ARTICLE / INVESTIGACIÓN

Awareness and attitude on infection prevention and control among medical students in Oman

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Abstract: Knowledge and awareness of infection prevention and control measures among medical students must be adequate and optimum. We evaluate medical students' understanding, knowledge, and attitude toward infection prevention and control. This cross-sectional study targets medical students at the College of Medicine, Oman. An adapted questionnaire was used to measure students' characteristics, concepts of infection prevention and control, hand hygiene, respiratory hygiene, cough etiquette, personal protective equipment, sharp instrument injuries and care of health care providers. The questionnaire explored the attitude and practice of infection prevention and control among medical students. A total of 628 medical students were included in the study. The majority were females (90.8%). A knowledge score on infection prevention and control was 61.83%. The hand hygiene knowledge score was higher (70.15%) than the general concept. The personal protective equipment knowledge score was 61.7%. Sharp injuries knowledge score was the lowest compared to other domains (37.74%). Respiratory hygiene and cough etiquette knowledge score was highest among all domains (78.05%). Care of health care providers had a lower total score of 50.2%. The knowledge of medical students on infection prevention and control was average. Proper training programs are required to protect medical students and their patients.

Key words: Control, infection, Oman, prevention, students.

Introduction

Infection prevention and control is a standard measure utilized by healthcare providers to minimize the risk of transmission of infectious diseases among patients and themselves[1].

Healthcare-associated infections are significant health problems that increase both morbidity and mortality[2]. Furthermore, it increases the health care costs in developed and developing countries[3].

Healthcare-associated infections are also associated with increased length of hospitalization and the development of multidrug-resistant bacteria[4].

It has been estimated that one out of 20 hospitalized patients will encounter healthcare-associated infections; such risk is substantial for patients and healthcare providers, including medical students[5]. Results from previous research in Middle Eastern countries showed a need for more knowledge among healthcare professional students about infection prevention and control[6-8].

Subsequently, all medical students must acquire knowledge and skills related to infection prevention and control through its incorporation into their training /orientation program[9].

Thus, this study was planned with the objectives of evaluating medical students' awareness (perception of a situation), knowledge (information acquired through education), and attitude (settled ways of thinking and perception) toward infection prevention and control, including standard precautions, hand hygiene, respiratory hygiene and cough etiquette, and use of Personal Protective Equipment (PPE), knowledge about sharps disposal and injuries, and care of health care providers. In addition, the study also aimed at exploring their prospects toward the current curriculum/training in providing them with adequate information and skills about infection prevention and control programs.

Materials and methods

A cross-sectional study was conducted in the College of Medicine and Health Sciences (COMHS), National University (NU), Suhar, to assess medical students' knowledge, attitude, and practice about infection prevention and control measures. Data was collected in January, February, and March 2022 after getting approval from the Research and Ethics Committee. We included all the medical students of COMHS from the first year (MD1) to the final year (MD6); thus, no sample size was calculated. Informed consent was taken from the students, and their participation was voluntary; data anonymity and confidentiality were maintained.

A structured pretested questionnaire adapted from available literature Amin *et al.*[10], was used to collect data from all the medical students from MD1 to MD6 who gave informed consent to participate in the study. The questionnaire was pilot-tested with a few students before the data collection to verify the validity of the content, grammar, and language use. Independent variables were demographic characteristics of students like age, gender, year of study, source of information on infection prevention and control and previous training on infection control. The dependent variable was the total knowledge score of all subsets. Knowledge score had further subsets as the overall concept of infection prevention and control, hand hygiene, respiratory hygiene, cough etiquette, personal protective equipment, sharp instrument

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injuries and care of health care providers. The questionnaire had closed-ended questions on all these domains in the form of True / False / I do not know or choosing one correct option. Similar questions were addressed to ascertain the attitude and practice of students related to infection control. Data was filled by the students in person in the college.

