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Research Article

**KNOWLEDGE, AWARENESS, AND ATTITUDE TOWARDS
INFECTION CONTROL IN THE OPERATING ROOM AMONG
MEDICAL STUDENTS AND INTERNS IN TAIF UNIVERSITY,
SAUDI ARABIA****Mohammad Eid Mahmoud Mahfouz¹, Yousef Abduljabbar Alzilfi^{2*}, Nawaf Saeed
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Alshehri², Meshari Mesfer Mastour Althobaiti²**¹Consultant Surgeon and Assistant Professor of surgery, Taif University, Taif, Saudi Arabia.,²Intern at Faculty of Medicine, Taif University, Taif, Saudi Arabia.**Abstract :**

Background: Sticking to infection control measures in general practice is very crucial for the safety of both patients and healthcare team. The situation is more critical in operating rooms where a risk of life-threatening infections for the patient in addition to hazardous exposure of operative team to sharp utensils and biological wastes. The aim of this study is to evaluate the behaviors of students and practitioners in Taif, Saudi Arabia regarding infection control measures in an operative setting.

Design and Setting: A multicenter, cross-sectional prospective study that was done in College of Medicine and College of Applied Medical Sciences, Taif University, Saudi Arabia after an infection control course. 195 participants responded to a questionnaire. Only participants who filled the questionnaire were included in the analysis.

Statistical analysis: Data were represented as frequencies and percentages for categorical variables. Mean, standard deviations (SD), were used to describe numerical variable. Student t test was used to compare numerical variables between the subgroups. IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) was used to perform all statistical calculations, version 21 for Microsoft Windows.

Results: Interns had better responses compared to students regarding their awareness ($p=0.046$), attitude ($p=0.016$) and overall behavior ($p=0.029$) toward infection control in operating rooms. Attending either college or hospital courses on infection control can improve knowledge and awareness of healthcare professionals.

Conclusion: National continuous educational programs on infection control are highly recommended. Further studies from other regions in Saudi Arabia are needed.

Keywords: Infection control, surgery, complications, sterility, operating room.

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INTRODUCTION:

Healthcare-associated infections are considered one of the major problems in healthcare institutes all over the world due to increased patients' mortality and morbidity in addition to increased healthcare costs [1]. It was revealed that about 50000 mortalities occur every year in Europe due to healthcare-associated infections [2].

Though, healthcare-associated infections were proved to be avoidable or at least their incidence can be significantly reduced, this could be achieved through effective infection prevention and control measures in healthcare institutes [3]. Therefore, a number of improved tools are now available, in order to improve compliance to infection control and prevention measures. Despite of that, many of these trials didn't prove to be successful in a real practice [4].

In order to decrease the occurrence of healthcare-associated infections standardized infection prevention and control strategies should be provided to every patient [5]. Unfortunately, it has been shown that compliance to these measures was very poor especially in operative setting, including needle stick exposure, hand hygiene and gloves handling [6]. Even global organizations were focusing on these measures. The WHO for instance, stated that more than 80% of needle stick exposures are considered avoidable through using safety tools and programs [7]. The reasons for this poor compliance were investigated and the major factors influencing compliance were level of education, knowledge and attitude of the healthcare team in addition to their workload [8].

Strong educational programs on infection control prevention and control have been proposed in the literature in both academic and clinical setting. Even for medical students, these programs should be a crucial part of their training where they spend most of their clinical years in a healthcare setting where they gain most of their skills [9]. Furthermore, The British Nursing and Midwifery Council doesn't register nurses as qualified nurses without demonstrating high levels in skills and attitudes including adherence to infection control and prevention policies and ensuring that the rest of the team is also compliant to these standards [10]. Evaluation in addition to increasing awareness of infection control standards among medical students may influence their behavior after graduation during their medical practice which consequently can decrease rates of nosocomial infection [11].

