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Healthcare Providers' Knowledge On Nosocomial Infections Preventive Measures And Its Associated Factors

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Abstract

Background *Nosocomial infections (NCIs) have been associated with several adverse outcomes including extended hospitalization, persistent disability, and heightened antimicrobial resistance, amplified socio-economic disruption, and elevated mortality rates. The adoption of infection prevention strategies has the greatest tendency to significantly reduce the risk and occurrence of NCIs among the population, particularly in resource constrained health systems. This study aimed to assess healthcare providers' (HCPs) knowledge on NCI preventive measures and its associated factors.* ***Methods:*** *A cross-sectional study was conducted in Makkah and Jeddah's Hospital, Saudi Arabia from March to May 2023. A sample of 237 HCPs was selected to participate in the study. Data was collected with a questionnaire designed in Google Forms.* ***Results:*** *Overall, most of the participants (69.2%) were not knowledgeable about the preventive measures of NCIs. HCPs who were within the age group of 20–40 years [aOR = 0.25 (95% CI = 0.09–0.69), p = 0.007] and 41–60 years [aOR = 0.05 (95% CI = 0.01–0.29), p = 0.001] were significantly less likely to be knowledgeable about the preventive measures of NCIs compared to those who those aged less than 20 years. HCPs who attended in-service training or workshop were approximately 10 times more likely to be knowledgeable about preventive measures of nosocomi[1]al infection compared to those who had never attended in-service training or workshop [aOR = 9.55 (95% CI = 1.23– 74.36), p = 0.031].* ***Conclusion:*** *The study concludes that age and participation in-service training or workshop is significant factors that influence the knowledge of HCPs in preventive measures for nosocomial infections. These results highlight the importance of providing ongoing training and professional development opportunities to HCPs to enhance their knowledge and improve their ability to prevent and control nosocomial infections. Additionally, the study emphasizes the need for targeted training programs that consider the age of HCPs, to ensure that training is tailored to their specific needs.*

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Introduction:

Globally, infections are considered a serious public health concern. While infections occur in different settings including at home, work and in outdoor settings, infections acquired at the healthcare facility pose a significant threat to the overall quality of healthcare delivery [(1)]. According to the World Health Organization [(2)], nosocomial infections (NCIs) or hospital acquired infections (HAIs) refer to "an infection occurring in a patient in a hospital or other health care facility in whom the infection was not present or incubating at the time of admission". This infection is acquired in the hospital but appearing after discharge and also occupational infections among staff of the facility [(2)]. These infections include urinary tract infections, surgical site infections (e.g., Staphylococcus aureus), bloodstream infections, and lower respiratory tract infections [(3)]. There are approximately 1.7 million patients worldwide who contract NCIs each year [(4)].

Recent studies estimated the prevalence of HAIs in Europe [(5)] and the USA [(6)] at 6.5% and 3.2%, respectively. The burden of HAIs is strikingly higher in low-resourced countries compared with high-income countries [(7-9)]. WHO-led systematic review revealed that the prevalence of HAIs varies between 7.6% and 15.5% in high-income and low- and middle-income countries, respectively [(10)]. A systematic review [(11)] has also estimated NCIs to be increasing worldwide with an annual increasing rate of 0.06, and with the African region having the highest rates of NCIs. For instance, Ghana has an estimated NCI prevalence of 8.2% [(12)]. If left unabated, the existence of NCIs would have serious repercussions for health care delivery, time spent at the hospital, and healthcare expenditure. NCIs have been associated with several adverse outcomes including extended hospitalization, persistent disability, heightened antimicrobial resistance, amplified socio-economic disruption, and elevated mortality rates [(12-14)]. However, the adoption of infection prevention strategies has the greatest tendency to significantly reduce the risk and occurrence of NCI among the population, particularly in resource constrained health systems [(15)].

