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Knowledge and Practices of Infection Control among Physicians and Nurses in a Military Fevers Hospital in Egypt

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ABSTRACT

Background: Healthcare-associated infections (HCAIs) pose a significant threat to patient safety and healthcare resources globally, impacting patient safety, treatment outcomes particularly in settings like military hospitals.

Aim of the Study: Was to investigate the knowledge and practices of infection control among 15 physicians and 72 nurses at a military fever hospital in Cairo, Egypt.

Subjects and methods: A cross-sectional study using a self-administered questionnaire and an observation checklist. The study assessed healthcare providers' knowledge of healthcare-associated infections (HCAIs), causative organisms, transmission routes, infection control measures, and related practices like hand hygiene, personal protective equipment (PPE) use, and safe waste disposal.

Results: Significant knowledge deficiencies among physicians; only 33.3% demonstrated satisfactory knowledge, with particularly low scores regarding HCAI definitions (20% satisfactory), isolation procedures (26.7% satisfactory), and safe waste disposal (13.3% satisfactory). Nurses demonstrated comparatively better knowledge, with 65.3% achieving satisfactory scores. Despite these knowledge gaps, both groups exhibited generally adequate practices, with 93.3% of physicians and 94.4% of nurses demonstrating adequate overall practice. However, hand hygiene was a notable area for improvement, with only 20% of physicians demonstrating adequate hand hygiene practices compared to 88.9% of nurses. Statistical analysis indicated that being a nurse and prior training were independent predictors of higher knowledge scores, explaining 29% of the variance. Nursing job alone positively predicted practice scores, explaining 10% of the variance.

Conclusion: The study highlights the need for targeted training interventions, particularly for physicians, to address identified knowledge gaps in HCAI definitions, isolation procedures, and safe waste disposal, thereby reinforcing best practices and enhancing patient safety within this unique military healthcare setting.

Keywords: Infection Control, Military Fevers Hospital, Infection Prevention.

INTRODUCTION

Hospital/healthcare-acquired or associated infections (HCAIs) pose a significant challenge to healthcare systems worldwide, impacting patient safety, treatment outcomes, and hospital resources [1,2]. Yearly, more than 1.4 million cases are reported in both the developing and developed world, yet the increasing incidence trend is more marked in developing countries [3]. The associated rise of antibiotic-resistant pathogens complicates treatment with longer hospital stays and increased mortality [4]. Comprehensive infection control policies should address the specific needs of the organization [5]. Effective infection control is not only about safeguarding patients but also about managing hospital resources efficiently [6].

Effective infection control practices are essential to mitigating the risk of HCAIs. Physicians and nursing staff play a crucial part in implementing and adhering to these practices, making their knowledge and compliance critical to infection prevention [7]. However, although adherence to infection control practices, such as hand hygiene, use of personal protective equipment (PPE), and disinfection protocols is paramount in maintaining a safe clinical environment, compliance rates remain variable and suboptimal [8]. Encouragement and recognition for adhering to infection control practices can motivate staff to maintain high standards [9]. Meanwhile, heavy workloads, time constraints, and stress are common barriers to adherence [10].

Ensuring that physicians and nursing staff are well-versed in infection control protocols can help reduce the incidence of HCAIs and improve overall patient outcomes [11]. Therefore, evaluating the knowledge and practices of healthcare professionals in these settings can provide valuable insights into the strengths and weaknesses of current infection control measures. This assessment can guide targeted interventions and training programs aimed at enhancing infection control practices and ultimately improving patient safety [12,13].

Military hospitals, such as the military fever hospital, face unique challenges due to their specific patient demographics and high patient turnover. In such hospitals, patients may be exposed to infectious diseases not commonly seen in civilian settings, and the high-stress environments make the standardization and effectiveness of infection control practices particularly vital [14]. Moreover, the high mobility of military personnel and the deployment of healthcare professionals in various settings can impact the consistency and effectiveness of these practices. Understanding how well these practices are implemented in the unique context of a military fever hospital is crucial for tailoring effective infection

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control strategies [1]. Customized training can address specific deficiencies and reinforce best practices [15,16].

