

Effect of Voice Reminder on Compliance with Recommended Hand Hygiene Practise among Health-care Workers in Kano Metropolis

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Abstract

Background: Poor compliance with recommended hand hygiene practise by health-care workers is an emerging public health threat associated with significant morbidity, mortality and spread of multidrug-resistant microorganisms. **Objective:** This study assessed the effect of voice reminder on compliance with recommended hand hygiene practise among the baseline, and post-intervention compliance with recommended hand hygiene among health-care workers using the WHO checklist for observation of 5-moments of hand hygiene of health-care workers in Kano. **Methods:** Quasi-experimental study design was used. A total of 408 (204 in each arm) baseline and post-intervention observations were conducted in two hospitals in Kano, selected using a multistage sampling technique. Voice reminders were installed in the intervention hospital, and post-intervention observation was conducted 3 months after introducing a voice reminder. SPSS version 22.0 was used for data analysis. Relationship between variables was tested using χ^2 and McNemar's test within the groups at 0.05 α -level of significance. **Results:** Baseline compliance with hand hygiene in the intervention and control hospitals were 31.4% and 48.0%, respectively. Post-intervention compliance in the intervention and control hospitals were found to be 78.0% and 65.2%, respectively. Voice reminder improved compliance with hand hygiene practise when compared with baseline by +148% ($P^* = 0.3$) in the intervention hospital compared with +36% ($P^* = 0.1$) in the control hospital. The differences were not statistically significant post-intervention when compared with the baseline. **Conclusions:** Voice reminder intervention improved hand hygiene compliance among health-care workers in the intervention hospital compared with the control hospital. Voice reminders should be provided in the hospitals by stakeholders. This can help in improving compliance with hand hygiene among health-care workers and reducing the burden of hospital-acquired infections due to the hands of health-care workers.

Keywords: Compliance, hand hygiene, health-care workers, hospitals, Kano

INTRODUCTION

During the delivery of health services, the health-care worker's hands come in contact with surfaces and other materials with the total number of hand exposures in a health-care facility ranging from as many as several tens of thousands per day, with each hand-to-surface exposure associated with the exchange of microorganisms.^[1] Clinician's compliance with hand hygiene practises was

reported to be low worldwide despite evidence that it reduces infections.^[1]

Up to about 50% of health-care-associated infection occurs through the hands of health-care providers.^[2-5] It is a significant public health problem, causing increased morbidity, prolonged

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hospital admissions, increased financial burden of care and increased in-hospital deaths, with the increasing high infection rates, generally linked to poor hand hygiene compliance.^[4-7] An economic analysis of the ‘clean your hands’ hand hygiene campaign reported that the programme would be cost-beneficial if health-care-associated infection rates were decreased by as little as 0.1%.^[3-7] A single hospital-acquired infection may cost the hospital significant resources per survivor.^[8,9] The magnitude of this problem is more in developing countries where basic infection control measures are inadequate in most health facilities due to combination of factors such as understaffing, poor hygiene, lack of basic equipment, all of which may be linked to inadequate financial resources.^[8,9]

The use of customised electronic hand hygiene reminder has been suggested to improve hand hygiene compliance among health-care workers.^[10] Electronic voice prompt has been acknowledged to provide hand hygiene reminder in hospitals and is effective in promoting practise of hand hygiene among service providers.^[6] Several electronic systems and tools have been developed to improve hand hygiene activity including video monitoring systems, individual health-care worker electronic devices and the use of alcohol sensor technology.^[10] The strategies necessary for improving hand hygiene compliance require an adequate provision of alcohol-based hand rub and soap and water, training and education of health-care workers on primary infection prevention and control including hand hygiene, evaluation and feedback of performance, provision of workplace reminders including voice reminder that could promote and improve hand hygiene behaviour.^[11-13]