Data entry and analysis were done in SPSS version 22. After data entry, thorough data cleaning was carried out; incomplete responses in 2 or more items were discarded. Descriptive statistics was used to summarize demographic variables in frequency and percentage for categorical variables and mean and standard deviation for continuous variables. In the knowledge questionnaire, correct responses were given a score of 1 and incorrect answers were assigned a score of zero. Each Section of the knowledge domain was calculated as a percentage score, and an overall knowledge percentage score was also calculated for all the questions in all sections. T-test and ANOVA were used for testing mean differences. Bivariate analysis using linear regression was deployed to find the association of the total knowledge score with the studied independent variables. It was represented by the beta coefficient, 95% confidence interval and p-value. A p-value of less than 0.05 was considered statistically significant for all statistical testing.

Results

Demographic characteristics

There were 628 participants in the study. The mean age of participants was 21.6 years ± 2.186. Most participants were females (90.8%), and only 9.2% were male students. Most participant students were from MD2, followed by MD6 and MD1. Only a few (16.4%) had attended any previous infection prevention and control training courses. Regarding the source of information, most of the students got information from self-learning (71.5%), 30.7% from formal curriculum teaching and 21.3% from bedside teaching. [Table 1]

Knowledge of students on infection prevention and control

All the students' knowledge of Section A, the general concept of infection prevention and control, showed a total score of 61.83%, out of which the maximum knew the goal of infection prevention and control (79.9%). The least was on the subset "source of infection as all body fluids except sweat" (44.3%). Regarding knowledge in Section B: Hand hygiene, the total knowledge score was higher (70.15%) than the general concept of Section A. In this Section, the most minor subset, known as "alcohol hand rub substitutes hand washing even if hands are soiled; a false statement" (34.9%), followed by "Hand washing is indicated between tasks and procedures on the same patient (True)" (49.5%). The rest of the other subsets of handwashing had a good knowledge score.

Regarding knowledge of Section C: PPE, the total score for all the components was 61.7%. The least known subset was "PPEs are exclusively suitable to laboratory and cleaning staff for their protection (False)" (27.7%), followed by "Hand washing is indicated between tasks and procedures on the same patient (True)" (39.6%). The other components of this knowledge domain had a good amount of knowledge. In Section D on Sharp Disposal and Sharp Injuries, the total score was the lowest compared to other knowledge domains (37.74%). Students had poor knowledge of "Used needles should be recapped after use to prevent injuries

Characteristic			Frequency (n=628)	Percentage
Age		Mean (SD)	21.6 (2.186)	
Gender		Female	570	90.8
		Male	58	9.2
MD year of study		MD1	121	19.3
		MD2	130	20.7
		MD3	82	13.1
		MD4	91	14.5
		MD5	79	12.6
		MD6	125	19.9
Previous Training course		Yes	103	16.4
		No	525	83.6
Source of information	***Self-learning***	Yes	449	71.5
		No	179	28.5
	Bedside	Yes	134	21.3
		No	494	78.7
	Formal curriculum	Yes	193	30.7
		No	435	69.3
	Courses	Yes	67	10.7
		No	561	89.3
	Others	Yes	206	32.8
		No	422	67.2

Table 1. Demographic characteristics of participants.

(False)" (21.7%) and "Soiled sharps objects should be shredded (cut into tiny pieces) before final disposal (True)" (23.7%). Other subsets of knowledge could have been better in this Section. In Section E on respiratory hygiene and cough etiquette, the total knowledge score was the highest among all sections, with 78.05%. All the subsets of this Section had good knowledge scores for all the students. The lowest score in this Section was "Wipe your hands on the inside of your white coat after you cough or sneeze (False)" (67.2%). In Section F on Care of health care providers, they had a lower total score of 50.2%. The minimum subset scored in this Section was "The risk for a health provider to acquire HIV infection after a needle-stick injury is (Option less than 0.5%)" (7.8%). The maximum score subset was 74.8% on "Immunization history of health care providers should be obtained before recruitment." [Table 2]