However, there is still few data in the literature on how attitudes and knowledge of healthcare professionals towards infection control measures in operative setting especially in Saudi Arabia [12]. Therefore, the aim of this study is to explore the influence of knowledge, attitude and awareness about infection control and prevention measures in operative setting among medical students as well as healthcare professionals in Taif, Saudi Arabia.

MATERIALS AND METHODS:**Study design:**

This is a multicenter, cross-sectional prospective study that was carried out in College of Medicine and College of Applied Medical Sciences, Taif University, Saudi Arabia upon finishing infection control training. 195 participants responded to the questionnaire. Only participants who filled the questionnaire were included in the analysis.

Data collection:

An online self-developed questionnaire was distributed, via link to Google forms, to medical students and interns. The questionnaire consists of 4 sections;

- 1- Participants' characteristics: Data about age, gender, level of education (student/ intern), training venue, and training duration.
- 2- Participants' knowledge: was assessed by 10 questions; one point is awarded for each correct answer, while zero point is awarded for: incorrect answer, or unanswered questions. Knowledge questions discusses the currently applied guidelines, policies, procedures, and protocols regarding infection control in Taif University, Saudi Arabia.
- 3- Participants' awareness: is assessed by 10 questions; one point is awarded for each "Yes", while zero point is awarded for "No" or unanswered questions. Awareness parameters are: Orientation attendance in college, orientation attendance in hospital, hand washing techniques, using face mask, needle stick injury, rules of safety during injection, dealing with isolated patients, proper way of wearing sterile gloves, infection control guide manual and proper methods of waste disposal.
- 4- Participants' attitude: are assessed by 10 questions with a 4-points scale (Strongly disagree, disagree, agree, and strongly agree). Since the items will be negatively worded, 4 points will be rewarded for strongly disagree, 3 points for disagree, 2 points for agree, and 1 point for agree.

Statistical analyses:

Data were represented in terms of frequencies and valid percentages for categorical variables. Mean, standard deviations (SD), minimum and maximum values were used to describe numerical variable. Student t test was used to compare numerical variables between the subgroups. All P values < 0.05 were considered statistically significant. IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) was used to perform all statistical calculations, version 21 for Microsoft Windows.

Ethical considerations:

Institutional research ethics board approval was acquired prior to conducting any study procedure.

RESULTS:

The present multicenter, cross sectional study included 195 responding students and intern after

finishing infection control training. The questionnaire aimed at assessing the responders' knowledge, awareness and attitude toward infection control in operative field. Descriptive figures and statistical analysis are shown below.

Responders' characters

The questionnaire included responders from both genders with 53.1% of females and 46.9 of males. Their level of education was varying between interns and students. Students represented 71.6% of the whole cohort, and interns represented 28.4%. Moreover, each participant was asked whether he/she had attended any hospital orientation courses on infection control previously, 57.2% mentioned that they attended previous courses while 42.8% didn't attend any course before. All characters are described thoroughly in terms of frequencies and percent in table 1.

