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# An assessment of hand hygiene perception and practices among undergraduate nursing students in Lagos State: A pilot study

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## Abstract:

**BACKGROUND:** The contaminated hands of health-care professionals (HCPs) is an implicated vector in the transmission of potentially pathogenic organisms to vulnerable patients. The aim of this study was to derive baseline data on hand hygiene (HH) practices among a cohort of students at the Lagos State School of Nursing and to determine their perception about the adequacy of instructions they receive.

**MATERIALS AND METHODS:** A descriptive, cross-sectional study was conducted on a probability random sample of 69 nursing students at the Lagos State School of Nursing at the Alimosho Igando General Hospital. The knowledge, attitude, and practice as well as the perception of the respondents on the adequacy of their infection control instructions were obtained using an interviewer-administered questionnaire. Data entry and analysis were done using SPSS software version 20 (IBM Corp., Armonk, NY, USA),  $P < 0.05$  was considered statistically significant. Multivariate linear and logistic regressions were done to assess which factors were truly significant predictors, with odds ratios (ORs) and 95% confidence intervals (CIs) specified as the measures of association between predictors and outcome variables.

**RESULTS:** Majority of participants were  $\leq 20$  years old (50.7%,  $n = 35$ ) and were in their second year of study (44.9%,  $n = 31$ ). Participants were least knowledgeable about the importance of discarding gloves and not washing or reusing them (16 [23.1%]). The mean score on the Hand Hygiene Beliefs Scale was  $86.2 \pm 9.0$ , with scores ranging from 23 to 88 out of a possible high score of 115. The most positive health beliefs were associated with being a role model for HH ( $3.57 \pm 0.52$ ), while the worst was associated with imitating bad HH practices performed by senior colleagues ( $1.29 \pm 1.20$ ). Caring for a wound (60 [87.0%]) was most associated with the need for HH, while demonstration and clinical practice were rated as the most effective teaching methods. Results of the multivariate logistic regression analysis, with the outcome variable of good self-reported HH practices, revealed that the odds of appropriate behavior were higher if the student nurses were in their third year of study (OR = 1.59; 95% CI: 1.01–2.45). An appropriate behavior was also more likely in student nurses with a higher risk perception (OR = 1.54; 95% CI: 1.03–2.51).

**CONCLUSION:** Despite the overwhelming evidence that HH is effective in the prevention of hospital-acquired infections, its performance among HCPs remains far less than optimal. Since students will someday be influencing future HH compliance behaviors of other health-care workers, the importance of HH should be adequately incorporated into their school curriculum.

## Keywords:

Hand hygiene, nosocomial infections, nursing students

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## Introduction

Healthcare-associated infections (HAIs) are those that become apparent while

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patients are being treated within health-care institutions, in whom the infection was not present or incubating at the time of admission. This includes infections acquired in the hospital but appearing after discharge, and also occupational infections among staff of the facility.<sup>[1]</sup> Primarily, patients bear the burden of morbidity, mortality, and prolonged hospitalization associated with HAIs, and it is projected that there are over 1.4 million people worldwide with infections acquired in hospitals at any period of time.<sup>[2,3]</sup> The prevention of infection requires a multifaceted strategy. Infectious agents can be transmitted to a susceptible host by a host of methods such as carriage on equipment, through airflow, and direct spread on the hands of health-care workers. The contaminated hands of health-care workers is an implicated vector in the transmission of potentially pathogenic organisms to vulnerable patients;<sup>[4]</sup> hence, such transmissions are preventable. Hand hygiene (HH) is a proven method to reduce the incidence of HAIs.