The reminder’s role was corroborated by a study investigating improved reminders at individual patient room entrances and found a significant increase in alcohol-based hand rub use and reduced health-care-associated infection rates.^[13] More so, the electronic motion sensor triggered audible reminder was found to significantly improve compliance among health-care providers.^[13,14] Due to the paucity of data, it is essential to conduct a survey that can assess compliance with hand hygiene practise among health-care workers in Kano to implement infection control measures mainly due to the identified evidence on the positive role of hand hygiene compliance in Nigeria.^[15] Similarly, instituting a voice reminder intervention that was reported to improve compliance in other countries can provide information on its local use in promoting compliance and this can provide the basis for comparison with other countries. This study assessed the effect of voice reminder intervention on compliance with recommended hand hygiene practise among health-care workers in Kano Metropolis.

METHODS

Ethical approval

Approval from the Health Research Ethics Committee of Kano State Ministry of Health and Aminu Kano Teaching Hospital with approval number MOH/Off/797/TI/752 and

NHREC/21/08/2008/AKTH/EC/2278 dated 08 June 2018 and 19 July 2018, respectively, were obtained. All the provisions of Helsinki’s declaration were ensured. Data were collected between February 2019 and October 2019.

Study design and setting

A quasi-experimental study design was used in Kano to study all the health-care workers in Specialist Hospitals of Kano involved in inpatient care who have been employed for at least 6 months. Members of infection prevention and control committee and newly employed health-care workers were excluded from the study. Health-care workers working in Primary Health Care Facilities owned by the local government and tertiary facilities owned by the federal government were not involved in this study. Kano is the capital of Kano state located in the northwestern part of Nigeria having a projected total population of 13,605,021 in 2019 based on 3.1% annual growth rate.^[16-18] There are 8 specialist hospitals within the metropolis owned by Kano state government, there is a teaching hospital and national orthopaedic hospital owned and manned by the Federal Government of Nigeria. For the specialist hospitals, there are about 800 medical professionals including doctors, nurses and community health extension workers working at the Murtala Muhammad Specialist Hospital (MMSH), currently has 250 beds and 20 departments, the largest being the department of medicine. Patients are seen all through the week, especially inpatients, but outpatients are seen mainly from Monday to Friday.^[17] There are about 120 health-care workers working at the Hasiya Bayero Paediatrics hospital and include doctors, nurses and Community Health Extension Workers (CHEWs). The hospital has 100 beds and 5 wards, in addition to immunisation clinic, DOTS clinic, sickle cell clinic, pharmaceutical unit, pathology unit, X-ray room and paediatrics outpatient section.^[17]

The management of the two hospitals ensures a continuous supply of water, soap and alcohol-based hand rub for proper hand hygiene as recommended by the WHO to prevent hospital-associated infections. Matron in charge of each unit is responsible for keeping the stocks of materials needed for hand hygiene.^[17,18]

Sample size calculation

The total number of hand hygiene opportunities observed was calculated using the formula for comparing two proportions.^[18]

$$n = \frac{(Z_{\alpha} + Z_{1-\beta})^2 (P_1[1-P_1] + P_2[1-P_2])}{(P_1 - P_2)^2}$$

Using Z_{α} = Standard normal deviate equivalent to 5% level of significance obtained from the normal distribution table = 1.96, $Z_{1-\beta}$ = Standard normal deviate, the probability of type II error (β) of power at 80% = 0.84 (obtained from normal distribution table), P_1 = Compliance rate of 78% among health-care workers in Nigeria^[19] and P_2 = 65.3% compliance rate from the previous study in Nigeria.^[20] To account for missing observation forms, 10% was added. Therefore, 408 (204) hand hygiene opportunities were observed at baseline 3-month post-intervention.

Sampling technique

A multistage sampling technique was employed in which two out of the eight specialist hospitals were selected by a simple random procedure. The selected hospitals were MMSH and Hasiya Bayero Paediatric Hospitals (HBPH). A coin was then tossed between two research assistants to determine whom to choose first in selecting which of the two hospitals will serve as intervention or control. Up to 25% of the wards in the selected intervention hospital (HBPH) and control hospital (MMSH) were randomly selected for the study by balloting. Hand hygiene opportunities to be observed were proportionately allocated based on the number of health-care workers (doctors, nurses and CHEWs) to be observed in the selected wards of the intervention and control hospital, respectively.