Available evidence suggests that adopting NCI prevention involves establishing a protective barrier between vulnerable host and microorganisms [(16)]. According to the WHO [(2)], NCI can primarily be prevented either by reducing person-to-person transmission or by preventing transmission from the environment. Reducing person- to-person transmission involves implementing various measures to minimize the spread of infections between patients, healthcare workers, and visitors. This includes promoting proper hand hygiene practices and practicing safe injection practices [(17)]. On the other hand, preventing transmission from the environment involves maintaining a clean and hygienic healthcare setting. It encapsulates practices such as sterilization, disinfection of patient equipment, proper waste management and cleaning of the hospital environment [(2)].

In the KSA, some urban hospitals recorded 2.2% of hospital infections monthly and other reports confirmed that hospital infection is still one of the most common health problems in the KSA [(18)]. Al Ra'awji et al., (2018) [(19)] observed that more than one quarter (37%) of HCWs in the KSA had poor knowledge of hand hygiene and there is a high need for training for the HCWs. The KSA has been trying to activate all infection control guidelines to improve the activities in the field of infection control to high standards [(20)]. This keen interest in NCI prevention in Ghana is evident in the country's implementation of a national infection prevention policy and guidelines for healthcare settings [(21)].

However, it must be noted that having the support of the government agencies and a policy framework is not enough for healthcare workers to implement NCI preventive measures. Their knowledge level is quintessential to the implementation of NCI preventive

measures [22]. HCPs' knowledge on NCI preventive measures is critical for successful implementation and compliance with infection control protocols. Moreover, adequate knowledge has the potential to empower HCPs to identify potential risks, implement preventive measures effectively, and respond promptly to infection control challenges [23].

Limited research has been conducted in KSA to assess the current state of HCPs' knowledge with respect to NCI prevention. While the existing body of literature has examined the extent to which knowledge influences the practice of NCI preventive measures [18-20, 24, 25], it fails to assess what factors predict the knowledge level of HCPs regarding NCI prevention in KSA. Understanding the level of knowledge and identifying factors associated with HCPs' knowledge gaps can inform targeted interventions and educational programs aimed at improving infection control practices. By addressing these gaps, healthcare facilities in KSA can enhance their infection prevention and control efforts, leading to a reduction in the burden of NCI and improved patient outcomes. Hence, the present study aimed to assess HCPs' knowledge on nosocomial infection (NCI) preventive measures and its associated factors in KSA.

Methods

A cross-sectional study was conducted in Makkah and Jeddah's Hospital, Saudi Arabia from March to May 2023. A sample of 237 HCPs was selected to participate in the study. Using Cochrane's single proportion formula, was estimated as follows; $n = \frac{z\ p\ (1-p)}{}$, considering 5% margin of error, 95% confidence interval = 1.96 and a proportion knowledge of 83.21% from a study conducted by Chitimwango, (2017) [26]. Where; n = Estimated sample size. p = 0.8321. q= (1-p). d = margin of error (0.05). Z = Test Statistic (1.96). Adding 10% to cater for non-response increased the estimated sample size to 237. HCPs were selected based on the following inclusion criteria: they must be present at the time of the survey, and they must express a voluntary interest in participating in the study. Additionally, HCPs who were on leave during the data collection period were excluded from the study.

Definition of variables

Outcome variable

Knowledge on preventive measures of nosocomial infections was the study's outcome variable. This was assessed using (11items) on the questionnaire. These items assessed whether respondents (I) have heard about infection prevention (II) could tell if gloves provide complete protection against acquiring or transmitting infections (III) knows if washing hands with soap or an alcohol- based antiseptic decreases the risk of transmission of nosocomial infections (IV) knows if the use of an alcohol-based antiseptic for hand hygiene is as effective as soap and water if hands are not visibly dirty (V) knows if gloves should be worn if blood or body fluid exposure is anticipated or not (VI) knows if there is a need to wash hands before doing procedures that do not involve bodily fluids or not (VII) knows if there is a need to wear the same pair of gloves for multiple patients as long as there is no visible contamination or not (VIII) knows the specific waste disposal buckets according to the level of their contamination (VIV) knows the written formula for preparing 0.5% chlorine solution (X) knows how long instrument or equipment should be disinfected and (XI) knows disease that are transmitted by needle stick injury.

