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Knowledge and Sources of Information Among Healthcare Students on Nosocomial Infections and Control Measures: A Cross Sectional Study

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Abstract

Background: Healthcare students act as potential vectors for pathogenic agents and play a vital role in transmitting nosocomial infections. Therefore, assessing their knowledge on nosocomial infections and control measures may aid in preventing these infections.

Objectives: This study was aimed to assess knowledge on nosocomial infections and control measures among healthcare students in the Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka.

Methods: A descriptive cross-sectional study was conducted among purposively selected 253 healthcare students. A pre-tested, self-administered questionnaire was used to assess knowledge about three main domains; nosocomial infections, standard precautions and hand hygiene. The sources of acquiring knowledge for these 3 areas were also recorded. The overall knowledge score ranged from 0-69 was categorized into three levels; low, moderate or high. The significance level was set as $p \leq 0.05$.

Results: Mean overall knowledge score of the participants was 48.00 (SD±10.63). Majority (64%) had a high level of knowledge score. Nursing students had a higher score (52.53, SD±7.94) than physiotherapy (47.60, SD±10.85) or radiography (43.16, SD±10.98) students. This difference was statistically significant ($P<0.001$). Mean scores for the domains of nosocomial infections, standard precautions and hand hygiene were 30.77 (SD±8.29), 10.23 (SD±2.59) and 7.00 (SD±1.86) respectively. Participants identified formal teaching in classrooms as the main source of information for all three domains.

Conclusion: The knowledge among healthcare students regarding nosocomial infections and control measures was found to be satisfactory. However, more practical components of hand hygiene and standard precautions in future educational approaches would be more effective.

Keywords: Healthcare-associated infections, Healthcare students, Hospital-acquired infections, Nosocomial infections, Standard precautions

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INTRODUCTION

Nosocomial infections (NIs) also known as healthcare associated infections occur in patients under medical care in a hospital or other healthcare facility which was neither present nor incubating at the time of admission to the healthcare facility. Usually, infections which become evident 48 hours or more after hospital admission or within 30 days of discharge are considered as "Nosocomial" or "Hospital Acquired Infection"[1,2,3,4]. This also includes occupational infections among healthcare team of the facility[5]. Despite the advanced development in health care, nosocomial infections continue to develop in hospitalized patients and results in significant morbidity and mortality in patients while affecting the healthcare workers as well[1,6,7,8].

Every day, NIs result in prolonged hospital stays, long-term disability, increased resistance of microorganisms to antimicrobials, massive additional costs for health systems, high costs for patients and their family, and unnecessary deaths[9,10]. Developing countries have reported having up to 20 times the risk of contracting a NI compared with developed countries[2,3]. Of every 100 hospitalized patients, 7 in developed and 10 in developing countries can acquire one of the NIs, at any given time[6,11,12]. Thus, the spread of infection is considered as a major source of worry for healthcare managers, particularly in developing countries, where the healthcare system is already overstretched[2,3,13].

The prevention of NIs requires a multifaceted approach because the infectious agents can be transmitted from their hosts to a susceptible host by various methods[14]. The infection control strategies include; standard precautions, transmission-based precautions, immunization, education and training[11]. Despite the increasing prevalence of NIs, current researchers indicate that up to one-third of all NIs may be prevented by adequate cleaning of equipment and thorough hand washing[4,15]. Hand hygiene is the most important and cost-effective method of nosocomial infection control[16,17,18,19,20]. Such measures not only protect the patients, but also the healthcare workers, students and the environment[21]. Healthcare students, especially the nursing students are involved in more frequent contact with patients than others and play a vital role in transmitting these infections. Hence, their knowledge and compliance regarding the NIs and control measures seem to be necessary for preventing and controlling NIs[6]. The risk is substantial not only for nursing students, but also for the other health care students including physiotherapy and radiography students as they are involved in frequent patient contacts. Thus, it is essential for these students to have an adequate knowledge about infection prevention and control practices before their initial training period at a hospital and to incorporate this knowledge in their professional training[13,19,21,22].