In military fever hospitals, where high demands are needed, ensuring that infection control practices are followed can help prevent the spread of infections, reduce the need for additional treatments, and minimize the strain on healthcare resources. By assessing the current knowledge and practices, this study can guide resource allocation to areas where it is most needed, thus improving overall efficiency. Also, by defining the level of infection control knowledge among physicians and nursing staff, its results can be used to refine training and education programs.

AIM OF THE STUDY

The study aims to raise awareness about infection control practices among physicians and nurses and also to suggest recommendations for better means of infection control based on the guidelines. This was through identifying the level of knowledge of infection control among physicians and nursing staff and assessing their degree of adherence to infection control practice.

SUBJECTS AND METHODS

Study design and settings: The study was carried out using a descriptive cross-sectional research design in Military Fever Hospital in Cairo. This is a 200 beds capacity hospital. It offers medical care services to military personnel and their families in different specialties.

Study population and sample: The study population consisted of all Healthcare personnel, physicians, or nurses, working in the setting during the study period with at least one year of work experience. Since the eligible number was limited (85), all of them were included in the study sample, i.e., Convenience sample size. They consisted of 70 nurses and 15 physicians.

Data collection tools:

Two tools were used in data collection. a questionnaire form for knowledge and an observation checklist for practice. They were developed based on pertinent literature ***(MOH National Guidelines for Infection Control, Part I-II, 2020; GAHAR Handbook for Hospitals Standards, 2021; CDC's Core Infection Prevention and Control Practices for Safe Healthcare Delivery in All Settings, 2022)*** [22] .

The first tool was a self-administered knowledge questionnaire that included a section for personal and job characteristics, and a knowledge test consisting of 21 multiple choice questions (MCQs) covering the areas of HCAI, causative organisms, transmission, infection control, hand hygiene, gloving and masking, safe injection, isolation, and safe waste disposal. Each correct answer received a score of 1, while incorrect answers received a score of 0. The item scores for each knowledge area and the overall questionnaire were aggregated and transformed into percentage scores. A percentage score of 60% or greater was deemed satisfactory, while a score below 60% was deemed unsatisfactory.

The second tool was an observation checklist to assess healthcare providers' practices related to infection control and HCAIs. It included checklists for hand hygiene, injection and medication safety, appropriate use of PPE, safe waste disposal, medical equipment practices, occupational health/safety practices, and minimizing exposure to environmental safety measures. Each checklist item was scored zero if "not done" and one if "done". The items marked as "not applicable" were not scored and excluded from the totals. The totals for each checklist and the total practice were expressed as percentage scores. If the percent score was 60% or higher, the practice was deemed adequate; if it was lower than 60%, it was deemed inadequate.

Instrument Validation and Reliability Assessment: To establish the psychometric integrity of the research instruments, a rigorous process of validation and reliability testing was undertaken. Initially, the preliminary versions of the data collection tools were submitted to a panel of subject matter experts encompassing the fields of public health, community medicine, and tropical medicine. These experts were tasked with evaluating the face validity, assessing whether the instruments appeared to measure the intended constructs, and the content validity, determining the extent to which the instruments comprehensively covered the relevant domains. Based on the insightful feedback, critiques, and constructive suggestions provided by the expert panel, the tools were subsequently revised and finalized to enhance their clarity, relevance, and comprehensiveness.

The reliability of the knowledge questionnaire, a critical component of the study, was rigorously evaluated by assessing its internal consistency. This was achieved through the application of the Guttman split-half coefficient, a statistical measure that assesses the extent to which different parts of the questionnaire yield consistent results. The calculated Guttman split-half coefficient of 0.783 indicates a good degree of internal consistency and, consequently, satisfactory reliability of the knowledge questionnaire, suggesting that the items within the instrument are measuring a similar underlying construct in a consistent manner.