Data collection tool

To exclude unintentional plagiarism, plagiarism detection tool was used to reduce similarity index to below 10%. Pre-tested observation form adapted from the World Health Organization technical reference manual (WHO) was used.^[6,21] The tool was modified to consist of three columns, to study the three categories of health-care workers involved in inpatients care and consists of a header and the corresponding grid.

Header

This was for precise recording of the location where observation for hand hygiene was conducted in terms of time and place (setting, date, session duration and the observer identification) including ward and department.

Grid

The observation grid was used for the collection of data needed to measure compliance. It was divided into three columns. The first column was dedicated to doctors, the second column was dedicated to nurses/midwives and the third column was dedicated to community health extension workers. Each column was independent of the other columns. The column contained eight boxes and each box corresponding to an opportunity where the indications and the positive or negative actions observed were entered. The grid employed the following abbreviations for the five hand hygiene indications: Bef pat: (before touching a patient), bef. asept (before clean/aseptic procedure), aft. b. f: (after body fluid exposure risk), aft. pat (after touching a patient) and aft. p. surr (after touching patient surroundings). Also included was HR: hand rubbing with an alcohol-based formulation and HW: handwashing with soap and water.^[6,21,22]

Glove use was only recorded when the health-care professional under observation was wearing gloves when an opportunity occurred and did not perform a hand hygiene action.^[6,21,22] Any personnel who decontaminated his or her hands immediately after contact with a patient and then directly attended another patient without touching any object, for example, equipment, door handles or any other patient was considered to have complied with hand hygiene practise in relation to the second patient, same for the other moments of

hand hygiene as determined by the WHO.^[6,21,22] Each form was checked immediately after the observation session and the end time, duration of the session and signed appropriately.^[6,21,22]

Data collection technique

Three trained doctors served as observers in each selected ward of the intervention and control hospitals. The doctors were recruited from other hospitals in Kano outside the study areas. Activities carried out during the training sessions included interactive PowerPoint presentation, role plays and demonstrations to ensure a good grasp of the tool. Two doctors served as simultaneous observers with the third doctor, more senior served as an independent observer in each of the selected wards and health-care workers were blinded to the observation and therefore were not aware of the observation. Health-care workers were blinded to the observation by the research assistants and therefore did not know that they were being observed to reduce observation bias.

Pre-intervention phase

The observations were conducted from 9 am to 12 pm daily in the morning and 5 pm to 8 pm for 10 days.^[22] Any move to have hand hygiene regardless of whatever it may be, was recorded based on the indication and the professional category (doctor, nurse and CHEW).^[17,22] A positive hand hygiene action was reported according to the method used that is, either hand rubbing with an alcohol-based hand rub, or washing with soap and water. Where a positive action was recorded without a corresponding indication, it was not counted for analysis. Negative hand hygiene actions were also recorded so that the opportunities were included in the analysis. Hand hygiene opportunities involving more than one indication, only one was considered for the sake of simplicity of analysis by applying the following priority rule: before-aseptic procedure > after-body fluid > after-patient contact > before-patient contact > after-patient surrounding.^[6,17,21] Several health-care workers were observed and blinded to the observation at the same time (when they were working with the same patient or in the same room), however, not more than two health-care workers were observed simultaneously.^[6,17,21,22]

Intervention phase

The following were conducted before the introduction of the voice reminder and were done in both the intervention and the control hospitals:

Providing hand hygiene consumables

In collaboration with the hospital management of the intervention and control hospitals, the barriers identified to hand hygiene compliance including the continuous supply of alcohol-based hand rub and soap and water were appropriately addressed. To ensure equity in the distribution, the units head were involved in the collection of the consumables and formal requests if there is need for re-stock.^[22]