There is a lack of evidence regarding explicit infection control training in the curriculum of most of the medical and allied health undergraduate courses, which needs to be promptly addressed if NIs are to be reduced[21]. Students who enter to degree programmes in health sciences are not required to fulfill any prerequisites in the area of infection control before they enter into the university. Therefore, their undergraduate years are the most appropriate period for acquiring necessary skills and knowledge[20,21]. Hence, it is very important to alert clinical instructors and supervisors to pay adequate attention towards conveying knowledge to students throughout their training period about NIs and their control measures[3].

Assessing healthcare students' knowledge on NIs and control measures may aid in preventing NIs and can provide a foundation for curricular reforms necessary to equip them with adequate knowledge and skills [13]. Healthcare students' knowledge of NIs and control measures is rarely compared; to our knowledge, no local studies have previously reported comparing the knowledge of NIs and control measures between students in different health curricular. Considering the lack of information describing the students' knowledge on NIs and preventive measures necessary to limit the spread of NIs, this study provides insight into knowledge about NIs among healthcare students

undertaking different training programmes. Therefore, this study was carried out to assess the knowledge on nosocomial infections and control measures among healthcare students in the Faculty of Allied Health Sciences, University of Peradeniya.

MATERIAL AND METHODS

A descriptive cross-sectional study design was employed. The study was carried out among the healthcare students in the Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka. The study covered a period from July 2019 to August 2019. Students were selected from each academic programme using a non-probability (purposive) sampling technique. Overall, 253 students from nursing (92 students), physiotherapy (81 students) and radiography (80 students) were selected for the study. Second, third and fourth year students of these academic programmes who were willing to participate in the study were included into the sample. The students who were not available at the time of the data collection were excluded from the study.

A pre-designed, pre-tested, self-administered structured questionnaire which was developed according to the international standards on prevention of nosocomial infections in line with the objectives of the study was used as the study instrument. This questionnaire was consisted of four major parts 1) demographic characteristics of the participants including age, gender, academic year, course of study, duration of clinical exposure, and training on infection control2) knowledge on nosocomial infections (Part A), 3) knowledge on standard precautions (Part B) and 4) knowledge on hand hygiene (Part C). Parts B and C separately measured the knowledge on different control measures of nosocomial infections. Part A was consisted of 46 items, while part B and C were consisted of 13 items and 10 items respectively.
The 69 items related to knowledge were assessed with “correct”, “incorrect” and “I don’t know” options. For each correct answer, one score was assigned and therefore, the total score for knowledge was ranged between 0-69. The maximum and minimum scores for each section vary based on the number of items in each section. Correct answers were calculated to obtain total scores for different sections of the questionnaire. The overall knowledge score was arbitrarily categorized into equal intervals. A score between 0-23 was considered low, 24-46 moderate, and 47 or above was considered as high. A higher score indicated a greater level of knowledge. In addition, their main sources of information regarding the above areas were also gathered through the questionnaire. Content validity of the questionnaire was obtained by two experts in infection control and prevention at hospitals. Their comments regarding the tool layout and format, relevance, accuracy, consistency, and scoring system were taken in consideration.

Prior to the study, participants were given a brief introduction to the purpose of the study, after which their consent was obtained. Once completed, the questionnaires were collected at the same time to avoid any non-response bias. A total of 253 questionnaires were distributed and all of them were returned making up a response rate of 100%. Therefore, 253 samples were included in the final analysis. The responses were recorded and analyzed using the statistical software IBMSPSS, version 22.0. Descriptive statistics were used to summarize the data obtained. Association between demographic characteristics and knowledge about nosocomial infections were tested using Chi-square test and the One-Way ANOVA test to compare differences in the knowledge between the different student groups. Independent t test was used to compare the difference in knowledge level between male and female students. Pearson correlation coefficient test was performed to examine the relationship between the duration of clinical exposure and the knowledge score of the students. A p-value ≤ 0.05 was considered as significant.

