

Original article

Assessment of Hand Hygiene Knowledge Among Undergraduate Medical Students and Intern Doctors in Misurata University, Libya: A Cross-Sectional Study

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Corresponding email. omar@med.misuratau.edu.ly**Abstract**

Hand hygiene is the most essential action to prevent the cross-transmission of harmful microorganisms in health care facilities and to decrease the prevalence of Healthcare-Associated Infections. The lack of related knowledge among medical students could cause adverse consequences as they constitute the future health workforce. This study aims to assess the level of knowledge regarding hand hygiene among preclinical students, clinical students, and intern doctors at Misurata University. A cross-sectional study was done on 255 participants from all study years in the faculty of medicine at Misurata University in July 2025, using an online questionnaire based on a validated WHO 25-point survey, and data were analyzed on SPSS-25. We found that the overall mean knowledge score about hand hygiene (HH) among medical students and interns was moderate. A significant difference was observed between preclinical and clinical year students; the latter had higher knowledge scores. No significant difference in knowledge scores between male and female participants. Participants who received formal training in hand hygiene in the last three years had significantly higher knowledge scores compared to those who did not. This study reveals that there were significant gaps between preclinical & clinical students regarding knowledge of hand hygiene. The overall score was moderate, so regular training sessions and the need to enhance teaching methods are recommended to achieve better results in the future.

Keywords. Hand Hygiene, Knowledge Assessment, Healthcare-Associated Infections, Medical Students, Training.

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Introduction

Healthcare-associated infections are considered a big problem that affects healthcare systems. Prolonged hospital stay, higher resistance to antibiotics, higher morbidity and mortality rates, and higher costs of healthcare service are common associations [1].

Healthcare-associated infections (HAIs), also known as nosocomial infections, are infections contracted by patients during their hospital stay or even after discharge, which were not present upon admission, as well as occupational infections among healthcare workers (HCWs) within the facility. The occurrence rate of HAIs in developed countries ranges from 5.1% to 11.6%, whereas in developing nations, this rate can rise up to 19%, positioning these infections among the top 10 causes of death related to hospital care. Several factors contribute to the occurrence of HAIs, including but not limited to improper hand hygiene (HH), extended stays in hospitals, complex medical procedures, long-term disabilities, improper use of medical devices, cross-infection, antimicrobial-resistant pathogens, and compromised immune systems of patients [2,3]. Worldwide, HAIs are a significant cause of morbidity and mortality, with human hands being the primary vehicle for the transmission of germs in all healthcare settings [4].

Hand hygiene (HH) is the most effective way to prevent the spread of germs and reduce healthcare-associated infections (HAIs) [5]. To combat these infections, including those caused by drug-resistant pathogens, you should use an alcohol-based hand rub for 20-30 seconds or wash your hands with soap and water for 40-60 seconds. This is recommended before and after patient contact, before procedures (both sterile and non-sterile), after potential exposure to germs, and after touching objects in the patient's room. According to current CDC guidelines, use hand sanitizer if your hands aren't visibly dirty; otherwise, wash them with soap and water if they are contaminated with bodily fluids [6,7].

To prevent healthcare-associated infections (HAIs), healthcare workers must maintain good hand hygiene [8]. Despite hand hygiene being a simple practice, adherence is surprisingly low, with a global average of only around 40%. Several factors contribute to this low compliance, including heavy workloads, time pressures, and a lack of knowledge, as well as negative attitudes and misconceptions about infection control. Healthcare facilities also face challenges like

insufficient resources, lack of supervision and training, and the absence of strong role models. Ongoing efforts are therefore focused on finding effective, long-term solutions to these issues [9].

HCAIs are a leading cause of death in hospitals globally, prompting the World Health Organization (WHO) to introduce its "My five moments for hand hygiene" strategy [10,11]. Despite hand hygiene being the most effective and cost-efficient method to prevent these infections, a critical gap in knowledge persists among healthcare providers and students. These infections affect an estimated 4% of hospital admissions and 5–15% of patients in developed countries. Therefore, to improve healthcare quality, it is essential that all individuals involved in patient care prioritize and correctly perform hand hygiene. This can be achieved through structured training and consistent surveillance programs [12].