Hand hygiene training

The training employed the use of PowerPoint presentations based on health belief model^[23] and covered: Hand hygiene,

standard isolation precautions, environmental cleaning, water and sanitation, sterilisation and disinfection procedures, infectious waste management and sharps safety consequences of poor compliance with infection prevention and control guideline to the health-care workers, their family and the community. Health-care workers not available during the training provided their E-mail addresses, and phone numbers to their unit heads and the presentations were shared with them, phone call was used to remind them and a physical meeting was organised for clarification of key areas of concern.

Posters on 5-moments of hand hygiene

Posters promoting five moments for hand hygiene were distributed for placement in all the wards of both intervention and control hospitals.

Voice Reminder (Reminder Rosie)[®]

Reminder Rosie was installed in the three selected wards of intervention hospital (HBPH). Rosie is a personalised, voice-controlled reminder system designed to solve memory loss challenges and serve to remind its users on what needs to be remembered. It uses cutting edge technologies and understands English and any other language.^[24] It has a hands-free trigger, custom reminders, multiple reminders – any time or date and emergency back-up system.^[24]

Reminders were recorded in both Hausa and English but at a different period to be repeated at intervals, reminding health-care workers to observe hand hygiene using the 5-moments of hand hygiene (before touching a patient, before performing an aseptic procedure, after touching a patient, after contact with body fluids and after contact with patients surrounding). It was placed in the central nurses' station located at the intervention hospital's selected wards and handed to the ward in charges.

Data management

Data were analysed using IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp after verification and consistency checks.

Pre-intervention phase

Results were presented in the form of tables, numbers and chats. Compliance with hand hygiene was assessed from incidences observed and reported in the observation form. The outcome variable was compliance with recommended hand hygiene practise (hand rubbing/hand washing) while the independent variables were professional cadre, ward, days of the week, shifting period/time of observation. For both baseline and post-intervention data, Chi-square test was used for comparison of proportions between compliance and the independent variables, and statistical significance was set at $P \leq 0.05$. Baseline and post-intervention predictors of compliance with recommended hand hygiene practise were determined using a $P \leq 0.10$.

Post-intervention phase

Observations and data collection activities were conducted

using the same technique used to collect the baseline data in the intervention and control hospitals, 3 months after introducing voice reminder intervention. Percentage difference was calculated as the difference in compliance after the intervention with compliance before the intervention. The result was then divided by the compliance before the intervention and expressed as a percentage. Effect of voice reminder intervention within the intervention and control hospitals was assessed using the McNemar's test.

RESULTS

Baseline compliance with recommended hand hygiene practise among health-care workers in the intervention and control hospitals

Table 1 shows that 59.8% of the baseline observation for compliance with recommended hand hygiene were conducted during working days in the intervention hospital compared with the observation of 91.2% in the control hospital. Baseline compliance was found to be 31.4% and 48% in the intervention and control hospitals, respectively, and was significantly higher (50.0%) during working days (Monday to Friday) in the control hospital compared with the intervention hospital ($P < 0.001$).

Post-intervention compliance with recommended hand hygiene practises among health-care workers in the intervention and control hospitals

Post-intervention compliance was 159 (78.0%) and 133 (65.2%) practise in the intervention and control hospitals, respectively. Up to 76.5% of the observations were conducted from Monday to Friday. Post-intervention compliance with recommended hand hygiene was significantly higher (83%, $P = 0.02$) in the intervention hospital compared with the control hospital as shown in Table 2 below.

Effect of voice reminder on compliance with recommended hand hygiene practise in the intervention and control hospitals

There was an increase in overall post-intervention compliance with recommended hand hygiene practise (+148%, $P^{\#} = 0.3$), 3 months after introducing a voice reminder in the intervention hospital. There was a significant increase in compliance with recommended hand hygiene in the intervention hospital when compared with the baseline observation of the same variable 3 months after introduction of voice reminder intervention, that is, morning hours compliance at baseline and 3-month post-introduction of voice reminder (+254%, $P^{\#} < 0.001$). Similar statistically significant association was obtained for Monday to Friday (+208%, $P^{\#} = 0.01$) and among nurses (+208%, $P^{\#} = 0.002$) in the intervention hospital as shown in Table 3.