Ethical approval for this study was obtained from the Ethics and Research Committee of Faculty of Allied Health sciences, University of Peradeniya (AHS/ERC/2018/061). In addition, the written informed consent was obtained from all the participants before data collection. Permission to collect data from students was obtained from heads of the relevant academic programmes. Data and other information of the study were only accessible to the researchers of the study and the participation was anonymous.

RESULTS

The questionnaire was found to be internally consistent with a Cronbach's alpha value of 0.84. All the participants completed and returned the questionnaire, giving a response rate of 100%.

Characteristics of the sample

The mean overall age of the sample was 24.0 years (SD±1.2). Out of the total sample (n=253), 65.0% were females and the majority of participating students were 2nd year students (42.0%). Nursing students represented the majority (36%) of the sample. The first year Physiotherapy and Radiography students (25.7%) have had no previous clinical experience. Mean duration of clinical exposure of the students who had previous clinical experience was 428.3 hours (SD±465.9). Approximately two third of the participating students (63.2%) reported that they were not exposed to any infection control training programme during their course work. However, 71% nursing students have participated in at least one infection control training programme (Table 1).

Table 1. Demographic characteristics of the sample (n=253).

Characteristic	n	%
Age		
22-24 years	174	68.8
25-27 years	79	31.2
Gender		
Male	89	35.2
Female	164	64.8
Academic year		
2nd year	105	41.5
3rd year	71	28.1
4th year	77	30.4
Course of study		
Nursing	92	36.4
Physiotherapy	81	32.0
Radiography	80	31.6
Exposed to clinical training		
Yes	188	74.3
No	65	25.7
Training programme on infection control		
Yes	93	36.8
No	160	63.2
If yes, number of training programmes		
Only one	64	25.3
Only two	19	7.5
More than two	10	4.0

Knowledge of nosocomial infections and control measures

The total knowledge score for the students ranged from 5 to 67, with a mean total score of 48.00 (SD±10.63) representing a score of 69.6% of the highest possible score of the scale. The majority (64%) had a high level of knowledge score whereas 31% had moderate and 5% had low level of knowledge score. Nursing students showed the highest score (52.53, SD±7.94) than physiotherapy students (47.60, SD±10.85) and radiography students (43.16, SD±10.98). Comparison of mean

knowledge scores among the three programmes using One-Way ANOVA test did show a statistically significant difference (F=19.1, p<0.001). The mean scores for the domains of nosocomial infections, standard precautions and hand hygiene were 30.77 (SD±8.29), 10.23 (SD±2.59) and 7.00 (SD±1.86) respectively. There was a statistically significant difference in mean scores, in all three domains of the questionnaire between the different student categories (p<0.001) (Table 2). Nursing students showed the highest knowledge scores in all three domains, whereas physiotherapy students showed better knowledge scores in two domains (nosocomial infections and hand hygiene) than radiography students.

Table 2: Comparison of knowledge of different student groups on nosocomial infections, and control measures (standard precautions, and hand hygiene).

Domain	Nursing	Physiotherapy	Radiography	p value
Nosocomial infections	33.50±6.67	31.25±8.44	27.14±8.58	<0.001*
Standard precautions	11.23±1.82	9.58±2.86	9.75±2.74	<0.001*
Hand hygiene	7.80±1.03	6.78±1.82	6.28±2.26	<0.001*
Total	**52.53±7.94**	47.60 ± 10.85	43.16 ± 10.98	

*Significant at 0.05 level based on One-Way ANOVA

Similarly, female students showed a higher total knowledge score (50.30, SD±8.38) than male students (43.73, SD±12.85) and the difference was statistically significant (t= -4.352, p<0.001). Students were assessed on the basis of their knowledge in relation to the demographic characteristics. Chi-Square test showed significant associations between gender (p<0.001), course of study (p<0.001), exposure to clinical practice (p=0.004), exposure to infection control training (p=0.014) and the level of knowledge on nosocomial infections and control measures (Table 3). Finally, Pearson correlation coefficient demonstrated that there was a statistically significant weak positive relationship between the duration of clinical exposure and the knowledge score of the students (r=0.214, p=0.001).