The overall total score combining the averages of all sections of the knowledge domain (Section A to Section F) was 60.1%, which shows that students' knowledge of infection prevention and control was average and not very good. Further, the students' attitudes on training in infection prevention and control were assessed by questions using a Likert scale. Most students agreed (75.7%) that they need more infection prevention and control training. Even though students' knowledge of infection prevention and control was average, when questioned about their hospital practice, they needed a better response to practicing the optimal measures. [Table 3]

Factors associated with total knowledge score

Different demographic factors were considered to find an association between them and the knowledge score.

Knowledge Domain	Frequency of correct response (n=628)	Percentage of correct answer (%)
A. General Concepts of Infection Prevention & Control		
The goal of infection control	502	79.9
Definition of standard precautions	437	69.6
All patients are sources of infections regardless of their diagnoses (True)	336	53.5
All body fluids except sweat should be viewed as sources of infection (True)	278	44.3
Total score of General concepts of Infection Prevention & Control: Mean (SD)	**61.83 ± 27.3**	
B. Hand Hygiene		
Hand washing minimizes microorganisms acquired on the hands if hands are soiled (True)	569	90.6
Hand washing reduces the incidence of healthcare-related infections (True)	543	86.5
In standard hand washing, the minimum duration should be (Option 15-20 seconds)	389	61.9
Hand decontamination: includes washing with antiseptic soap for 30 seconds (Option hands and wrists)	322	51.3
Alcohol hand rub substitutes hand washing even if the hands are soiled (False)	219	34.9
Hand washing is indicated between tasks and procedures on the same patient (True)	311	49.5
Use of gloves replaces the need for hand washing (False)	514	81.8
Hand washing is indicated after removal of gloves (True)	520	82.8
Hand washing is needed while dealing with respiratory infections, including COVID-19 (True)	578	92
Total score of Hand Hygiene: Mean (SD)	**70.15 ± 18.3**	
C. Personal Protective Equipment (PPE)		
PPEs such as masks and head caps provide protective barriers against infection (True)	556	88.5
The use of PPEs eliminates the risk of acquiring occupational infections (True)	444	70.7
PPEs are exclusively suitable for laboratory and cleaning staff for their protection (False)	174	27.7
PPEs should be used only whenever there is contact with blood (False)	487	77.5
Gloves and masks can be re-used after proper cleaning (False)	529	84.2

Table 2. Knowledge of infection prevention and control.

Used PPEs are to be discarded through regular dust bins (False)	272	43.3
Gloves should be changed between different procedures on the same patient (True)	361	57.5
Masks made of cotton or gauze are most protective (False)	249	39.6
Masks and gloves can be re-used if dealing with the same patient (False)	418	66.6
Total score of PPE: Mean (SD)	**61.7 ± 19.5**	
D. Sharp Disposal and sharp injuries		
Used needles should be recapped after use to prevent injuries (False)	136	21.7
Used needles should be bent after use to prevent injuries (False)	192	30.6
Sharps container is labeled with (Option biohazard symbol)	221	35.2
Soiled sharps objects should be shredded (cut into tiny pieces) before final Disposal (True)	149	23.7
Sharps injuries should be managed without any reporting (False)	435	69.3
Needle-stick injuries are the least commonly encountered in general practice (False)	251	40
Post-exposure prophylaxis is used for managing Needle-stick injuries from an HIV-infected patient (True)	307	48.9
Immediate management of sharps injuries includes the option to wash thoroughly with running water)	204	32.5
Total score of Sharp Disposal and sharp injuries: Mean (SD)	**37.74 ± 23.7**	
E. Respiratory Hygiene and cough etiquette		
Cough/sneeze on a disposable napkin and wash your hands (True)	559	89
Cough/sneeze over elbow if a napkin is not available (True)	470	74.8
Keep 1 meter from others when coughing (True)	510	81.2
Wipe your hands on the inside of your white coat after you cough or sneeze (False)	422	67.2
The total score of Respiratory Hygiene: Mean (SD)	**78.06 ± 24.81**	
F. Care of Health care provider		
Immunization history of health care providers should be obtained before recruitment (True)	470	74.8
The risk for a health provider to acquire HIV infection after a needle-stick injury is (Option less than 0.5%)	49	7.8
Post-exposure immunization prevents the risk of hepatitis B infection following exposure (True)	262	41.7
For the prevention of hepatitis B, immunizations are recommended for all healthcare workers (True)	440	70.1
Following exposure to a patient with flu, antibiotics are required for prevention of infection (False)	257	40.9
Health providers with the highest risk of exposure to tuberculosis include radiologists (True)	222	35.4
Health providers should receive an annual influenza vaccine (True)	441	70.2
All unvaccinated health providers should get varicella and MMR vaccines (True)	380	60.5
Total score of Care of Health care provider: Mean (SD)	**50.2 ± 25.92**	
Total Knowledge score (Average of all knowledge domains total scores of Infection Prevention & Control): Mean (SD)	**60.1 ± 16.25**	