Table 4 shows an overall increase in post-intervention compliance with hand hygiene practise in the control hospital by +36%, $P^{\#} = 0.1$ when compared with the overall baseline compliance. Compliance with recommended hand hygiene was found to significantly increase when the baseline compliance

Table 1: Comparison of baseline compliance with recommended hand hygiene practise among health-care workers in the intervention and control hospitals

Variables	Intervention hospital (n = 204)			Control hospital (n = 204)			χ^2	P
	n	Compliant, n (%)	Non-compliant, n (%)	n	Compliant, n (%)	Non-compliant, n (%)		
Ward								
Emergency	85	13 (15.3)	72 (84.7)	34	9 (26.5)	25 (73.5)	0.4	0.5
Non-emergency	119	51 (42.9)	68 (57.1)	170	89 (52.4)	81 (47.6)	2.5	0.1
Days of the week								
Monday-Friday	122	32 (26.2)	90 (73.8)	186	93 (50.0)	93 (50.0)	17.3	<0.001*
Saturday-Sunday	82	32 (39.0)	50 (61.0)	18	5 (27.8)	13 (72.2)	0.8	0.4
Time of the day								
Morning (9 am-12 pm)	64	15 (23.4)	49 (76.6)	81	31 (38.3)	50 (61.7)	3.6	0.06
Evening (\geq 5 pm)	140	49 (35.0)	91 (65.0)	123	67 (54.5)	56 (45.5)	10.1	0.002*
Profession								
Doctors	66	25 (37.9)	41 (62.1)	81	54 (66.7)	27 (33.3)	12.1	<0.001*
Nurses	89	23 (25.8)	66 (74.2)	73	25 (34.2)	48 (65.8)	1.4	0.2
CHEWs	49	16 (32.7)	33 (67.3)	50	19 (38.0)	31 (62.0)	0.3	0.6
Hand hygiene indication								
Before patient contact	48	12 (25.0)	36 (75.0)	44	15 (34.1)	29 (65.9)	0.9	0.3
Before aseptic procedure	35	7 (20.0)	28 (80.0)	35	17 (48.6)	18 (51.4)	6.3	0.01*
After contact with body fluid	61	26 (42.6)	35 (57.4)	53	37 (69.8)	16 (30.2)	8.5	0.004*
After patients contact	20	8 (40.0)	12 (60.0)	27	15 (55.6)	12 (44.4)	1.1	0.3
After contact with patient's surrounding	40	11 (27.5)	29 (72.5)	45	14 (31.1)	31 (68.9)	0.1	0.7

*Statistically significant. OR: Odds ratio, CI: Confidence interval, CHEWs: Community Health Extension Workers

Table 2: Comparison of post-intervention compliance with recommended hand hygiene practise among health-care workers in the intervention and control hospitals