This study aims to assess the level of knowledge and awareness regarding hand hygiene practices among preclinical students, clinical students, and intern doctors at Misurata University, to compare knowledge levels between study stages, and to assess the impact of formal training on hand hygiene knowledge.

Methods

A cross-sectional study was carried out among undergraduate medical students and intern doctors in the faculty of medicine, Misurata, Libya. The study was conducted in July 2025. A convenience sampling method was used, and all the students from the first year up to the fifth year, as well as intern doctors, were invited to participate in the study via sending an online questionnaire to their groups on social media applications (Facebook, WhatsApp, and Telegram). Students were assured strict confidentiality of the data, and they were assured their anonymous answers.

The WHO Hand hygiene knowledge questionnaire for health care workers was used to assess students' knowledge. Included multiple choice questions; "yes" or "no" questions; and "true" or "false" questions. The questions were related to hand hygiene training, the main route of cross-transmission of the harmful pathogens between patients in a health-care facility, the most common source of germs responsible for HCAs, and hygiene actions that prevent transmission of germs to the patient, and to the health-care worker, minimal time needed for alcohol-based hand rub to kill most microorganisms on hands, and what should be avoided, as associated with a likelihood of colonization of hand with harmful pathogens. The correct response for the questionnaire was obtained from the WHO document for the same.

To assess participants' knowledge, each correct response in the 25-item questionnaire was awarded one point. The total score for each participant was then calculated and hence classified into three categories: scores less than 50% (0-12 points) were considered poor; scores between 50% and 75% (13-18 points) were considered moderate; and scores above 75% (19-25 points) were considered good.

Data entry was done in an MS Excel sheet, and statistical analysis was performed using SPSS (version 25) software. Mean was used to ascertain the central tendency, and standard deviation was used to describe the dispersion. Descriptive statistics were summarized in the form of frequencies and percentages. Inferential statistics were expressed by using the t-test and one-way ANOVA test. The $P < 0.05$ was taken as significant.

Results

A total of 255 participants from Misurata University took part in the study (response rate was 17%), including medical students and intern doctors. There were 205 (80.4%) females and 50 (19.6%) males. The majority of participants (59.6%) were aged between 23–27 years. In terms of academic level, 88 (34.5%) were preclinical students, 72 (28.2%) were clinical students, and 95 (37.3%) were intern doctors.

Regarding formal training in hand hygiene within the last three years, only a limited portion (40%) of the participants had received such training. Around 43.1% mentioned that they routinely use an alcohol-based hand rub for hand hygiene, with a notable difference observed across academic levels (only 28.4% among preclinical students, compared to 58.3% of clinical students and 78.9% of intern doctors).

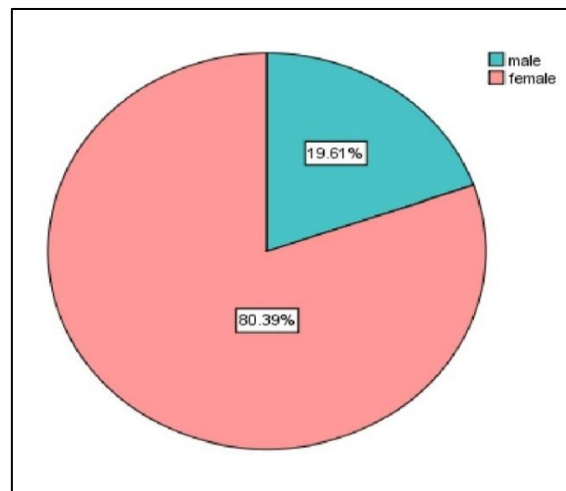


Figure 1: Pie chart describing gender distribution of study participants.