Fieldwork: After obtaining all official permissions to conduct the study, the researcher visited the study settings and met with the medical and nursing directors of the hospital. She explained to them the aim of the study and the data collection procedures to acquire their cooperation and to set a suitable schedule for data collection. The researcher then met with the physicians and nurses individually to explain the aim of the study

and the data collection process. Those who gave their oral informed consent to participate were given the knowledge forms with instructions on how to fill them. The researcher was available all the time to respond to any inquiries. Then, the filled forms were collected and checked for their completeness. Then, the healthcare providers' practice was assessed using the observation checklists while performing their daily tasks related to infection control and prevention of HCAIs.
A participant observation process was utilized during the data collection to avoid any bias in their practice.

Administrative and Ethical Considerations:

To secure approval for conducting the study, official letters were sent to the directors of the hospital. They elucidated the purpose of the research, and a copy of the data collection forms was included. They were informed about the study's purpose and methods. The Research Ethics Committee at the Military Institute of Health and Epidemiology, Military Medical Academy in Cairo, Egypt approved the study protocol.

The researcher met with each study subject one-on-one to clarify the purpose of the research and obtain their informed consent for participation. Complete confidentiality and anonymity regarding any acquired data were guaranteed.

Statistical analysis

Data management and statistical analyses were performed using SPSS version 20.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics, including frequencies and percentages for categorical variables and means with standard deviations, range, and medians for continuous variables, were employed to summarize the data. The reliability of the developed questionnaire was assessed for internal consistency using the Guttman split-half coefficient. Comparisons between qualitative categorical variables were conducted using chi-square tests. Spearman's rank correlation coefficient was calculated to evaluate the relationships between continuous and ranked variables. Multiple linear regression analysis was utilized to identify independent predictors of knowledge and practice scores. Statistical significance was defined as a p-value less than 0.05.

RESULTS

The physician cohort in this study comprised only male participants, with ages ranging from 24 to 43 years and a median age of 37.0 years (Table 1). A substantial majority (73.3%) of the physicians were unmarried, and the predominant educational attainment was a bachelor's degree (73.3%). The median duration of their professional work experience was 5.0 years, with a range spanning from 4 to 11 years. Furthermore, approximately 60% of the physicians reported prior attendance at training courses, primarily occurring in a workplace setting.

Table 1: Socio-demographic characteristics of physicians in the study sample (n=15)

	Frequency	Percent
Age:		
<35	5	33.3
35+	10	66.7
Range	24-43	
Mean±SD	34.73±5.9	
Median	36.0	
Gender:		
Male	15	100.0
Female	0	0.0
Marital status:		
Unmarried	11	73.3
Married	4	26.7
Qualification:		
Bachelor	11	73.3
Master	3	20.0
Doctorate	1	6.7
Work experience years:		
<5	3	20.0
5+	12	80.0
Range	4-11	
Mean±SD	5.6±2.2	
Median	5.0	
Had training courses:		
Yes	9	60.0
No	6	40.0
Courses attended (n=9):		
Pre-employment	4	44.4
During job	5	55.6

As for the sample of nurses, table 2 indicates that it consisted of a great majority of females (90.3%) and their ages ranged between 21 and 35 years, with a median of 25.0 years. They were mostly diploma nurses, and approximately three-fifths were married (59.7%). Their median years of work experience was 5.0, ranging between 4 and 11 years. A majority (84.7%) reported having previously attended training courses, mostly during the job (91.8%).