Variables	Intervention hospital (n = 204)			Control hospital (n = 204)			χ^2	P
	n	Compliant, n (%)	Non-compliant, n (%)	n	Compliant, n (%)	Non-compliant, n (%)		
Ward								
Emergency	63	52 (82.5)	11 (17.5)	46	26 (56.5)	20 (43.5)	8.8	0.003*
Non-emergency	141	107 (75.9)	34 (24.1)	158	107 (67.7)	51 (32.3)	2.4	0.1
Days of the week								
Monday-Friday	156	126 (80.8)	30 (19.2)	127	75 (59.1)	52 (40.9)	16.0	<0.001*
Saturday-Sunday	48	33 (68.8)	15 (31.2)	77	58 (75.3)	19 (24.7)	0.6	0.4
Time of the day								
Morning (9 am-12 pm)	129	107 (83.0)	22 (17.0)	117	77 (65.8)	40 (34.2)	9.6	0.002*
Evening (\geq 5 pm)	75	52 (69.3)	23 (30.7)	87	56 (64.4)	31 (35.6)	0.4	0.5
Profession								
Doctors	42	33 (78.6)	9 (21.4)	71	56 (78.9)	15 (21.1)	0.001	0.97
Nurses	133	106 (79.7)	27 (20.3)	101	62 (61.4)	39 (38.6)	9.5	0.002*
CHEWs	29	20 (69.0)	9 (31.0)	32	15 (46.9)	17 (53.1)	3.0	0.1
Hand hygiene indication								
Before patient contact	28	18 (64.3)	10 (35.7)	31	12 (38.7)	19 (61.3)	3.9	0.05*
Before aseptic procedure	95	81 (85.3)	14 (14.7)	98	77 (78.6)	21 (21.4)	14.5	<0.001*
After contact with body fluid	35	34 (97.1)	1 (2.9)	38	26 (68.4)	12 (31.6)	10.3	0.001*
After patients contact	17	12 (70.6)	5 (29.4)	14	8 (57.1)	6 (42.9)		†0.4
After contact with patient's surrounding	29	14 (48.3)	15 (51.7)	23	10 (43.5)	13 (56.5)	0.1	0.7

*Statistically significant. OR: Odds ratio, CI: Confidence interval, CHEWs: Community Health Extension Workers

was compared with the post-intervention compliance during evening shift (+18.0%, $P^{\#}$ =0.02) and among doctors (+18.3%, $P^{\#}$ =0.01) in the control hospital.

DISCUSSION

The World Health Organization has recommended guidelines

Table 3: Compliance with recommended hand hygiene practise among health-care workers in the intervention hospital

Variables	Before intervention		After intervention		Percentage difference	P [#]	OR (95% CI)
	Compliant	Non-compliant	Compliant	Non-compliant			
Overall compliance	64 (31.4)	140 (68.6)	159 (78.0)	45 (22.0)	+148	0.3	0.05 (-0.4-0.1)
Ward							
Emergency	13 (15.3)	72 (84.7)	52 (82.5)	11 (17.5)	+440	0.07	1.4 (0.9-2.0)
Non-emergency	51 (42.9)	68 (57.1)	107 (75.9)	34 (24.1)	+77	0.003*	0.6 (0.5-0.9)
Days of the week							
Monday-Friday	32 (26.2)	90 (73.8)	126 (80.8)	30 (19.2)	+208	0.01*	0.7 (0.5-0.9)
Saturday-Sunday	32 (39.0)	50 (61.0)	33 (68.8)	15 (31.2)	+76.2	0.06	1.5 (0.9-2.0)
Time of the day							
Morning (9 am-12 pm)	15 (23.4)	49 (76.6)	107 (83.0)	22 (17.0)	+253	<0.001*	0.5 (0.3-0.6)
Evening (≥5 pm)	49 (35.0)	91 (65.0)	52 (69.3)	23 (30.7)	+98	0.001*	1.8 (1.2-2.5)
Profession							
Doctors	25 (37.9)	41 (62.1)	33 (78.6)	9 (21.4)	+107	0.3	1.2 (0.8-2.0)
Nurses	23 (25.8)	66 (74.2)	106 (79.7)	27 (20.3)	+208.4	0.002*	0.6 (0.4-0.8)
CHEWs	16 (32.7)	33 (67.3)	20 (69.0)	9 (31.0)	+111	0.07	1.7 (0.9-2.9)
Hand hygiene indication							
Before patient contact	12 (25.0)	36 (75.0)	18 (64.3)	10 (35.7)	+157	0.01*	2 (1.1-3.5)
Before aseptic procedure	7 (20.0)	28 (80.0)	81 (85.3)	14 (14.7)	+326	<0.001*	0.3 (0.2-0.5)
After contact with body fluid	26 (42.6)	35 (57.4)	34 (97.1)	1 (2.9)	+128	0.9	1.0 (0.6-1.7)
After patient's contact	8 (40.0)	12 (60.0)	12 (70.6)	5 (29.4)	+76.5	1.0	1.0 (0.4-2.2)
After contact with patient's surrounding	11 (27.5)	29 (72.5)	14 (48.3)	15 (51.7)	+75.5	0.02*	2.1 (1.1-4.0)

