantly higher after patient contact than before patient contact. This may occur because of the health care workers' consciousness of infection prevention and control practices and their risks of being infected with patients' blood or blood products. This is in line with the findings of a study that found an increase in hand hygiene compliance from 27.0% to 60.6% and from 22.2% to 48.6% in intervention arms 1 and 2, respectively. Both intervention arms showed increased hand hygiene compliance after the intervention compared to controls, which had a 21.6% compliance rate [3].

We observed that the intervention significantly affected consumption rates of hand hygiene materials. The consumption of soap and water, as well as the use of the hand rub, greatly increased after the intervention. We also concluded that the

participants preferred hand rub as long as it was available in their facility. The reason for this could be due to the ease of hand rub's usage, constituents, and portability when compared with the use of soap and water, which is more sophisticated. Hand washing also necessitates a hand drier or towel after handwashing. On the contrary, Le et al. [2] reported that handwashing was the preferred method among their study participants and claimed its effectiveness over hand rub especially when handling patients.

We found that the positive attitude towards hand hygiene among the physicians did not translate to their compliance. This could be a result of individual intentions and decisions to not exhibit hand hygiene. This may be explained in the theory of planned behavior, which suggests that intention is the most important predictor of behavior. Intention is affected by three factors: attitude, subjective norm, and perceived behavioral control. As such, physicians' rate of compliance to hand hygiene practice may be due to their individual beliefs about whether internal and external variables may hinder or facilitate in the performance of a behavior. For example, for the factor of "behavioral control," physicians may believe that their lack of time prohibits them from completing hand hygiene. Physicians may have a poor disposition to reminders, such as verbal reminders or visual reminders. Thus, these reasons may contribute to physicians having a lower hand hygiene compliance rate compared to other professional groups.

5. Limitations

First, data for this study were obtained from one hospital. Future studies should investigate this issue with more healthcare workers in different hospitals using cluster-randomized controlled trials. Second, the Hawthorne impact, which refers to the tendency of people to behave differently when they know that they are being observed, could be a major source of bias. In our observational study, we had observers directly monitor participants for compliance, which may have influenced participant behavior. Hand hygiene compliance is often greater throughout observation time points because healthcare workers are aware of being observed, and are therefore inclined to present better performance. Factors such as individual differences among patients during the course of the study, and the safety culture among others are likely to have affected the findings. Furthermore, qualitative examinations are required to discover nurses' life experiences about aspects influencing the hand hygiene compliance rate. It is, therefore, recommended that future researchers

conduct a wide multicenter research study. Since several unexamined factors including individual and institutional factors (e.g., educational status, work experience and safety culture) could influence hygiene compliance [9], the impact of Reminders Cards will likely be impressed by these factors. Future research must incorporate clinical scientists' experience with that of behavioral scientists who are capable of incorporating qualitative interpretation of contextual factors into the analysis of results.

6. Conclusion

To promote quality, safe care and infection prevention in the hospital, integrating patient participation strategies such as the use of a 'Reminder Card' into routine inpatient care should no longer be delayed by healthcare workers. The healthcare personnel should also make conscious efforts to practice hand hygiene as specified in the infection prevention and control guidelines. In addition to this, they should also receive proper orientation about hand hygiene and attach more importance to hand hygiene for all situations.

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Conflict of interest

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