Table 2. Knowledge of infection prevention and control.

Attitude domain (Agree & Strongly Agree)	Frequency (no.)	Percentage (%)
The current teaching curriculum provides enough information on infection control	246	39.2
Training/orientation sessions about infection control provide enough information	300	47.7
Faculty provided you with enough information on how to avoid health facilities related- infections before clinical rotations	267	42.5
You feel that you need to receive more training on infection control	475	75.7
Practice domain to those going to hospital for training (Yes)	204	32.5
Washing hands	197	31.4
Wearing white coat	189	30.1
Nails trimming	174	27.7
Short hair/tying hair/tight scarf	153	24.4
Your dress is not touching the floor	177	28.2

Table 3. Attitude and practice of infection prevention and control.

On Bivariate analysis, it was found that the knowledge had a significant association with age; Pearson correlation coefficient r=0.527 (p<0.001). With every unit increase in age, the knowledge score increased by 3.92. When gender was compared with total knowledge score, it was found that males had a higher mean score of 62.25 compared to females, 59.7%, but this difference was not statistically significant; t (626)=1.134, p=0.257. Those with previous training on infection prevention and control had a higher knowledge score of 69.7 than those without training (58.04), and this difference was statistically significant t (626)=6.904, p <0.001. When questioned on different sources of information, it was found that through bedside information received in clinical years, the mean total score was better (67.18±14.720) than those who did not receive it (57.99±16.097); t (626)=5.96, p<0.001. Similarly, those who got information through formal curriculum had a higher mean total score (64.99±13.409) than those who did not have it (57.71±16.893); t (626)=5.294, p<0.001.

Knowledge scores of different MD years were compared, and it was found that clinical years MD4, MD5, and MD6 had higher knowledge scores than premed and preclinical years. Adjusted for Bonferroni correction, 1-way ANOVA shows significant results when comparing MD1 to MD6; F (5,270)=69.8, p<0.001. Further in Linear regression, it was found that MD6 (Coefficient=25.8 CI=22.5 to 29.1, p<0.001), MD5 (Coefficient =18.1, CI=14.4 to 21.8, p<0.001) and MD4 (Coefficient=19, CI=15.4 to 22.5, p<0.001) where students are going to hospitals has highly statistically significant total score of knowledge. [Table 4]

Discussion

Infection prevention and control are crucial for the safety of both healthcare workers and patients. Health professional students need to have adequate knowledge about infection prevention and control to reduce the risk of transmission of infection among them and the patients while learning and training[7]. Consequently, we assessed medical students' knowledge, attitude, and practice regarding infection control measures in this study.