HH is a comprehensive term that includes hand washing which involves removing soil and transient microorganisms from the hands using soap and water and hand antisepsis which entails the removal or elimination of microorganisms from the hands with an antiseptic agent, in the form of an alcohol-based hand rub or an antiseptic soap. HH also includes the care of the fingernails. Adherence to HH recommendations is the single most important practice for preventing the transmission of microorganisms in health care, which directly contributes to patient safety.<sup>[5]</sup> A number of studies have showed a positive effect of improved HH on nosocomial infection rates<sup>[6,7]</sup> as well as transmission risks in day-care centers, schools, and community settings.<sup>[8]</sup>

Nonetheless, in spite of CDC guidelines that recognize HH as the most significant process in the prevention of nosocomial infection,<sup>[9]</sup> an unacceptable compliance rate is still observed among health-care professionals (HCPs).<sup>[10]</sup> Nigeria is one of the countries with a high burden of HCAs,<sup>[11,12]</sup> yet the HH campaign is not commonly promoted in many health-care facilities in the country. Some researchers have shown that adherence of HCPs to guidelines for HH is very low, generally <50%.<sup>[13,14]</sup> Many HCPs are not aware of the standard procedures involved in HH, and appropriate facilities for optimal infection control are also often lacking, including reasonably simple measures such as provision of water, soap, and clean paper towels to regularly wash hands between patient contacts.<sup>[15]</sup> Other factors perceived as contributing to poor HH compliance include unavailability of hand washing sinks, time required to perform HH, patient's condition, effect of HH products on the skin, and insufficient knowledge of the guidelines.<sup>[16,17]</sup> In addition, some authors opine that

role models, group behavior, and the level of managerial support influence the reported levels of compliance.<sup>[17]</sup>

Nurses are a very strategic subset of health workers and they are more likely to have more frequent contact with patients than other HCPs. The provision of patient hygiene is one of the most regularly performed nursing care activities, making them frequently exposed to blood and other bodily fluids of the patient. The recent Ebola outbreak in Nigeria amplifies this reality as it was observed that the first Nigerian victim, who eventually died was a nurse. Health workers' education is a key strategy in the reduction of HAIs through infection prevention and control programs. Some researchers have highlighted the inadequacy of many undergraduate programs to effectively train students of various clinical disciplines,<sup>[18,19]</sup> possibly indicating a causal link between undergraduate education and the lack of compliance with infection control guidelines.

The aim of this study was thus to derive baseline data on HH practices among a cohort of students in the Lagos State School of Nursing and to determine their perception about the adequacy of instructions they receive. The information derived from this research will provide the basis for recommendations for the modification of the standard precautionous component of their training with a view to significantly improve their compliance with hospital infection control guidelines.

## Materials and Methods

### Research design

A descriptive, cross-sectional study was conducted on a probability random sample of 69 consenting participants recruited from a pool of 120 undergraduate nursing students registered in years 1, 2, and 3 in the School of Nursing of the Alimosho Igando General Hospital of Lagos State.

### Ethical considerations

The protocol for the study was submitted to the Hospital's Health Research and Ethics Committee and written approval was obtained (HREC. 10/06/277). In addition, the departmental heads of the nursing and midwifery School of Nursing were contacted, and access to their nursing students was requested. Eighty students were recruited, but only 69 agreed to participate in the anonymous survey. Participation was voluntary, and the students were assured that their responses will be kept confidential. Written informed consent was also obtained from all the participants.

### Study setting

This study was conducted from August to September 2015 at the Lagos State School of Nursing located within

the premises of the Alimosho Igando General Hospital, which is a multispecialty hospital serving the most populated local government area with a population of 1.28 million people. It is also a referral center for the environs and it provides services in community health; surgery; obstetrics and gynecology; pediatrics; ophthalmology; hematology; and dental and medical services. It has approximately 450 staff members inclusive of 29 administrative/clerical, 144 nurses, and 71 medical doctors. The Lagos State School of Nursing is located in the premises of the hospital. The participants in this study were years 1, 2, and 3 in the School of Nursing of the Alimosho Igando General Hospital of Lagos State. The students were surveyed at their school during their off-clinic hours.