Table 3: Association between demographic variables and the level of knowledge

Association	X^2 value	p value
Age and level of knowledge	0.612	0.736
Gender and level of knowledge	18.234	<0.001*
Academic year and level of knowledge	5.197	0.268
Course of study and level of knowledge	29.093	<0.001*
Exposed to clinical practice and level of knowledge	15.517	0.004*
Exposed to infection control trainings and level of knowledge	8.503	0.014*

*Significant at 0.05 level based on Chi-Square test

Sources of information

Participants identified formal teaching in classrooms as the main source of information for all three domains (reported by 41.5% of students for nosocomial infections, 42.7% for standard precautions, and 41.1% for hand hygiene) and a few reported that the most important source was self-learning (reported by 25.7% of students for nosocomial infections, 17.0% for standard precautions, and 22.5% for hand hygiene). The alternative source of information was practical learning in hospital wards (reported by 26.1% of students for nosocomial infections, 29.6% for standard precautions, and 31.2% for hand hygiene).

DISCUSSION

Based on our scoring system in this study, nearly two third of the students could be described having high level of knowledge regarding nosocomial infections and control measures. In our study, mean overall score for knowledge among healthcare students was considered to be acceptable (ie. 48 of 69). However, the knowledge of students differed according to the specific areas (nosocomial infections, standard precautions and hand hygiene) and the curricula of healthcare students. The low knowledge score may be the result of not having a special course on infection control in the healthcare students' curricula. The total percentage mean of correctly answered questions in our study was 69.6%. The highest scores were achieved for knowledge of standard precautions and hand hygiene, and the lowest score was for knowledge of nosocomial infection. However, knowledge related to the appropriate use of alcohol-based hand rub was insufficient. Therefore, knowledge of hand hygiene should be improved, because it is the most effective measure for interrupting the transmission of microorganisms that cause nosocomial infection. Moreover, hand hygiene should become a teaching priority[22]. Similar levels of knowledge among healthcare workers with regard to the efficacy of alcohol-based hand rub have been reported previously. In another study, it is reported that 42% of medical students gave correct responses for indications of alcohol-based hand rub use[22]. The results of their study revealed that knowledge about nosocomial infections was the weakest of the three areas. Only 46.2% knew that the nosocomial infections also include occupational infections among staff of the healthcare facility[22]. In our study, the students' knowledge on sources and transmission modes of nosocomial infections seems to be better than reported in other studies. It is previously reported that the students did not recognize the patients' and healthcare workers' hands as the main sources of multi-resistant bacteria[22]. According to our findings, 79.4% of students identified the direct skin to skin contact with patients as a main transmission mode of nosocomial infections. Moreover, the majority (86.6%) of the present study knew that nosocomial infections are preventable.

The overall scores were different for the three categories of healthcare students and this difference was statistically significant. Nursing students achieved the best score in all three domains (nosocomial infections, standard precautions and hand hygiene) and the differences were statistically significant. These results are in line with a previous study which has reported that nursing students achieved the best scores in the three areas, independent of the source of information and student's age[22]. In another study, it is reported that the knowledge of standard precautions was better among nursing students than medical students[24]. In addition, even though the performance of each student category in these studies was different across the domains, only the knowledge on standard precautions showed a statistically significant difference between the training courses[3,13]. We expected our students' knowledge level about nosocomial infections and control measures would be similar regardless of the curriculum. Since other healthcare students also have a substantial risk of contracting a nosocomial infection as do nursing students, because of their limited clinical experience they should also follow the same precautions during patient care to avoid cross-transmission and to prevent spread of nosocomial infections[22].