For each of the items (I-X), respondents were asked to choose from the two responses "yes" or "no" provided. For question (XI), respondents were provided with a list of diseases (HBV, HCV, TB, and HIV) to choose from. Respondents were allowed to choose from the list multiple times. A composite knowledge score was obtained by

assigning a score of 1 to all the positive responses to the eleven (11 questions). All negative responses on the other hand were assigned the score of 0. A mean score was generated by adding all these responses and HCPs who scored below the mean were considered "not knowledgeable" on the preventive measures of nosocomial infections, whereas HCPs who scored above the mean were considered "knowledgeable". The study incorporated the classification of knowledge on the preventive measures of nosocomial infections into "not knowledgeable" and "knowledgeable" from previous studies [27-29].

Explanatory variable

For the study, five (5) explanatory variables were considered in our estimations. These variables included age, sex, level of education, years of working experience and in-service training or workshop. None of these variables were chosen at random; rather, they were chosen based on the findings of previous studies on knowledge in preventive measures of nosocomial infections among healthcare workers [30-32]. In assessing these socio-demographic information of the respondents, age and years of working experience were collected as continuous variables and categorized into (< 20 years, 20–40 years, 41–60 years) and (1–10 years, 11–20 years and > 20 years) respectively. Respondents' sex (male or female), level of education (certificate, diploma, degree, masters or doctoral), and in-service training or workshop (yes or no) were collected as categorical variables.

Data was collected using a well-structured questionnaire comprising of both open and close-ended questions which were pretested. The questionnaire was designed in Google Forms. It comprised of 35 items related to the socio- demographic factors, knowledge in preventive measures and practice of preventive measures of NCIs. The questionnaires were prepared in English then translated into Arabic and translated back to English to check the consistency. A pilot test was conducted to check the consistency of the questionnaire among (10%) of HCPs before the study period. Before any data were gathered, all study participants provided their verbal agreement. Subjects were made aware of the study's objective before researchers began to collect data. Information about the participants was kept private and anonymous. The assurance that their involvement in the study was optional was offered to every participant. They were made aware that they could discontinue the study at any moment and without explanation.

The data was extracted from Google Forms to Excel Sheet for cleaning and then exported into SPSS version 28. Descriptive statistics were performed to interpret the socio-demographic features including age, sex, level of education, work experience, and in-service training or workshop on nosocomial infection prevention. However, inferential statistics were done to test the association between socio-demographic factors and healthcare workers' knowledge in preventive measures of nosocomial infections. Frequencies and percentages related to the study findings were presented using tables and graphs.

Results

Table (1) shows a distribution of the socio-demographic characteristics of the respondents. The majority of the HCPs were females 124 (52.3%) while males were 113 (47.7%). More than two-thirds of them, 195 (82.7%) were within the age group of (20–40) years. Most of the participants, 127 (53.6%) were Diploma holders. Regarding their work experience, almost all of them 204 (86.1%) had work experience ranging between (1–10) years. Out of the total 237 HCPs, 218 (92.0%) had attended in-service training or workshop on nosocomial infection prevention while 19 (8.0%) had never attended any in-service training or workshop on nosocomial infection prevention.

Knowledge of HCPs on preventive measures of nosocomial infections

Table (2) shows the distribution of HCPs' knowledge on NCI preventive measures. Out of the total 237 HCPs who participated in the study, more than 90% 216 (91.1%) indicated that they had heard about infection prevention. More than half 148 (68.5%) out of the 216 (91.1%) who had heard about infection prevention believed that gloves cannot provide complete protection against acquiring or transmitting infections. Almost all of them 213 (98.6%) believed that washing your hands with soap or using an alcohol-based antiseptic decreases the risk of transmission of NCI. More than 80% of them 187 (86.6%) also indicated that the use of an alcohol-based antiseptic for hand hygiene is as effective as soap and water if hands are not visibly dirty. All of them 216 (100%) agreed that there is a need to wash hands before doing procedures that do not involve bodily fluids. Furthermore, 198 (83.5%) of the HCPs know the specific waste disposal buckets according to the level of their contamination. Most of the participants, 210 (88.6%), indicated that instruments or equipment should be disinfected for 10 min.