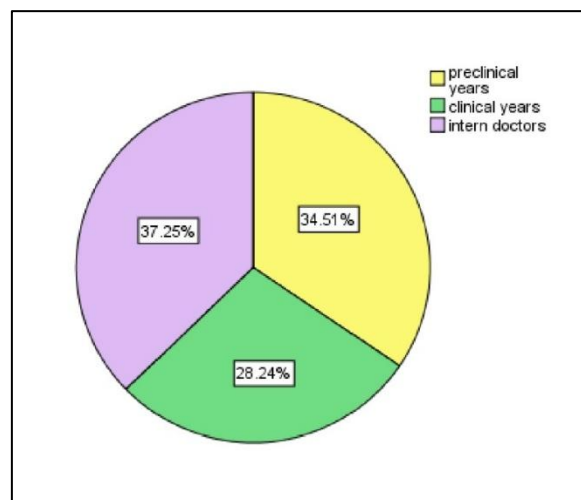


Figure 2: Percentage of participants according to academic stage.

Table 1. Participants' responses to the questions regarding hand hygiene

Section	Sub-Section	Correct Answer	Number (N)	Percentage (%)
Main Route of Germ Transmission	Main route for cross-transmission of germs between patients	Health-care workers' hands when not clean	122	47.8
Source of HCAI Germs	The most frequent source of germs for healthcare-associated infection	Germs are already present on or within the patient	62	24.3
Comparison of Hand rubbing vs. Handwashing	Hand rubbing is more rapid for hand cleansing than handwashing	True	185	72.5
	Hand rubbing causes skin dryness more than handwashing	False	31	12.2
	Hand rubbing is more effective against germs than handwashing	False	130	51.0
	Handwashing and hand rubbing are recommended to be performed in sequence	False	28	11.0
	Before touching a patient	Yes	216	84.7

Hand Hygiene Actions to Prevent Patient Transmission	Immediately after a risk of body fluid exposure	Yes	108	42.4
	After exposure to the immediate surroundings of a patient	No	132	51.8
	Immediately before a clean/aseptic procedure	Yes	108	42.4
Hand Hygiene Actions to Prevent Healthcare Worker Transmission	After touching a patient	Yes	181	71.0
	Immediately after a risk of body fluid exposure	Yes	153	60.0
	Immediately before a clean/aseptic procedure	No	155	60.8
	After exposure to the immediate surroundings of a patient	Yes	161	63.1
Required Method by Situation	Before palpation of the abdomen	Rubbing	188	73.7
	Before giving an injection	Rubbing	204	80.0
	After emptying a bedpan	Washing	201	78.8
	After removing examination gloves	Rubbing/Washing	77/151	30.2/59.2
	After making a patient's bed	Rubbing	119	46.7
	After visible exposure to blood	Washing	189	74.1
Minimal Time for Handrub	Minimal time needed for alcohol-based hand rub to kill most germs	20 seconds	138	54.1
Actions Increasing Germ Colonization	Wearing jewelry	Yes	219	85.9
	Damaged skin	Yes	220	86.3
	Artificial fingernails	Yes	244	95.7
	Regular use of a hand cream	No	184	72.2

Significant differences were observed in several knowledge areas among the three groups. Clinical students demonstrated better knowledge than preclinical students regarding the main route of cross-transmission ($p = 0.018$). Intern doctors had significantly higher knowledge regarding hand hygiene before touching a patient ($p = 0.014$) and immediately after a risk of body fluid exposure ($p = 0.002$). Clinical students were more knowledgeable about the effectiveness of hand rubbing compared to preclinical students ($p < 0.001$). Furthermore, significant differences were found in the knowledge of appropriate hand hygiene methods after emptying a bedpan ($p = 0.015$), after visible exposure to blood ($p = 0.003$), and in the avoidance of wearing jewelry ($p < 0.001$).

Table 2: Comparison between preclinical students, clinical students & intern doctors' response to questions regarding hand hygiene knowledge.