*Statistically significant, #McNemar. OR: Odds ratio, CI: Confidence interval, CHEWs: Community Health Extension Workers

Table 4: Compliance with recommended hand hygiene practise among health-care workers in the control hospital

Variables	Before intervention		After intervention		Percentage difference	P [#]	OR (95% CI)
	Compliant	Non-compliant	Compliant	Non-compliant			
Overall compliance	98 (48.0)	106 (52.0)	133 (65.2)	71 (34.8)	+35.7	0.1	0.1 (-0.01-0.1)
Ward							
Emergency	9 (26.5)	25 (73.5)	26 (56.5)	20 (43.5)	+113.0	0.9	0.9 (0.6-1.7)
Non-emergency	89 (52.3)	81 (47.7)	107 (67.8)	51 (32.2)	+29.0	0.06	0.8 (0.6-1.0)
Days of the week							
Monday-Friday	93 (50.0)	93 (50.0)	75 (59.1)	52 (40.9)	+18.0	0.2	1.2 (0.9-1.7)
Saturday-Sunday	5 (27.8)	13 (72.2)	58 (75.3)	19 (24.7)	+171.2	<0.001*	0.2 (0.1-0.4)
Time of the day							
Morning (9 am-12 pm)	31 (38.3)	50 (61.7)	77 (65.8)	40 (34.2)	+72.0	0.02*	0.6 (0.5-0.9)
Evening (≥5 pm)	67 (54.5)	56 (45.5)	56 (64.4)	31 (35.6)	+18.2	1	1.1 (0.7-1.4)
Profession							
Doctors	54 (66.7)	27 (33.3)	56 (78.9)	15 (21.1)	+18.3	0.001*	0.5 (0.3-0.8)
Nurses	25 (34.2)	48 (65.8)	62 (61.4)	39 (38.6)	+79.2	0.2	0.8 (0.5-1.1)
CHEWs	19 (38.0)	31 (62.0)	15 (46.9)	17 (53.1)	+23.4	0.02*	2.1 (1.1-3.8)
Hand hygiene indication							
Before patient contact	15 (34.1)	29 (65.9)	12 (38.7)	19 (61.3)	+13.5	0.008*	2.4 (1.2-4.7)
Before aseptic procedure	17 (48.6)	18 (51.4)	77 (78.6)	21 (21.4)	+61.8	<0.001*	0.2 (0.1-0.4)
After contact with body fluid	37 (69.8)	16 (30.2)	26 (68.4)	12 (31.6)	+2.0	0.1	0.6 (0.3-1.1)
After patient's contact	15 (55.6)	12 (44.4)	8 (57.1)	6 (42.9)	+3.0	0.4	1.5 (0.6-3.7)
After contact with patient's surrounding	14 (31.1)	31 (68.9)	10 (43.5)	13 (56.5)	+40.0	0.001*	3.1 (1.5-6.3)