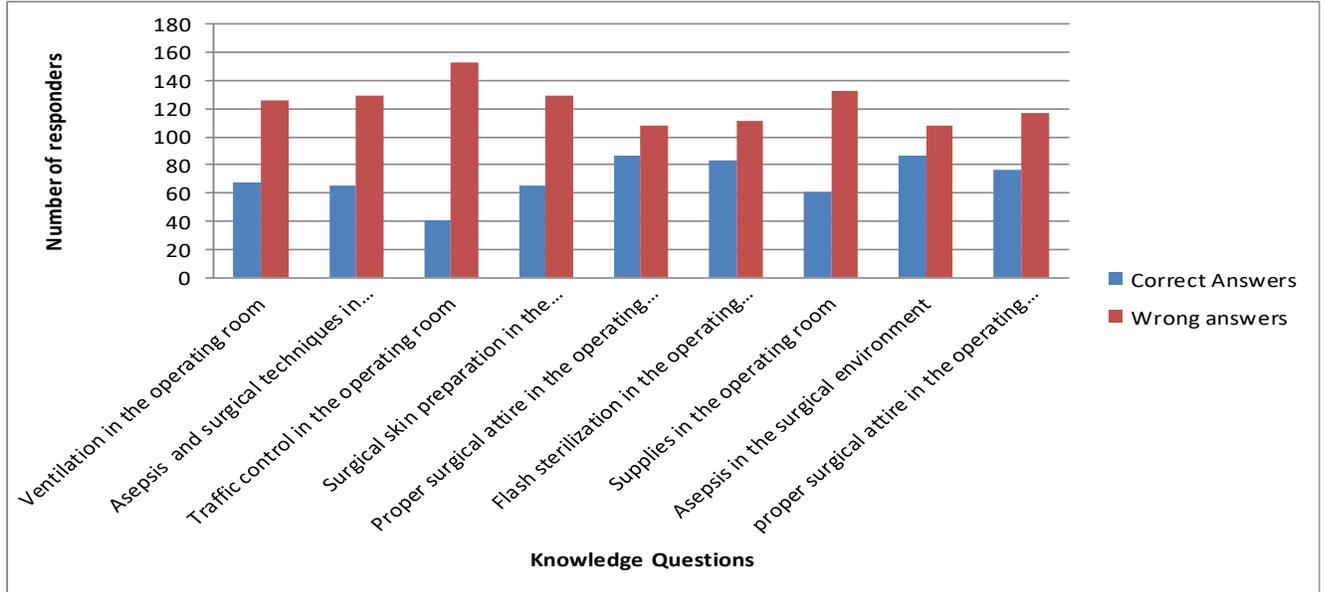
Table 1 Characteristics of the study participants

Variable	Frequency	Percent
Gender		
Female	103	53.1
Male	91	46.9
Level of education		
Intern	55	28.4
Student	139	71.6
Attending hospital orientation		
No	83	42.8
Yes	111	57.2

Knowledge Questions

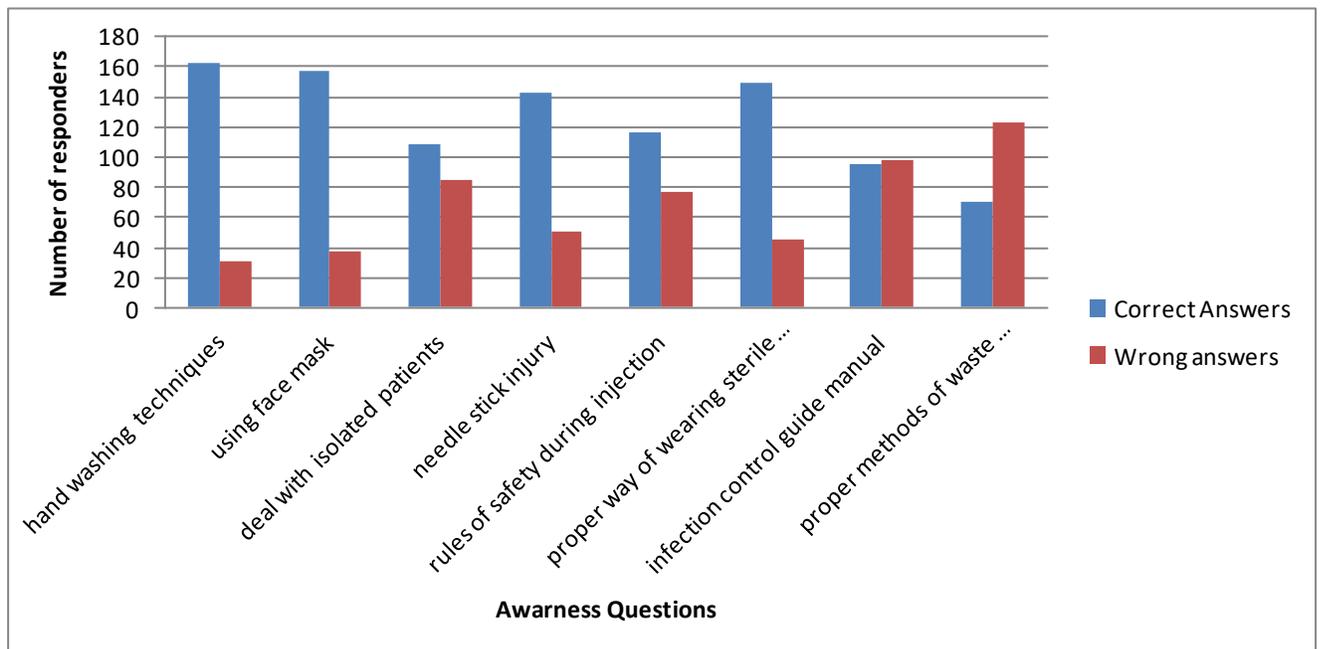
The first part of the questionnaire included questions related to the knowledge on infection control in operative rooms. The questions were mainly examining knowledge related to surgical techniques, skin preparation, surgical attire and traffic control. The highest frequency of correct answers (86 responses) were recorded in questions related to