Questions	Preclinical	Clinical	Intern	P-value
Which of the following is the main route of cross-transmission of potentially harmful germs between patients in a health-care facility?				
(correct answer: Health-care workers' hands when not clean)	34 (38.6%)	44 (61.1%)	44 (46.3%)	0.01
What is the most frequent source of germs responsible for healthcare-associated infections?				
(correct answer: Germs already present on or within the patient)	2 (2.3%)	2 (2.8%)	0 (0.0%)	0.50
Which of the following hand hygiene actions prevents transmission of germs to the patient?				
a. Before touching a patient (yes)	67 (76.1%)	62 (86.1%)	87 (91.6%)	0.01
b. Immediately after a risk of body fluid exposure (yes)	30 (34.1%)	43 (59.7%)	35 (36.8%)	0.00

c. After exposure to the immediate surroundings of a patient (no)	47 (53.4%)	30 (41.7%)	55 (57.9%)	0.10
d. Immediately before a clean/aseptic procedure (yes)	34 (38.6%)	36 (50.0%)	38 (40.0%)	0.29
Which of the following hand hygiene actions prevents transmission of germs to the health-care worker?				
a. After touching a patient (yes)	55 (62.5%)	54 (75.0%)	72 (75.8%)	0.09
b. Immediately after a risk of body fluid exposure (yes)	40 (45.5%)	52 (72.2%)	61 (64.2%)	0.00
c. Immediately before a clean/aseptic procedure (no)	56 (63.6%)	43 (59.7%)	56 (58.9%)	0.79
d. After exposure to the immediate surroundings of a patient (yes)	53 (60.2%)	47 (65.3%)	61 (64.2%)	0.77
Which of the following statements on alcohol-based hand rub and hand washing with soap and water are true?				
a. Hand rubbing is more rapid for hand cleansing than hand washing (true)	66 (75.0%)	49 (68.1%)	70 (73.7%)	0.59
b. Hand rubbing causes skin dryness more than hand washing (false)	10 (11.4%)	13 (18.1%)	8 (8.4%)	0.16
c. Hand rubbing is more effective against germs than hand washing (false)	26 (29.5%)	44 (61.1%)	60 (63.2%)	0.00
d. Hand washing and hand rubbing are recommended to be performed in sequence (false)	8 (9.1%)	10 (13.9%)	10 (10.5%)	0.62
What is the minimal time needed for alcohol-based hand rub to kill most germs on your hands?				
(Correct answer: 20 seconds)	51 (58.0%)	47 (65.3%)	40 (42.1%)	0.09
Which type of hand hygiene method is required in the following situations?				
a. Before palpation of the abdomen (rubbing)	51 (58.0%)	53 (73.6%)	84 (88.4%)	0.09
b. Before giving an injection (rubbing)	70 (79.5%)	56 (77.8%)	78 (82.1%)	0.01
c. After emptying a bedpan (washing)	60 (68.2%)	58 (80.6%)	83 (87.4%)	0.01
d. After removing examination gloves (rubbing/washing)	80 (90.9%)	62 (86.1%)	86 (90.5%)	0.03
e. After making a patient's bed (rubbing)	46 (52.3%)	36 (50.0%)	37 (38.9%)	0.04
f. After visible exposure to blood (washing)	56 (63.6%)	52 (72.2%)	81 (85.3%)	0.00
Which of the following should be avoided, as associated with an increased likelihood of colonization of hands with harmful germs?				
a. Wearing jewelry (yes)	64 (72.7%)	64 (88.9%)	91 (95.8%)	0.00
b. Damaged skin (yes)	78 (88.6%)	61 (84.7%)	81 (85.3%)	0.72
c. Artificial fingernails (yes)	80 (90.9%)	71 (98.6%)	93 (97.9%)	0.02
d. Regular use of a hand cream (no)	68 (77.3%)	52 (72.2%)	64 (67.4%)	0.33

There was a statistically significant difference in knowledge scores among the different study years ($p=0.000$). A significant difference was observed between preclinical and clinical year students. Clinical year students had higher knowledge scores. No significant differences were found between other groups. There was no significant difference in knowledge scores between male and female participants. Participants who received formal training in hand hygiene in the last three years had significantly higher knowledge scores compared to those who did not.