*Statistically significant, #McNemar. OR: Odds ratio, CI: Confidence interval, CHEWs: Community Health Extension Workers

for hand hygiene, and its central theme is to wash hands with soap and water when it is visibly dirty or soiled with blood or other body fluids or after toilet use. The guidelines recommended washing with water and soap or an alcohol-based hand rub.^[1,3,6] This study reported the overall

baseline compliance with handwashing with soap and water or hand rubbing with an alcohol-based hand rub to be 32.0% in the intervention and 48.0% in the control hospital, respectively. The difference in the baseline compliance between the intervention and the control hospitals may likely be due to the

scope of services provided, with the control hospital providing both medical and surgical services, unlike the intervention hospital, being predominantly a paediatric hospital and may serve as one of the limitations of this study. This may, however, result in more hand hygiene training, especially among the hospital's surgical specialities by both governmental and non-governmental organisations. Overall, both hospitals' finding was low concerning the prevention of transmission of hospital-acquired infection and in keeping with studies conducted in Nigerian Teaching Hospitals and other studies globally.^[3,19,20,25] However, a study conducted in a private Nigerian tertiary hospital found overall compliance with hand hygiene to be 55.0% in agreement with what was reported by a study conducted in Saudi Arabia,^[5] likely due to less number of patients who can afford care in private hospitals in Nigeria and a good number of health-care workers relative to the number of patients that will look after patients in the private setting, in addition to readily available materials and consumables necessary to observe hand hygiene.^[17] The compliance was also found to be higher than what was obtained in a study conducted in a University Teaching Hospital in Ethiopia serving more than five million Ethiopians as a referral facility^[3] that reported compliance of (16.5%) among the study participants which was attributed to lack of training on hand hygiene and materials needed by the health-care workers. However, the presence of other neighbouring referral health facilities owned by both the State Government and Federal Government in Kano may reduce the number of patients thereby reducing the workload among the health-care workers and maybe the likely reason for better compliance identified by this study that may translate into lower prevalence of hospital-acquired infections.

Baseline compliance reported in emergency wards of intervention hospital (15.3%) was lower than what was reported by a study conducted in a private Nigerian tertiary hospital of 16.7%^[26] and lower than the reported compliance in the control arm (26.5%) of this study. This poor compliance may be linked to the high patients turnout in the emergency wards unlike in non-emergency wards which could be explained by a limited number of health-care providers to meet up with the demand of emergency cases, especially in resource-poor countries like Nigeria.

Post-intervention compliance in the intervention and control hospitals were found to be 78.0% and 65.2%, respectively, with overall increased in compliance to be + 148% and + 36% in the intervention and control hospitals. Although not statistically significant, these show improvement in compliance when compared with the baseline. The difference emphasised the recommendation by the WHO^[1,6,27] on the need for a multifaceted hand hygiene programmes to ensure improved compliance with hand hygiene. This implies that, if other components such as surveillance for hand hygiene, use of hand hygiene champions and role models, hand hygiene policies, among others are integrated could significantly improve compliance with hand hygiene guidelines.

An interventional study conducted in Argentina found the baseline compliance to be 62%, and post-intervention compliance in the control group was 66.0% and 75.6% compliance in the intervention group.^[28] This was in agreement with the finding by this study that demonstrated relative increase in compliance in the control group, likely due to hand hygiene training and improve supply of hand hygiene consumables, though better compliance was observed in the intervention hospital, which may be explained by using voice reminder targeted towards improving compliance. Similarly, a study conducted in Washington^[10] that utilised voice reminder found 24% and Baltimore, Maryland^[29] 28% increase in compliance after the intervention. Many folds increase in compliance were identified in this study after introducing voice reminder intervention compared with baseline compliance. This could be explained by voice reminder which was programmed to offer a regular reminder, in the form of spaced learning and can promote positive behaviour change as demonstrated by a significant increase in compliance during working days (+208%) and during morning hours (+253%) in the intervention hospital.

This study was limited by intra-observer, and inter-observer variations, these were minimised in observing hand hygiene opportunities by having two independent observers. Furthermore, the Hawthorne effect was minimised by blinding the health-care workers to the person conducting the observation and observation time and therefore did not know that they were been observed.

CONCLUSION AND RECOMMENDATIONS

Voice reminder significantly improved compliance with recommended hand hygiene practises among health-care workers. The government should domesticate and ensure the installation of voice reminders in the hospital wards to improve hand hygiene compliance.

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Conflicts of interest

There are no conflicts of interest.

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