### Sample selection

From a reference study with a knowledge prevalence of 59.8%,<sup>[20]</sup> the estimated sample size of 189 was computed using an equation for descriptive studies. A total of 69 students were however enlisted for this pilot study due to the low student population in the nursing school. A multistage sampling method was utilized with stratification of the students into the three levels at the first stage and simple random sampling at the second stage using the nominal roll of students as the sampling frame.

### Data collection

A self-administered questionnaire was used for data collection. The first section of the questionnaire obtained the examined sociodemographic characteristics of the study participants, while the second segment utilized the modified Hand Hygiene questionnaire which had ten multiple-choice questions that assessed basic HH knowledge; 13 Likert scale inquiries that assessed the students' opinions of the effectiveness of various teaching methods about HH; 23 Likert scale questions which assessed students' attitude and health belief about HH; and 14 Likert scale questions on the students' practices of HH. Each correct knowledge score obtained 1 mark, while each wrong response had a score of 0. Scores on individual items in the Likert scale ranged from 1 to 5.

### Data collection procedure

On approval of the study by the relevant authorities, written consent was obtained from all the enlisted participants after explaining to them that their participation is voluntary and that their responses will be kept confidential. Self-administered questionnaires were then given to participants during their off-clinic hours. The questionnaires had clear instructions on how to fill the multiple response segment as well as the Likert-like questions while the students were encouraged to seek further clarification where necessary. Each filled questionnaire was checked to ensure that it was

completed in its entirety, and gratitude was expressed to the participants.

### Data analysis

The data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 20 (IBM Corp., Armonk, NY, USA). Data were normally distributed as assessed by the Shapiro–Wilk test. Results were presented as percentages and frequencies, using charts and tables including univariate analysis. Bivariate analysis was done to measure the association between dependent and independent variables. The maximum obtainable knowledge, attitude, and practice scores were 10, 115, and 70, respectively. Knowledge scores were dichotomized as 0–3 for poor; 3.1–7 for fair; and >7 for good. Attitude and practice scores were categorized as poor or good based on scores above or below the mean scores of  $86.2 \pm 9.0$  and  $57.1 \pm 6.4$ , respectively, while individual mean scores for each question were also obtained. The Chi-square test was used to determine the level of association between categorical variables. The Student's paired *t*-tests and ANOVA tests were used to compare means to determine the level of association between the variables. Multivariate linear and logistic regressions were done to assess which factors were truly significant predictors, with odds ratios (ORs) and 95% confidence intervals (CIs) specified as the measures of association between predictors and outcome variables. A 95% CI and  $P < 0.05$  (two tailed) were considered statistically significant.

## Results

### Description of demographic characteristics of participants

The total number of participants recruited for this study were 69, of which 95.7% ( $n = 66$ ) were female and 4.3% ( $n = 3$ ) were male. The majority of participants were  $\leq 20$  years old (50.7%,  $n = 35$ ). Majority of the respondents (44.9%,  $n = 31$ ) were in their second year of study [Table 1].

The HH knowledge was evaluated with ten multiple-choice questions. Scores on the questionnaire were presented as a percentage of correct answers. The combined scores on the ten questions ranged from 2.9% to 81.2%. Participants were most knowledgeable about the performance of HH before patient contact, following emptying of a drain, and prior to/after venepuncture. They were least knowledgeable about the importance of discarding gloves and not washing or reusing them (16 [23.1%]) [Table 2].

The mean score on the Hand Hygiene Beliefs Scale was  $86.2 \pm 9.0$ , with scores ranging from 23 to 88 out of a possible high score of 115; higher scores were associated with more positive health beliefs. Scores

on individual items in the scale ranged from 1 to 5. The most positive health beliefs were associated with being a role model for HH (3.57 ± 0.52); having HH emphasized by supervisors (3.57 ± 0.52); and having it in the curriculum (3.54 ± 0.92), while the worst was associated with imitating bad HH practices performed by senior colleague (1.29 ± 1.20) [Table 3].