Table 2: Socio-demographic characteristics of nurses in the study sample (n=72)

	Frequency	Percent
Age:		
<25	43	59.7
25+	29	40.3
Range	21-35	
Mean±SD	5.4±2.4	
Median	25.0	
Gender:		
Male	7	9.7
Female	65	90.3
Marital status:		
Single	43	59.7
Married	25	34.7
Divorced	4	5.6
Qualification:		
Bachelor	2	2.8
Technical institute diploma	57	79.2
Secondary nursing diploma	13	18.1
Work experience years:		
<5	35	48.6
5+	37	51.4
Range	4-11	
Mean±SD	5.43±2.4	
Median	5.0	
Had training courses:		
Yes	61	84.7
No	11	15.3
Courses attended (n=61):		
Pre-employment	3	4.9
During job	56	91.8
Both	2	3.3

Comparing the knowledge of HCAIs and their control between the physicians and the nurses in the study sample revealed some statistically significant differences as presented in table 3. These were related to the areas of HCAIs definition, gloving/masking, safe injection, isolation, and safe waste disposal. It is evident that in all these comparisons, the nurses had more satisfactory knowledge compared with the physicians. In total, 33.3% of the physicians had satisfactory knowledge compared with 65.3% of the nurses. This difference was statistically significant.

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Table 3: Comparison of the total knowledge of HCAIs and control measures among physicians and nurses in the study sample

Satisfactory (60%+) Knowledge of:	Job				X^2 test	p-value
	Physicians (n=15)		Nurses (n=72)			
	No.	%	No.	%		
Healthcare acquired infections (HCAI) definition:						
Satisfactory	3	20.0	48	66.7		
Unsatisfactory	12	80.0	24	33.3	11.15	<0.001*
Causative organisms:						
Satisfactory	14	93.3	66	91.7		
Unsatisfactory	1	6.7	6	8.3	0.05	0.83
Transmission:						
Satisfactory	6	40.0	46	63.9		
Unsatisfactory	9	60.0	26	36.1	2.95	0.09
Infection control:						
Satisfactory	2	13.3	10	13.9		
Unsatisfactory	13	86.7	62	86.1	0.00	0.95
Hand hygiene:						
Satisfactory	5	33.3	39	54.2		
Unsatisfactory	10	66.7	33	45.8	2.16	0.14
Gloving/masking:						
Satisfactory	5	33.3	56	77.8		
Unsatisfactory	10	66.7	16	22.2	11.70	<0.001*
Safe injection:						
Satisfactory	7	46.7	56	77.8		
Unsatisfactory	8	53.3	16	22.2	6.01	0.01*
Isolation:						
Satisfactory	4	26.7	63	87.5		
Unsatisfactory	11	73.3	9	12.5	25.95	<0.001*
Safe waste disposal:						
Satisfactory	2	13.3	51	70.8		
Unsatisfactory	13	86.7	21	29.2	17.24	<0.001*
Total knowledge:						
Satisfactory (60%+)	5	33.3	47	65.3		
Unsatisfactory (<60%)	10	66.7	25	34.7	5.27	0.02*

(*) Statistically significant at p<0.05

When comparing occupational health and safety practices between physicians and nurses within the study sample, as detailed in table 4, only one statistically significant difference was observed, specifically concerning hand hygiene practices. Notably, a higher proportion of nurses demonstrated adequate hand hygiene practices compared to the

physician cohort. Overall, 93.3% of physicians exhibited adequate total occupational health and safety practice scores, compared to 94.4% of nurses. This marginal difference in total adequate practice was not statistically significant.