Figure (1) illustrates that knowledge mean score was generated using the items used to measure the level of knowledge among the HCPs. Those who scored below the mean were considered not knowledgeable on the preventive measures of NCIs, whereas those who scored above the mean were considered knowledgeable. The findings from this study revealed that 164 (69.2%) of the participants were not knowledgeable on the preventive measures of NCIs

Factors associated with HCPs' knowledge on preventive measures of nosocomial infections

Table (3) revealed that Age and in-service training or workshop was the only factors that were significantly associated with the participants' knowledge on NCI preventive measures. Sex, level of education and years of working experience showed no significant association with HCPs' knowledge on NCI preventive measures. Specifically, HCPs who were within the age group of 20–40 years [aOR = 0.25 (95% CI = 0.09–0.69), p = 0.007] and 41–60 years [aOR = 0.05 (95% CI = 0.01–0.29), p = 0.001] were significantly less likely to be knowledgeable about the preventive measures of NCIs compared to those who those aged less than 20 years. HCPs who attended in-service training or workshop were approximately 10 times more likely to be knowledgeable about preventive measures of nosocomial infection compared to those who had never attended in- service training or workshop [aOR = 9.55 (95% CI = 1.23– 74.36), p = 0.031].

Table (1): Distribution of the socio-demographic characteristics of the respondents

Variable	**Frequency (n = 237)**	**Percentage (%)**
Sex		
Female	124	52.3
Male	113	47.7
Age		
< 20 years	19	8.0
20–40 years	195	82.3
41–60 years	23	9.7
Level of Education		
Certificate	15	6.3
Diploma	127	56
Degree	80	33.8
Masters	14	5.9

Variable	Frequency (n = 237)	Percentage (%)
Doctoral	1	0.4
Years of Working Experience		
1–10 years	204	86.1
11–20 years	23	9.7
> 20 years	10	4.2
In-service training or Workshop		
No	19	8.0
Yes	218	92.0

Table (2): Distribution of HCPs' knowledge on preventive measures of nosocomial infections

Variables		Percentage (%)
Heard about infection prevention		
No		8.9
Yes		91.1
Gloves provide complete protection against acquiring or transmitting infections (n = 216)		
No		68.5
Yes		31.5
Hand washing with soap and water or an alcohol-based antiseptic decreases the risk of nosocomial infectiontransmission (n = 216)		
No		1.4
Yes		98.6
Using an alcohol-based antiseptic for hand hygiene is as effective as using soap and water if hands are notvisibly dirty (n = 216)		
No		13.4
Yes		86.6
Gloves should be worn if blood or body fluid exposure is anticipated (n = 216)		
No		17.6
Yes		82.4
There is a need to wash hands before carrying out procedures that do not involve bodily fluids (n = 216)		
No		0.00
Yes		100
There is a need to wear the same pair of gloves for multiple patients as long as there is no visible contamination (n = 216)		
No		93.1
Yes		6.9
Know the specific waste disposal buckets according to the level of their contamination		
No		16.5
Yes		83.5
Know the written formula for preparing 0.5% chlorine solution		

Variables		Percentage (%)
No		21.5
Yes		78.5
Duration for the disinfection of instruments or equipment		
10 min		88.6
1 h		8.4
24 h		3.0
Diseases transmitted by needle stick injury (More than one answer is possible)		
HBV; HCV		0.4
HBV; HCV; HIV		49.4
HBV; HCV; TB; HIV		1.3
HBV; HIV		21.9
HBV; TB; HIV		0.8
HIV		24.5
TB; HIV		1.7

HBV: Hepatitis B Virus; HCV: Hepatitis C Virus; HIV: Human Immunodeficiency Virus; TB: Tuberculosis