proper surgical attire in operating rooms and asepsis in the surgical environment, followed by proper surgical attire in the operative room with 77 responses. The lowest number of correct answers (41 responses) was recorded for question on traffic control. Figure 1 shows a detailed description of correct and wrong answers for all questions assessing knowledge on infection control.

Figure 1. Responses to knowledge questions**Awareness Questions**

The second part focused on the awareness of participants about infection control measures. This part included questions related to hand hygiene, needle stick injury, wearing sterile gloves in addition to wastes disposal. The best answers were on the question asking about awareness on hand washing techniques with 163 correct responses followed by 157 correct answers for awareness on wearing a face

mask. On the other hand, number of participants with wrong answers exceeded number of participants with correct answers for questions on awareness about infection control guide manual (98 wrong responses) and awareness about proper methods of waste disposal (123 wrong responses). Figure 2 shows the frequencies of correct and wrong answers in section 2.

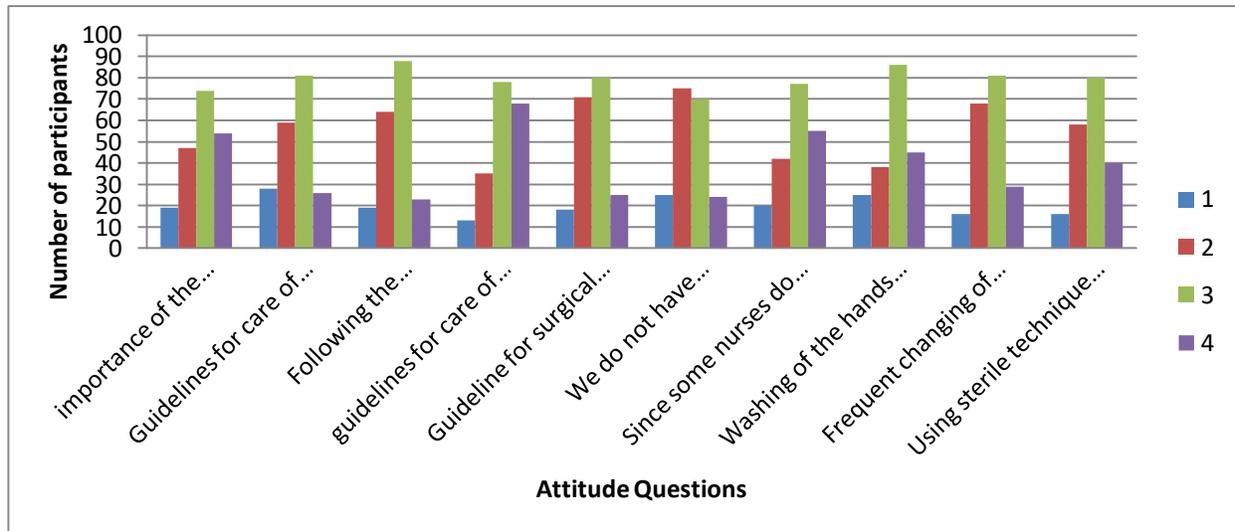
Figure 2. Responses to Awareness questions