In this study, we found that clinical years (MD4, MD5 and MD6) had higher infection prevention and control knowledge scores than preclinical (MD3) and premed (MD1 and MD2) years. This finding is consistent with Khubrani *et al.*[7], Nalunkuma *et al.*[11], and Silva et al. studies[12]. This can be related to the less clinical exposure at the beginning of the MD program and to the curriculum point of view.

Regarding the knowledge of hand hygiene, most of the students demonstrated good ability. However, they needed to learn about hand washing versus alcohol use, hand washing between tasks and the standard hand washing time. It compares to Hammerschmidt et al. study that, showed higher knowledge of hand hygiene and normal hand washing time[13]. This can imply increased risks of transmission of infection between patients by medical students.

In this study, more than half of the medical students gave a wrong answer that "All body fluids except sweat should be viewed as sources of infection," which was consistent with the Khubrani et al. study, and this reflects inadequate knowledge about body fluids being one of the mode transmissions of infection between and patients and medical students[7].

Most medical students (n=556, 88.5%) in our study know the importance of PPE, such as masks and head caps, in providing protective barriers against infection. However, other related knowledge of PPE, such as "discarding the PPE bins" and "types' of protective masks," is poor. This finding is consistent with Khubrani *et al.*[7], Nalunkuma *et al.*[11], and Tavolacci *et al.* studies[14]. Such inadequate knowledge of PPE can increase the risk of spreading infections between patients.

Regarding the knowledge of our medical students about sharp Disposal and sharp injuries, we found that it represents the lowest level of knowledge, which is also consistent with Khubrani *et al.*[7], Nalunkuma *et al.*[11], and Tavolacci *et al.* studies[14]. These finding necessitates improving knowledge of handling sharp objects to minimize the risk and complication of such sharp injuries.

The good respondents among the medical students in our study to respiratory hygiene and cough etiquette could be because of the COVID-19 pandemic that emphasizes these measures. This finding is similarly seen in other studies[15,16].

Most of our medical students agreed (75.7%) that they need more infection prevention and control training. Even

Factors		Total knowledge score		Bivariate analysis		
		Mean	SD	Coefficient (B)	95% Confidence interval	P value
Age		-	-	3.92	3.424 - 4.416	**<0.001**
A unit increase in age						
Gender	Female	59.71	15.943	Reference		
	Male	62.25	18.962	2.539	-1.856 – 6.935	0.257
Previous Training course	No	58.04	16.202	Reference		
	Yes	69.7	12.605	11.661	8.344 - 14.977	**<0.001**
MD year of study	MD1	47.73	15.269	Reference		
	MD2	50.75	14.357	3.022	-2.16 – 6.260	0.67
	MD3	58.50	12.530	10.766	7.099 – 14.433	**<0.001**
	MD4	66.76	12.173	19.025	15.468 – 22.582	**<0.001**
	MD5	65.87	13.555	18.136	14.428 – 21.844	**<0.001**
	MD6	73.59	9.433	25.860	22.590 – 29.129	**<0.001**

Table 4. Factors associated with knowledge score.

though students' knowledge of infection prevention and control was average, when questioned about their hospital practice, they had poor responses to practicing the optimal measures.

Conclusions

The average total knowledge score on infection prevention and control of students was 60%. The maximum knowledge of the students was on respiratory hygiene and cough etiquette (78%), followed by hand hygiene (70%). More emphasis must be given to topics like personal protective equipment, sharp Disposal, and care of health care providers. Age, previous infection control training, clinical years, and late preclinical years had statistically significant higher total knowledge scores ($p<0.001$). Formal curriculum and bedside teaching impart better knowledge than self-learning as it requires hospital visits and observing practical skills.

More sessions should be taken on infection prevention and control for students in the early years of the medical program. They should be built within the curriculum as training courses for preclinical years and hospital bedside exposure in clinical years.

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Conflicts of Interest

The authors declare no conflict of interest.

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