Table 4: Comparison of the total practices among physicians and nurses in the study sample

Practices (Adequate: 95%+)	Job				X^2 test	p-value
	Physicians (n=15)		Nurses (n=72)			
	No.	%	No.	%		
Hand hygiene:						
Adequate	3	20.0	64	88.9		
Inadequate	12	80.0	8	11.1	33.28	<0.001*
Injection and medication safety:						
Adequate	NA		72	100.0		
Inadequate			0	0.0	--	--
Use of Personal Protective equipment's (PPEs)						
Adequate	15	100.0	66	91.7		
Inadequate	0	0.0	6	8.3	1.34	0.25
Safe waste disposal:						
Adequate	14	93.3	65	90.3		
Inadequate	1	6.7	7	9.7	0.14	0.71
Medical equipment:						
Adequate	NA		52	72.2		
Inadequate			20	27.8	--	--
Occupational health and safety practice:						
Adequate	15	100.0	72	100.0		
Inadequate	0	0.0	0	0.0	--	--
Minimizing exposure and environmental safety measures:						
Adequate	15	100.0	72	100.0		
Inadequate	0	0.0	0	0.0	--	--
Total practice:						
Adequate	14	93.3	68	94.4		
Inadequate	1	6.7	4	5.6	0.03	0.87

(*) Statistically significant at p<0.05 (--) No valid test (NA) Not applicable

Table 5 illustrates a statistically significant moderate positive correlation between physicians' knowledge and practice scores regarding occupational health and safety (r = 0.524). Conversely, these scores did not exhibit significant correlations with physicians' age, professional qualifications, or years of work experience. Among nurses, knowledge scores demonstrated weak but statistically significant positive correlations with both age (r = 0.287) and years of experience (r = 0.307). However, no significant correlation was found between nurses' knowledge and practice scores in this domain.

Table 5: Correlations between physicians and nurses' knowledge and practice and their socio-demographic characteristics

	Spearman's rank correlation coefficient			
	Physicians (n=15)		Nurses (n=72)	
	Knowledge	Practice	Knowledge	Practice
Practice	0.524*	1.000	-0.125	1.000
Characteristics:				
Age	-0.420	0.010	0.287*	-0.068
Qualification level	0.133	0.054	-0.100	-0.010
Experience years	-0.439	0.109	0.307**	-0.003

(*) Statistically significant at p<0.05 (**) Statistically significant at p<0.01

In multivariate analysis, table 6 demonstrates that being a nurse and having previously attended training courses were the statistically significant independent positive predictors of the score of knowledge among healthcare providers. The model explains 29% of the variation in this score as revealed by the r-squared value. Meanwhile, none of the other socio-demographic characteristics had a significant effect on the knowledge score.

Table 6: Multiple linear regression model for the knowledge score

	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Constant	32.56	5.62		5.792	<0.001*	21.38	43.75
Nursing job	24.10	5.34	0.43	4.513	<0.001*	13.48	34.72
Training courses	12.90	5.09	0.24	2.536	0.013*	2.79	23.02

(*) Statistically significant at p<0.05 r-square=0.29 Model ANOVA: F=17.04, p<0.001
Variables entered and excluded: age, gender, qualification, experience, rank, marital status

Regarding the score of practice, table 7 shows that being a nurse was the only statistically significant independent positive predictor of this score among healthcare providers. However, the model explains only 10% of the variation in this score as revealed by the r-squared value. None of the other socio-demographic characteristics had a significant effect on the practice score.

Table 7: Multiple linear regression model for the practice score

	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Constant	99.66	0.67		148.98	<0.001*	93.35	95.45
Nursing job	1.37	0.58	0.26	2.528	0.013*	0.29	2.45

(*) Statistically significant at p<0.05 r-square=0.10 Model ANOVA: F=6.39, p=0.013
Variables entered and excluded: age, gender, qualification, experience, rank, marital status, training courses.

DISCUSSION

Healthcare providers have critical roles in the prevention and control of HCAIs, yet, the literature demonstrates that their related knowledge and practices are suboptimal [17]. Hence, measuring healthcare providers' knowledge and practices related to HCAIs is essential for effective prevention and control [18]. The aim of the current study was to raise awareness about infection control practices among physicians and nurses and suggest recommendations for better means of infection control based on the guidelines. It was intended to identify the level of knowledge of infection control among physicians and nursing staff, assess their degree of adherence to infection control practice, and suggest recommendations for better means of infection control.