Attitude Questions

The final part of the questionnaire comprised ten questions to assess participants' attitude toward infection control in operating rooms. The responders had to choose between four different responses where strongly disagree got the highest score of 4 and strongly agree got the least score of 1. For all questions, most of the participants got a score of 3

(disagree). Question related to the necessity of guidelines for care of surgical wounds got the best response with 68 responders are strongly disagreeing with this statement. While question related to time spent to follow surgical wound care guidelines had the worst response with only 23 responders are strongly disagreeing that it can take much time. A full description of the attitude questions is described in figure 3.

Figure 3. Responses to Attitude questions



Comparison between groups regarding their knowledge, awareness and attitude

Responses to different questions were analyzed and total score for each section was calculated in addition to the grand total score for the three sections collectively. Means and standard deviations of the scores were calculated. Student t-test analysis was done to compare means of different groups of responders based on their gender, level of education

and attendance of infection control training in college or in hospital. Level of significance was determined at $p \text{ value} \leq 0.05$.

The first comparison was carried out between males and females in the three sections in addition to the grand total scores. No significant difference was found between scores of males and females in all sections including the grand total score as shown in table 2.

Table 2 shows comparison between scores of males and females regarding to their knowledge, awareness and attitude on infection control in operative rooms, in terms of means and standard deviations

		Mean \pm SD	P value
Total score for Knowledge	Male	3.49 \pm 1.95	0.813
	Female	3.56 \pm 2.07	
Total Score for awareness	Male	5.27 \pm 2.17	0.282
	Female	5.60 \pm 2.05	
Total Score for attitude	Male	27.15 \pm 5.09	0.858
	Female	27.02 \pm 5.32	
Total score	Male	35.92 \pm 6.42	0.779
	Female	36.18 \pm 6.5	

The second comparison was between students and interns. A significant difference was found between students and interns in awareness, attitude and grand total scores, where interns scored higher in the three

sections with mean scores 5.93 \pm 1.80 for awareness ($p= 0.046$), 28.51 \pm 5.17 for attitude ($p= 0.016$) and 37.64 \pm 6.09 for grand total score ($p=0.029$) as shown in table 3.

Table 3 shows comparison between scores of students and interns regarding to their knowledge, awareness and attitude, in terms of means and standard deviations

		Mean \pm SD	P value
Total score for Knowledge	Student	3.66 \pm 2.03	0.151
	Intern	3.20 \pm 1.93	
Total Score for awareness	Student	5.26 \pm 2.19	0.046*
	Intern	5.93 \pm 1.80	
Total Score for attitude	Student	26.52 \pm 5.11	0.016*
	Intern	28.51 \pm 5.17	
Total Score	Student	35.44 \pm 6.50	0.029*
	Intern	37.64 \pm 6.09	

*Level of significance at $p < 0.05$

The final comparison was between the scores of those who attended a college or hospital training previously and those who didn't, it was found that total score of knowledge and awareness questions were significantly better in those who attended college courses (3.97 ± 2.12 and 6.25 ± 1.73) with p

values 0.001 and <0.001 , respectively. As for hospital courses, almost all the scores of those who attended hospital courses were significantly better than those who didn't attend any courses. Table 4 and 5 show detailed description of these comparisons.

Table 4 shows comparison between scores of college course attendants and non-attendants regarding to their knowledge, awareness and attitude, in terms of means and standard deviations

		Mean \pm SD	P value
Total score for Knowledge	Attended orientation	3.97 \pm 2.12	0.001*
	Didn't attend orientation	3.01 \pm 1.75	
Total Score for awareness	Attended orientation	6.25 \pm 1.73	<0.001 *
	Didn't attend orientation	4.51 \pm 2.12	
Total Score for attitude	Attended orientation	26.59 \pm 5.07	0.153
	Didn't attend orientation	27.66 \pm 5.32	
Total score	Attended orientation	36.81 \pm 6.23	0.079
	Didn't attend orientation	35.18 \pm 6.62	