Table 3: grades of overall knowledge of participants on hand hygiene.

Score of knowledge	Number of participants	Percentage
Poor (0-12)	37	14.5%
Moderate (13-18)	188	73.7%
Good (19-25)	30	11.8%
Total	255	100.0%

Table 4: Comparison of mean knowledge score regarding hand hygiene according to study stage, gender, and previous training.

Variable	Category	Mean of knowledge score	Std. Deviation	Level of knowledge	P-value
Study stage	Preclinical (88)	14.2	2.64	moderate	0.000
	Clinical (72)	16.0	2.60	moderate	
	Intern (95)	15.8	2.65	moderate	
Gender	Male (50)	15.2	2.39	moderate	0.719
	Female (205)	15.3	2.82	moderate	
Previous training	Yes (102)	16.0	2.70	moderate	0.000
	No (153)	14.8	2.66	moderate	
Overall (255)		15.3	2.74	moderate	0.000

Discussion

The overall mean knowledge score about hand hygiene (HH) among medical students and interns was moderate. Only 40% of participants had received formal training in HH, which is lower than rates reported in similar studies. Participants routinely used alcohol-based hand rub 43.1%, and 47.8% correctly identified unclean hands as the main route of germ transmission. Only 24.3 % correctly recognized the patient's germs as a frequent source of healthcare-associated infections. A significant difference was observed between students in the preclinical and clinical years. Clinical year students had higher knowledge scores. No significant differences were found between other groups. There was no significant difference in knowledge scores between male and female participants.

The findings of the current study are in strong agreement with several recent and previous investigations exploring hand hygiene knowledge among medical students. In comparison with a study conducted by Shyaka et al in 2024 [13], a global scoping review emphasized that clinical exposure and structured hand hygiene training are the most consistent predictors of knowledge and compliance across diverse educational contexts. The current study confirms this relationship, showing significantly higher knowledge scores among clinical-year students compared to preclinical students ($p = 0.020$), and among those with recent formal training ($p = 0.014$). Similarly, a study conducted in India reported that formal training and clinical involvement will lead to improvements in both knowledge and attitudes [14]. Our findings reinforce this conclusion and underscore the importance of early and continuous educational exposure. Further supporting this trend, Narula et al (2024) conducted a cross-sectional study and concluded the importance of induction training among medical and paramedical students to instruct good knowledge about hand hygiene and good hand hygiene practices among them [15]. Moreover, (Nair et al, 2014) reported in their study that medical and nursing students at a teaching medical center in India had varying levels of knowledge with better knowledge among nursing students and more adherence to hand hygiene, they also emphasized the need to bridge the gap between knowledge and practice by incorporating hand hygiene education early in the curriculum—a view closely aligned with the findings of the current study [16]. Across all four studies, there is clear and consistent evidence that hand hygiene knowledge improves with clinical exposure and formal instruction, while knowledge levels remain lower in the preclinical years. These findings affirm the need to implement structured hand hygiene training earlier in the medical education process and to reinforce it continuously through hands-on clinical experience.

Hand hygiene (HH) is a fundamental component of infection prevention and control, and one of the most effective measures for reducing healthcare-associated infections (HCAIs). According to the World Health Organization (WHO), proper hand hygiene practices can prevent 15–30% of HCAs [5]. This study underscores the critical need for enhanced and continuous training programs on HH for medical students and interns. The influence of mentors and senior physicians is also pivotal, as students frequently emulate the clinical behaviors of their supervisors [6]. Therefore, structured hand hygiene education should be systematically incorporated into the medical curriculum, accompanied by regular workshops aligned with WHO and CDC guidelines. Furthermore, promoting hand hygiene as an essential element of patient care — rather than as an optional task — is vital to fostering a culture of safety, responsibility, and professionalism among future healthcare providers. By implementing these targeted interventions, healthcare systems can significantly improve HH compliance, enhance patient safety, and reduce the financial burden associated with preventable infections [6].