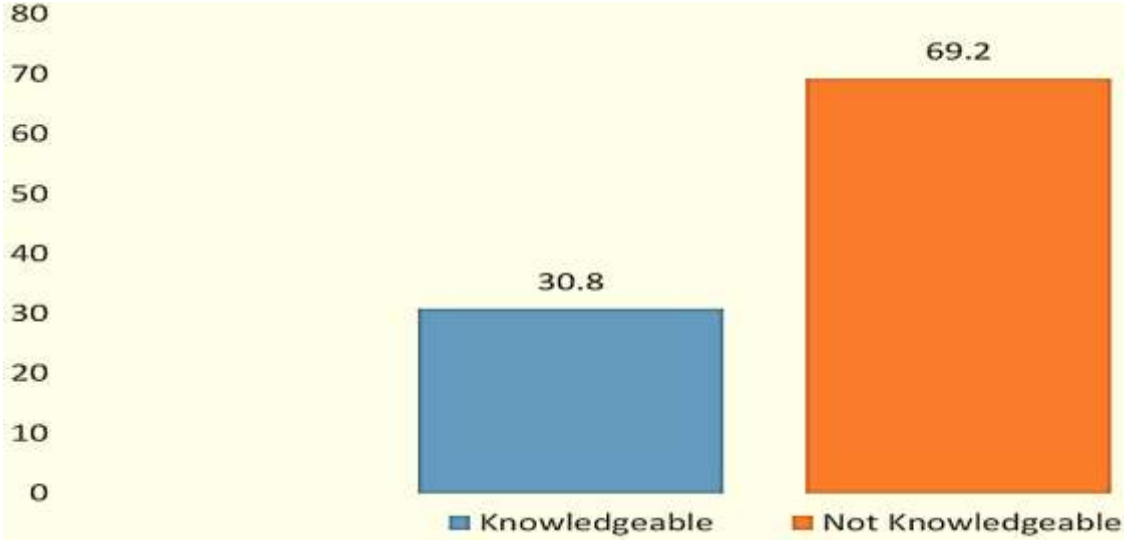

Figure (1): Overall level of knowledge of HCPs in preventive measures of nosocomial infections

Table (3): Factors associated with HCPs' knowledge on preventive measures of NCIs

Variable	Level of Knowledge in Preventive Measure		cOR [95% CI]	P-values	aOR [95%CI]	P-values
	Not Knowledgeable = 164 n(69.20%)	Very Knowledgeable = 73 n(30.80 %)				
Sex						
Female	92 (56.10)	32 (43.84)	0.51 [0.12–0.71]	0.081	-	-
Male	72 (43.90)	41 (56.16)	6.12 [1.01–1.99]	0.132	-	-
Age						
< 20 years	7 (4.27)	12 (16.44)	**Ref**		**Ref**	
20–40 years	136 (82.93)	59 (80.82)	**0.25 [0.09–0.67]**	**0.006***	**0.25 [0.09–0.69]**	**0.007***
41–60 years	21 (12.80)	2 (2.74)	**0.06 [0.01–0.31]**	**0.001*****	**0.05 [0.01–0.29]**	**0.001*****
Level of Education						
Certificate	10 (6.10)	5 (6.85)	6.43 [2.62–9.67]	0.072	-	-
Diploma	84 (51.22)	43 (58.90)	0.87 [1.08–6.95]	0.111	-	-
Degree	56 (34.15)	24 (32.88)	5.43 [0.03–1.72]	0.065	-	-
Masters	13 (7.93)	1 (1.37)	0.97 [0.07–0.49]	0.232	-	-
Doctoral	1 (0.60)	0 (0.00)	3.25 [1.33–4.11]	0.142	-	-
Years of Working Experience						
1–10 years	136 (82.92)	68 (93.15)	5.16 [2.04–6.63]	0.074	-	-
11–20 years	18 (10.98)	5 (6.85)	2.95 [0.19–1.42]	0.081	-	-
> 20 years	10 (6.10)	0 (0.00)	1.66 [0.01–0.31]	0.061	-	-
In-service training or Workshop						
No	18 (10.98)	1(1.37)	**Ref**		**Ref**	
Yes	146(89.02)	72(98.63)	**8.88 [1.16–67.81]**	**0.035***	**9.55 [1.23–74.36]**	**0.031***

aOR: adjusted odds ratio, CI: confidence interval, cOR: crude odds ratio, Ref: Reference point; *p < 0.05; ***p < 0.001