The frequency that participants reported performing HH is presented in percentages. The scores ranging from 23.2% to 81.2% and a score of 100% signify that HH is always performed on every indication. Caring for a wound (60 [87.0%] participants with mean (MN) ± standard deviation (SD) = 3.81 ± 0.58) was associated mostly with the performance of HH, while before coming in contact with a patient was least perceived to require HH (16 [23.2] participants with MN ± SD = 1.59 ± 1.06) [Table 4]. Overall, 27.5% of the respondents had good knowledge, while 31.9% and 44.9% had good practices [Table 5].

**Table 1: Demographic characteristics of the study participants**

Variable	Frequency (%)
Age	
≤20	35 (50.7)
21-25	30 (43.5)
≥26	4 (5.8)
Mean±SD	20.86±2.44
Gender	
Female	66 (95.7)
Male	3 (4.3)
Year of study	
First	14 (20.3)
Second	31 (44.9)
Third	24 (34.8)

Minimum and maximum ages were 17 and 30 years, respectively. SD: Standard deviation

**Table 2: Frequency and percentage of correct answers to knowledge questions**

Knowledge questions	Correct response	n (%)
Alcohol-based hand rubs should not be used	When hands are visibly soiled	41 (59.4)
Incorrect statement about alcohol-based hand rubs	Alcohol-based hand rub is effective if applied for 60 s	25 (36.2)
Incorrect statement about HH	HH is not required following the removal of gloves	18 (26.1)
Acceptable method for hand drying in patients' care areas	Single-use cloth towels and paper towels are acceptable for drying hands in patient-care areas	25 (36.2)
When HH should be performed	HH must be performed before patient contact, following emptying of a drains, and prior to/after venepuncture.	56 (81.2)
Position of hand when using alcohol-based hand rub	When using an alcohol-based hand rub to decontaminate hands, they should be rubbed together until dry	33 (47.8)
HH not required	Following handling of paperwork	49 (71.0)
Which of the following is incorrect?	HH is not required following contact with bed linen with a multidrug-resistant <i>Staphylococcus aureus</i> infection.	39 (56.5)
Which of the following is incorrect?	The use of hand creams and lotion is not recommended or health-care workers because they increase the load of pathogens on the hands	28 (40.6)
Which of the following statement about gloves is incorrect?	The same pair of gloves can be used when caring for different patients as long as they are washed between patients	16 (23.1)

HH: Hand hygiene

The teaching methods that participants rated as the most effective were demonstration and clinical practice with mean scores of 3.47 ± 0.68 and 3.41 ± 0.63, respectively, out of a possible score of 5. The lowest rated methods included research articles, websites, computer simulations, and videos, with more than half of the participants rating each as mildly effective or not effective [Table 6].

Table 7 displays the results of the multivariate logistic and linear regression models. Student nurses in their 3<sup>rd</sup> year of study (OR = 1.64; 95% CI: 1.15–3.02), those with a higher risk perception (OR = 1.35; 95% CI: 0.82–2.06), and those who perceived the HH teaching methods they received as effective (OR = 1.24; 95% CI: 0.81–2.01) had better knowledge about HH (Model 1).

The results of the linear regression model showed that third-year student nurses, student nurses with a higher risk perception, and those who do not follow the example of senior health-care worker when deciding whether or not to perform HH had significantly more positive attitudes about HH (Model 2).

Results of the multivariate logistic regression analysis, with the outcome variable of good self-reported HH practices, also revealed that the odds of appropriate behavior were higher if the student nurses were in their third year of study (OR = 1.59; 95% CI: 1.01–2.45). An appropriate behavior was also more likely in student nurses with a higher risk perception (OR = 1.54; 95% CI: 1.03–2.51) (Model 3).