In our study, statistically significant associations could be found between gender, course of study, exposure to training and the level of knowledge on

nosocomial infections and control measures. The influence of gender may be described in terms of the female majority in the sample and also, they may tend to do academically better than male students. The association between knowledge and the course of study implies that the students recorded different mean scores in the three domains of the questionnaire which was statistically significant to account for knowledge acquisition on the basis of the course of the study. Nonetheless, previous studies showed no significant associations between the course of study and the knowledge amongst students[3,13]. Participating in infection control trainings can improve knowledge and practice of students. Only 36.8% students in the sample have participated for at least one infection control training programme. Studies showed that specific training of standard precautions can quickly improve students' knowledge of infection control in a short period of time[22]. Moreover, present study reported a statically significant difference between the knowledge scores of male and female students even though previous study could not find a difference between males and females[22]. In the current study, we found a weak positive relationship between overall students' knowledge scores and the duration of clinical exposure. This implies that the students' clinical exposure is not a predictor of knowledge on nosocomial infections and control measures.

Formal teaching in classrooms (41.8%) was shown to be the major source of information for the three domains. This proportion was relatively low compared with that obtained in another study, in which 92% of the students citing formal teaching in class as their main source of information[22]. This disparity may be the result of different teaching methods and different teaching environments used in study settings. Nevertheless, the highest reference made to formal teaching in both studies was suggestive of a more theoretical approach to campaign about nosocomial infection control[3]. Further, information about standard precautions was emphasized more during the practical learning in the ward for nursing students than for other healthcare students. This may be because; they are engaged in comparatively more clinical training than the other healthcare students during their academic programme. Surprisingly, only 31% of students had hand hygiene or standard precautions training in the hospital ward. Several studies have reported that the hand hygiene practices of mentors influence the hand hygiene practices of students[22]. Self-learning was appeared to be a significant source of information only for a few students.

To our knowledge, this is the first study in Sri Lanka which has compared knowledge on nosocomial infections among healthcare students in different curricula. Therefore, this study provides further directions for future research. This study also has several limitations, which should be addressed for future research. The study was exclusive to one faculty of a government university in Sri Lanka. And, the study used purposive sampling method for achieving the sample size. Therefore, generalizability of the results to all health care students in other universities needs to be taken with caution since the study was limited to a single government university in Sri Lanka. Further studies involving other healthcare students from different curricula (ie., medical and dental) should be encouraged. The study used arbitrary cutoffs to categorize the level of knowledge which may have affected the conclusions of the study. In addition, this study only assessed the knowledge and sources of information regarding nosocomial infections and control measures. Therefore, assessing practices and attitudes of healthcare students regarding infection control is also recommended. In addition, future research should also focus on improving knowledge and practices among healthcare students through educational interventions, during their clinical training by assessing their knowledge and practices before and after intervention.

CONCLUSION

Based on the findings of the study, it could be concluded that the knowledge of nosocomial infections and control measures was high among healthcare students sampled. Future educational approaches should include more practical components of effective hand hygiene and standard precautions, and feedback from teachers during clinical training. The findings highlighted the need of a core infection control curriculum and common infection control training programme for all healthcare students, so that all the healthcare

students get the same training during their initial undergraduate period.

Author declaration

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Author Contributions
Both authors substantially contributed to all of the followings: (1) the conception and design of the study, acquisition of data, analysis and interpretation of data, (2) drafting the article and revising it and, (3) final approval of the version to be submitted

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Availability of data and materials
Data can be provided as a supplemental file on request from corresponding author.

Ethics approval and consent to participate
The ethical clearance for this study was obtained from the Ethics Review Committee of Faculty of Allied Health Sciences, University of Peradeniya (AHS/ERC/2018/061). Permission for the data collection was obtained from the Heads of the departments (Nursing, Physiotherapy and Radiography). And, informed written consent was obtained from all the participants prior to the distribution of questionnaire.

Competing interests
None

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