The study revealed obvious deficiencies in healthcare providers' knowledge of HCAIs and their control measures. This was more noticed among the physicians in comparison with the nurses. Conversely, their practices were adequate in all related skills, with a few defects in some skills such as hand hygiene and safe waste disposal. The knowledge and practice scores were better among nurses. The findings thus provide clear answers to the research questions posed.

Overall, only one-third of the physicians in the current study had satisfactory knowledge, with mostly unsatisfactory knowledge regarding HCAIs definition, isolation, and safe waste disposal. The only exception was related to the causative organisms, which might be explained by the higher physicians' concern about the types of organisms as they prescribe suitable specific antibiotics. Conversely, they may consider the areas of isolation and safe waste disposal as nurses' responsibilities. This deficient knowledge among physicians is alarming as it would negatively affect their related practices. It might be explained by their low interest and concern about the subject and their low attendance of related training courses. In congruence with this, a KAP study in Iran reported that only around 40% of the physicians had good knowledge of HCAIs [19]. Conversely, **Saraswat *et al.*** [20] in a study of the awareness of HCAIs in India found high scores among physicians, reaching 82%. The difference might be attributed to differences in the settings' infection control policies and procedures and the continuing education activities.

Conversely, the findings of the current study showed that nearly all physicians in the study sample had adequate practice in nearly all practice areas and their related skills. The only exception was in the area of hand hygiene, where the majority had inadequate practice mainly due to a lack of performance in the steps of immediate hand washing after gloves removal and washing hands with soap and water when hands are visibly soiled. This could be due to a lack of facilities for hand washing, or a lack of time due to the heavy workload. A similar finding was reported in a prospective study of staff knowledge and practice of

hand hygiene in India where physicians' practice was deficient [21].

Concerning the nurses in the current study, around two-thirds had a satisfactory level. Although this might seem acceptable, it should be considered suboptimal since their knowledge is critical for the prevention and control of HCAIs in the study setting where the risks of contamination and transmission are very high. A similar percentage of nurses having satisfactory knowledge scores was reported by **Yüksek and Buzgan** [22] in their study of the knowledge of the prevention and control of HCAIs in operating rooms in Turkey. Furthermore, a study of nurses in Poland reported that slightly more than one-half had satisfactory knowledge [23].

The current research indicates that the areas of deficient knowledge among the nurses were mainly those of infection control particularly regarding the PPE in ICUs and hand hygiene steps. These two areas are critical in the prevention and control of HCAIs and should be satisfactorily known by all nurses. The findings agree with a recent review that reported a wide variation in nurses' knowledge of HCAIs prevention and control [24]. On the other hand, almost all present study nurses had adequate practices of HCAIs' control measures particularly safe injection and medication, occupational health and safety, and minimizing exposure and environmental measures. These tasks represent nurses' daily work in patient care. A similarly high percentage of adequate practice of injection and medication safety was reported by **Khatrawi *et al.*** [25] in a multi-country online survey. On the same line, a study in Nigeria demonstrated that a majority of the nurses had adequate practice [26].

In the meantime, just a few of the present study nurses missed the steps of immediate hand washing after gloves removal, not using the same gown/ gloves for more than one patient, separation of waste from the source, and separation between clean and soiled equipment. These deficiencies could be due to a lack of knowledge, a shortage of needed resources, or a lack of time due to work overload. In agreement with this, **Yüksek and Buzgan** [22] in Turkey found that about one-fourth of the nurses had inadequate practice of hand-washing. As for the adequate practice of the use of PPE, a similar deficiency was reported, by **Yousif *et al.*** [27] in a study in Ribat University Hospital, where about one-third of the nurses had inadequate practice by failing to wear gloves when anticipating contact with infectious materials. As for equipment sterilization and reuse, a multi-center survey in Nepal [28] reported that 86.8% of the participants had adequate practice, which is slightly higher than the present study result.