## Discussion

Nurses constitute the highest percentage of HCP, and they devote more time to patient care than other HCPs,



**Table 3: Attitude/positive beliefs of respondents about hand hygiene**

Questions on attitude/beliefs	Mean±SD
HH is considered an important part of the curriculum	3.54±0.92
The facilities in which I do practicals emphasize the importance of HH	3.35±0.80
The importance of HH is emphasized by my clinical supervisors	3.39±0.89
I have duty to act as a role model for other health-care workers	3.57±0.52
When busy, it is more important to complete my task than to perform HH	2.48±1.30
Performing HH in the recommended situation can reduce patients' mortality	3.29±0.77
Performing HH in the recommended situation can reduce medical cost associated with hospital-acquired infections	3.19±0.86
I can't always perform HH in recommended situation because my patients' needs come first	1.70±1.08
Prevention of hospital-acquired infection is a valuable part of health-care workers' role	2.58±0.65
I follow the example of senior health-care workers when deciding whether or not to perform HH	1.29±1.20
An infectious disease contracted in the health-care setting may threaten my life or my career	3.47±0.74
I believe I have the power to change poor practice in the workplace	3.31±0.53
Failure to perform HH in the recommended situation can be considered negligence	3.13±0.78
HH is a habit for me in my personal life	3.41±0.73
I'm confident that I can effectively apply my knowledge of HH to my clinical practice	3.53±0.56
It is an effort to remember to perform HH in recommended situations	2.94±0.90
I would feel uncomfortable reminding other health professionals to wash their hands	2.42±1.30
Performing HH slows down building immunity to disease	1.92±1.62
Dirty sinks can be reason for not washing hands	2.35±1.27
Lack of acceptable soap product can be a reason for not cleansing hands	1.91±1.34
Performing HH after caring wound can protect from infection	2.56±0.81
Cleansing hands after toilet use can reduce the transmission of infectious diseases	3.89±0.30

SD: Standard deviation, HH: Hand hygiene

and hence their compliance with HH recommendations appears to be more critical in the prevention of disease transmission among patients. The total number of participants recruited for this study were 69 and they were mainly females since the profession is mainly populated by the female gender. Participants were most knowledgeable about the performance of HH before patient contact, following emptying of a drain, and prior to/after venepuncture. They were however least knowledgeable about the importance of discarding gloves and not washing or reusing them. Failure to replace or discard contaminated gloves, the erroneous belief that glove use negates the need for HH, and the failure of HCPs to implement HH prior to and

**Table 4: Self-reported hand hygiene practices of respondents**

HH practices	Always	Mean±SD
After going to the toilet	47 (68.1)	3.49±0.85
Before caring for a wound	33 (47.8)	3.06±1.07
After caring for a wound	60 (87.0)	3.81±0.58
After touching potentially contaminated objects	52 (75.4)	3.70±0.58
After contact with blood or bodily fluids	55 (81.2)	2.75±0.60
After inserting an invasive device	39 (56.5)	3.53±0.55
Before entering a patient's room	35 (50.7)	2.23±0.89
After contact with a patient's skin	41 (59.4)	2.42±0.79
After existing a patient's room	43 (62.3)	3.49±0.85
Before suctioning a patient	28 (40.6)	2.01±0.98
After contact with a patient's secretions	51 (73.9)	2.65±0.64
Before patient contact	16 (23.2)	1.59±1.06
After removing gloves	35 (50.7)	2.33±0.80
If the hands look or feel dirty	41 (59.4)	3.25±1.04

SD: Standard deviation, HH: Hand hygiene

after glove use are factors that have been previously reported as affecting HH compliance.<sup>[21]</sup> A previous descriptive study of HCPs revealed that the failure to change or remove contaminated gloves was a major factor resulting in poor HH compliance and high risk for microbial transmission.<sup>[22]</sup> The practice of using gloves, but not replacing them after contamination, increases the possibility of cross-transmission of pathogens and increased risk of HAIs.<sup>[23]</sup>