Factors that may influence knowledge level include Age, gender, academic years, and previous training. Regarding the age factor in this study, the results showed that most of the participants were between the ages of 23-27 years (59.6%), followed by 18-22 years (29.4%), while only 11% were older than 27 years. This distribution is consistent with the expected nature of the sample, with medical students representing this age range. A detailed study conducted by Huber M et al [17] during the COVID-19 pandemic in Switzerland documented that the use of alcohol-based hand sanitizers increases with age, reinforcing preventive behaviors. However, age may not have been an influential factor in this study, given the proximity of participants' ages and similar levels of clinical training.

Regarding the gender factor, the percentage of females participating in the sample was high (80.4%) compared to males (19.6%). The reason may be the actual distribution of students in medical colleges or the tendency of females to commit to participate in health studies. Although our study shows no significant difference between male & female participants, however, Evidence revealed by Nagassar et al [18], suggests that females often adhere better to hand washing practices, and the studies on medical students by Abdelrahman AM et al [19] and Abd Elaziz KM & Bakr IM [20] indicated that females achieved better performance than males at a significant level, although the differences were not always statistically significant in knowledge - aligning with our findings - but were significant in adherence to the practice.

The distribution of participants in different educational levels was 34.5% in preclinical years, 28.2% in clinical years, and 37.3% internship physicians. The results of the study showed a significant difference in the level of hand hygiene knowledge between the different stages of the academy, as clinical and internship students had a higher level compared to preclinical students, for example, where a higher percentage of clinical students 61.1% and interns 46.3% were able to identify that unclean hands of workers are a direct source of infection transmission between patients compared to preclinical students 38. The results indicate that practical training contributes to improving knowledge of infection control procedures, and studies have shown similar results, Jayarajah et al [12] showed that knowledge and commitment to hand hygiene practice increases as the clinical years progress, and another study by Alotaibi et al [2] showed that students in the clinical stages have higher awareness than preclinical years students.

The World Health Organization (WHO, 2009) guidelines emphasize the importance of implementing intensive educational programs during the first years of medical study to promote adherence to these practices during clinical training [21].

The results of the study showed that a large proportion of the participants had not received any formal training on hand hygiene during the past three years, which may explain their knowledge gaps. Several previous studies support this conclusion. An Indian study conducted by Kanungo S et al [22] showed that the average knowledge score increased from 11.4 to 17.34 after participating in training workshops, and the Kosovo study by Sopjani et al [23] recorded a clear improvement in adherence after implementing a training program based on WHO guidelines. This evidence confirms the importance of applying training programs and a methodology that includes theoretical and practical aspects with continuous follow-up to ensure the promotion of hand washing concepts and adherence to them among medical students and interns.

Conclusion

Our study revealed that participants had a moderate overall knowledge of hand hygiene. Those who had Hand hygiene training were found to have significantly higher knowledge scores. Furthermore, knowledge scores showed a statistically significant difference across academic levels, with clinical students and intern doctors demonstrating a better understanding than preclinical students. These findings underscore the critical need for integrating structured and regular hand hygiene education into the curriculum for all academic stages, particularly for preclinical students, to improve overall knowledge and practice.

Recommendations

We recommend implementing training programs and workshops to enhance students' awareness of the hand hygiene process in healthcare settings, as the overall level of knowledge among participants was moderate and has room for improvement. Further research is also encouraged in other universities to allow comparison and to contribute to the advancement of medical education.

Limitations

The main limitation of this study was the use of a convenience sampling method, which may not adequately represent all medical students in our university. Additionally, data were collected through an online questionnaire, with a response rate of 17%. As well as the authenticity of the responses cannot be ensured, and the respondents' personal biases cannot be ignored.

Conflict of interest

The authors declare that they have no conflicts of interest.

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