Discussion

This study assessed HCPs' knowledge on NCI preventive measures and its associated

factors in KSA. The present study revealed that more than two-thirds of HCPs (69.2%) were not knowledgeable about NCI preventive measures. The observed proportion of HCPs who were knowledge about NCI prevention measures is less when compared a previous study conducted by Bayleyegn et al., (2021) [16] where 90% of HCPs had good knowledge on NCI preventive measures. Nevertheless, these findings align with a prior study conducted by Algarni et al., (2019) [30] revealed that only 50% of HCPs were knowledgeable about infection prevention measures, including NCIs. The observed low knowledge on NCI preventive measures among HCPs poses a significant threat to patient safety. This is in the sense that patients often rely on HCPs to provide safe and effective care. Therefore, having a low knowledge about NCI preventive measures implies that HCPs may be involved in practices that exacerbate the risk of NCI transmission [22, 24, and 33].

The study revealed that having participated in an in-service training or workshop was positively associated with HCPs' knowledge on NCI preventive measures. That is, the likelihood of being knowledgeable about NCI preventive measures was significantly higher among those who had participated in an in-service training or workshop compared to those who had not participated in such initiatives. Similar findings have been reported in North-East Ethiopia [32] and Nigeria [34]. A plausible explanation for this result could be that in-service training and workshops serve as reinforcement mechanisms for existing knowledge. Even if HCPs have received prior education on infection control, attending training sessions provides an opportunity to refresh their knowledge, identify areas for improvement, and correct any misconceptions or outdated practices. The repetition of key concepts and information during the training sessions has the potential to reinforce the importance of NCI prevention and increases retention of knowledge among employees [34].

Another finding from this study was the significant association between age and HCPs' knowledge on NCI prevention. Contrary to previous studies that have shown that HCPs' knowledge on NCI prevention increases with increasing age [31, 33]. The present study found that older age was associated with lower odds of being knowledgeable about NCI prevention compared to those of younger age. That is, the present study challenges the existing literature that posits that older HCPs tend to be more knowledgeable about NCI prevention through years of experience and working collaboratively with senior staff [31].

It is possible that younger HCPs, who may have recently completed their education or training, are likely to have been exposed to more up-to-date information and guidelines regarding NCI prevention. They may have received more comprehensive training that includes the latest research, technological advancements, and evidence-based practices. In contrast, older HCPs may not have had the same exposure to these updated resources, leading to a knowledge gap between the age groups. We also postulate that older HCPs may be less inclined to adopt new practices or update their knowledge base, especially if they have been practicing for a long time without encountering significant issues related to NCI. This resistance to change can result in a slower uptake of new information and guidelines, hence, explaining their lower knowledge levels regarding NCI prevention.

The study highlights the urgent need for the Ministry of Health, Health Service, and hospital administrators to prioritize education and sensitization initiatives on NCI preventive measures for HCPs. Also, the positive association between participation in in-service training or workshops and HCPs' knowledge on NCI preventive measures emphasizes the importance of these initiatives. Healthcare institutions should provide regular opportunities for HCPs to attend such training sessions, as they serve as reinforcement mechanisms for existing knowledge and contribute to improved understanding and implementation of NCI prevention measures. To bridge the knowledge gap observed among older HCPs, healthcare institutions should design and implement

tailored training programs that specifically address their needs. These programs should focus on updating their knowledge base, addressing resistance to change, and providing them with the necessary skills to adopt current NCI preventive measures.

Conclusion

A significant proportion of HCPs in KSA lack knowledge on NCI prevention. The study concludes that age and participation in-service training or workshop is significant factors associated with HCPs' knowledge NCI prevention. These results highlight the importance of providing ongoing training and professional development opportunities to HCPs to enhance their knowledge and improve their ability to prevent and control nosocomial infections. Additionally, the study emphasizes the need for targeted training programs that consider the age of HCPs, to ensure that training is tailored to their specific needs and learning styles.

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