Concerning the attitude of the participants, the most positive health beliefs were associated with being a role model for HH and having HH emphasized by supervisors, while the worst was associated with imitating bad HH practices performed by senior colleague. Previous researchers have shown that the influence of poor role modeling negatively influences HH compliance among students and that intention to perform HH among health workers is often influenced by how they perceive the opinions of important role models.<sup>[24-26]</sup> The significance of the role model has been observed and used efficaciously as an fundamental part of campaigns promoting HH in the intensive care setting.<sup>[27,28]</sup> Seto *et al.*<sup>[24]</sup> confirmed that communication of information by opinion leaders was significantly more effective for implementing a new guideline on care than other strategies. Conversely, the perception of being a model to other colleagues was independently associated with better compliance with HH among physicians.<sup>[26]</sup> These studies thus imply that when opinion leaders become cognizant of their influence, they are more compliant and their commitment may have a positive impact on health-care workers' perceptions and intention to comply with HH.

In our study, caring for a wound and activities that were perceived to present with a higher risk of

**Table 5: Knowledge, attitude, and practice of respondents about hand hygiene**

Categories	Frequency (%)
Knowledge	
Poor (<4)	12 (17.4)
Fair (4-6)	38 (55.1)
Good (>7)	19 (27.5)
Attitude	
Poor (<81)	47 (68.1)
Good ( $\geq 82$ )	22 (31.9)
Practice	
Poor (<57)	38 (55.1)
Good ( $\geq 57$ )	31 (44.9)

**Table 6: Perceived effectiveness of hand hygiene teaching methods**

Teaching Methods	Highly effective	Mean $\pm$ SD
Lectures	43 (62.3)	3.06 $\pm$ 0.75
Tutorials	30 (43.5)	2.68 $\pm$ 0.98
Clinical practice	33 (47.8)	3.41 $\pm$ 0.63
Demonstrations	39 (56.5)	3.47 $\pm$ 0.68
Practical laboratory sessions	19 (27.5)	2.30 $\pm$ 1.28
Videos	13 (18.8)	1.94 $\pm$ 1.42
Textbooks	26 (37.7)	2.31 $\pm$ 1.13
Lecturer notes	26 (37.7)	2.34 $\pm$ 1.13
Computer simulation	23 (33.3)	1.91 $\pm$ 1.43
Websites	20 (29.0)	2.03 $\pm$ 1.21
Research article	21 (30.4)	2.13 $\pm$ 1.24
National or international hygiene guidelines	35 (50.7)	2.67 $\pm$ 0.93
Posters	28 (40.6)	2.19 $\pm$ 0.94

SD: Standard deviation

infection to the health worker were most associated with the performance of HH. Overall, compliance was greater when the perceived risk was apparently higher. In addition, the students had very high compliance for personal HH practices such as using the toilet and when the hand looks or feels dirty. Conversely, HH performance was perceived to be least important before coming in contact with a patient. These findings are in agreement with that by other studies that reveal a low rate of HH before interacting with the patients.<sup>[29-31]</sup> The rates of performance were higher after patient interactions, confirming the suggestions of some authors that health workers' hand washing rates increase when there is perceived risk for their own health.<sup>[29,30]</sup> This perception was demonstrated in these studies by higher percentages of HH compliance after touching patients than before touching patients and also in high-risk patient contact service centers such as the emergency room, wound dressing/treatment rooms, and labor ward than that it was in medium-risk patient contact centers such as the inpatient wards. The greatest motivating factor for hand washing among the health workers is thus the fear of contracting disease.

Age and gender were not significantly associated with the knowledge and health belief of the study participants associated with hand washing behavior. Third-year respondents were however significantly more likely to have better knowledge, attitude, and HH practices. Exposure of the senior students to more clinical practice may be responsible for this observation. Overall, 27.5% of the respondents had good knowledge, while 31.0% and 44.9% had good practices. These results reveal obvious deficits in the cognitive, affective, and behavioral domains of the respondents with regard to HH. The teaching methods that participants rated as most effective were demonstration and clinical practice, while the lowest rated methods included evidence-based sources such as research articles, websites, computer simulations, and videos, with more than half of the participants rating each as mildly effective or not effective. This result suggests that undergraduate education of the students on transmission-based precautions may be inadequate.<sup>[32]</sup> Some international studies observed that nurses prefer to approach colleagues for information rather than access evidence-based resources.<sup>[33,34]</sup> The reasons mentioned in the literature for preferring human sources to evidence-based information include convenience, an apparent lack of computer skills, and avoidance of large amounts of retrieved information which has to be read, analyzed, and evaluated.<sup>[35]</sup>