In the present study, only one-third of the physicians had satisfactory knowledge compared to around two-thirds of the nurses, and the difference was statistically significant. Such a difference could be explained by the differences in the curricula of the medical and nursing schools, where the nursing curricula give more emphasis on such topics. Moreover, nurses often receive extensive training specifically focused on infection control, standard precautions, and patient safety, which may contribute to their better knowledge of HAIs compared to physicians. Additionally, nurses are more involved in direct patient care, with more opportunities to acquire practical knowledge through hands-on experience. In agreement with this, a study of the knowledge of physicians and nurses regarding nosocomial infections revealed that only 40% of the physicians had correct knowledge compared with 90% of the nurses [29].

Furthermore, in the present study, significantly more nurses had sufficient knowledge of HCAIs definition, gloving/masking, safe injection, isolation, and safe waste disposal compared with physicians. This could be attributed to their background knowledge and attendance of related training courses. These findings agree with **Barry *et al.*** [30] in Saudi Arabia and, **Yousif *et al.*** [27] in Ribat. Conversely, **Saraswat *et al.*** [20] studying the awareness of HCAIs in India, found significantly higher scores among physicians compared to nurses. Similarly, a KAP study in Saudi Arabia, Iraq, India, the United States, Sudan, and Nigeria found that physicians had significantly better knowledge than nurses [25]. The discrepancy with the current study could be due to the different methodologies used in the process of data collection.

As regards practice, the majority of both physicians and nurses had adequate total practice. The only difference of statistical significance between both groups was regarding hand hygiene practices, which were better among nurses. This could be due to their more frequent use of this practice given the nature of their work and their roles in the direct care of their patients.

The current study results established that physicians' knowledge and practice scores were positively and significantly correlated, but not in the nurses' sample. This suggests that physicians gain more practical than theoretical knowledge during their studies, influenced by the curriculum and teaching methods. In alignment with our study, a KAP study of healthcare personnel concerning HCAIs found no significant correlation between nurses' knowledge and practice scores [31].

The multivariate analyses in the present study acknowledged the nursing job as a significant independent positive predictor of the scores of knowledge and practice among the healthcare providers. This is expected due to a greater focus on infection prevention and control, particularly concerning HCAIs in nursing schools' curricula. Moreover, nurses need to apply all related principles during their daily work. Thus, their practices of procedures such as hand hygiene, safe injection, use of PPE, and safe waste disposal are more frequent compared to physicians. Consistent with this, research conducted in Chinese ICUs showed that being a doctor

was associated with lower knowledge and practice scores [32].

Lastly, the multivariate analysis of the present study has similarly identified the previous attendance of related training courses as a significant independent positive predictor of the knowledge score. This again underscores the important role of training and continuing education for all healthcare providers' categories. In congruence with this, a study of the knowledge of HCAIs among the healthcare providers in ICUS in Rome identified the attendance of scientific meetings and training as a significant positive predictor of the knowledge score [33]. On the same line, **El Sebaey *et al.*** [34] studying the impact of infection control training on medical interns' knowledge and practices in a large academic hospital in Egypt found that most of them had adequate practices after training. Moreover, the frequency and recency of the attended training courses predicted providers' knowledge of HCAIs as shown in the study in Poland [23].

CONCLUSION AND RECOMMENDATIONS

The healthcare providers in the study setting had deficient knowledge of HCAIs and their control measures, particularly the physicians, with adequate practice of all related skills. Having a nursing job positively predicts knowledge and practice scores and the training courses positively predict the score of knowledge.

The study recommends addressing the identified knowledge gaps through regular tailored training, using e-learning modules, webinars, and mobile applications. To enhance practice, implementing hand hygiene campaigns is proposed, with hands-on workshops, regular monitoring of compliance, and organizational support. More research is needed to evaluate the effectiveness of a tailored training program on improving physicians/nurses' HCAIs' knowledge and practices.

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