*Level of significance at $p < 0.05$

Table 5 shows comparison between scores of hospital course attendants and non-attendants regarding to their knowledge, awareness and attitude, in terms of means and standard deviations

		Mean \pm SD	P value
Total score for Knowledge	Attended orientation	3.97 \pm 2.12	0.001*
	Didn't attend orientation	3.01 \pm 1.75	
Total Score for awareness	Attended orientation	6.25 \pm 1.73	<0.001 *
	Didn't attend orientation	4.51 \pm 2.12	
Total Score for attitude	Attended orientation	26.59 \pm 5.07	0.153
	Didn't attend orientation	27.66 \pm 5.32	
Total score	Attended orientation	36.81 \pm 6.23	0.079
	Didn't attend orientation	35.18 \pm 6.62	

*Level of significance at $p < 0.05$

DISCUSSION:

The present study evaluated the knowledge,

awareness and attitudes of students and interns in College of Medicine and College of Applied Medical

Sciences, Taif University, Saudi Arabia, regarding infection control measures in operating rooms. It was revealed that interns had better responses compared to students regarding their awareness ($p=0.046$), attitude ($p=0.016$) and overall behavior ($p=0.029$) toward infection control in operating rooms. Additionally, it was found that attending either college or hospital courses on infection control can improve knowledge and awareness of healthcare professionals.

Other trials also evaluated knowledge, awareness and attitudes of other healthcare professionals in different setting. A survey study [13] on 135 dentists assessed their knowledge and attitude in addition to their behavior toward infection control measures. The study spotted a weakness in infection control knowledge of included dentists and recommended encouraging continuing education and professional courses on infection control to fill this gap. The results of the present work support the same conclusion of this study, where responders who had previous training in infection control had better knowledge and awareness as well as overall behavior toward infection control practices. However, participants in the present work were either students or practicing interns and the questionnaire was mainly focusing on surgical setting, the other survey [13] was mainly targeting dentists.

Moreover, other studies focused mainly on one measure of infection control techniques. Salem *et al.* for instance [14], assessed the knowledge and attitudes of medical students toward needle stick injuries through surveying 119 medical students in their clinical years. The study observed an increasing exposure to needle stick injury in spite of increasing knowledge about needle stick injury with higher seniority levels. The study recommended increasing the teaching courses on infection control and dealing with sharp injuries.

In the present work, needle stick injury was one of the important evaluated aspects while other measures were also evaluated. Also, both medical students and interns were surveyed. Our work didn't evaluate the real-life practice of students or interns; instead, we focused mainly on their own responses. Our findings related to attendance of training supports the recommendations of this trial as well, highlighting the importance of continuous training.

To our Knowledge, this is the first trial to evaluate the knowledge, awareness and attitude of both students and practicing interns regarding infection

control practices in operating rooms in Saudi Arabia. Similar data from other parts of the world was also published. A Chinese trial [15] evaluated the knowledge, awareness and attitude of operating room staff on infection control practice. The study surveyed 115 professionals of different educational levels and age groups. The study also focused on the importance on the improved education levels and significance of continuous educational programs. Similar findings were also recorded from Africa from both Uganda [16] and Ethiopia [17].

Finally, this study figured out an overview on the behavior of medical students and practitioners in Taif, Saudi Arabia toward infection control strategies in operating rooms. We would highly recommend arranging for national training programs to improve the knowledge of healthcare staff on this critical aspect of medicine. Additionally, further studies are needed to give descriptions on behaviors in different areas in Saudi Arabia.

CONCLUSION:

Level of knowledge, awareness and attitude of medical students and interns needs to be improved. This could be achieved through organized national continuous educational programs on infection control, in addition to encouraging students' activities and campaigns in order to increase awareness about the importance of infection control strategies in operating rooms. Further studies from other regions in Saudi Arabia are needed in order to have a complete picture on the behaviors towards infection control in Saudi Arabia.

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