The recent outbreak of Ebola hemorrhagic fever in Nigeria due to its importation into the country by a Liberian National made these deficiencies obvious even though the public health institutions in the country eventually rose to the occasion. This was after a period of ill preparedness and glaring deficiencies in compliance to standard precaution protocols. The increasing presence of new and evolving pathogens in health-care environments and the effect of clinician education on reducing the spread of HAIs require an urgent review of the present curriculum. While it is important to educate HCPs about the theoretical and practical aspects of HH, it must however be similarly appreciated that inadequate education is not the only barrier to compliance.<sup>[36]</sup> Provision of materials and equipment for HH such as regular water supply, sinks, waste disposal facilities, alcohol-based hand rubs, and other toiletries are known to be inadequate in resource-constrained environments like Nigeria. It is imperative that these additional barriers to HH practice are eliminated if proper compliance is anticipated.

Literature shows that compliance to standard precaution measures reduces the rate of hospital-acquired infections. Hand washing with clean water and soap and/or use of alcohol-based hand rubs has been recommended by the WHO as a practical infection prevention strategy prior to and after patient contact.<sup>[37]</sup>

**Table 7: Multivariate logistic (1 and 3) and linear (2) regression model results**

Variables	OR adjusted	95% CI	P
<b>Model 1: Knowledge about HH</b>			
Log likelihood, $\chi^2$ , P	-288.5, 10.24, 0.0162		
Educational level - year of study			
First*	1.0		
Second	1.22	0.67-1.89	0.198
Third	1.64	1.15-3.02	0.007
Student nurses with higher risk perception	1.35	0.82-2.06	0.012
Perceived effectiveness of HH teaching methods	1.24	0.81-2.01	0.131
Variables	Coefficient	t	P
<b>Model 2: Positive attitude/beliefs about HH</b>			
F, P, R <sup>2</sup>	4.96, 0.0003, 4.48%		
Educational level - year of study			
First*	1.0		
Third	0.4	1.63	0.065
Constant			
Student nurses with higher risk perception	0.33	1.82	0.038
Student nurses who do not follow the example of senior health-care worker when deciding whether or not to perform HH	0.25	1.75	0.055
Variables	OR adjusted	95% CI	P
<b>Model 3: Good self-reported HH practices</b>			
Log likelihood, $\chi^2$ , P	243.23, 21.17, 0.0012		
Educational level - year of study			
First*	1.0		
Second	1.34	0.62-1.72	0.188
Third	1.59	1.01-2.45	0.025
Student nurses with a higher risk perception	1.54	1.03-2.51	0.038
Student nurses who do not follow the example of senior health-care worker when deciding whether or not to perform HH	1.42	0.95-2.61	0.031

\*Reference group. CI: Confidence interval, OR: Odds ratio, HH: Hand hygiene

## Conclusion

This study demonstrated inadequate HH knowledge, health beliefs, and practices among nursing students. It also showed that they were inadequately exposed to evidence-based information sources. Despite the overwhelming evidence that consistent HH practice is effective in preventing infection and reducing the spread of HAI, HH behavior among HCPs remains far less than optimal.<sup>[37]</sup> Since students will someday be influencing future HH compliance behaviors of other health-care workers, the importance of HH should be adequately incorporated into their school curriculum. Obvious limitations of the study are the sample size, the single center selected, and the fact that it would have been more effective if compliance with HH was observed rather than obtained with a questionnaire. However, the fact that some of the students were at the preclinical stage of their studies precludes direct observation. These data however provide useful baseline data for further exploratory and intervention studies.

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## Conflicts of interest

There are no conflicts of interest.

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