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Infection Prevention and Control Knowledge among Health Sciences Students: A Cross-Sectional Study from Malaysia

Abdul Rahman Fata Nahas[1*], Hanis Zulaikha Samsuri[1] , Muhammad Eid Akkawi[1], Mohamed Hassan Elnaem[2], Tarek El Sayed[3], Nor Hidayah Binti Mohd Taufek[1], and Abdulkareem Mohammed Al-Shami[4]

[1]*Department of Pharmacy Practice, Faculty of Pharmacy, International Islamic University Malaysia, Pahang, Malaysia.*
[2]*School of Pharmacy and Pharmaceutical Sciences, Ulster University, Coleraine, United Kingdom.*
[3]*Pharmaceutical Technology Department, Faculty of Pharmacy, Sultan Zainal Abidin University, Terengganu, Malaysia.*
[4] *Department of Pharmacy Practice and Clinical Pharmacy, Faculty of Pharmacy, University College of MAIWP International, Kuala Lumpur, Malaysia.*

Abstract

Introduction: Infection prevention and control (IPC) is a crucial component of the healthcare system that demands adherence to standards to avoid and reduce the risk of infectious diseases spreading among patients, staff members, and visitors to healthcare institutions. The aim of this study was to assess IPC knowledge among undergraduate health sciences students and to identify the critical IPC components that need to be addressed. **Materials and method:** A cross-sectional online survey was conducted among 235 final-year health science students at International Islamic University Malaysia (IIUM), involving five faculties: the Faculty of Medicine, Dentistry, Pharmacy, Nursing, and Allied Health Science. A 45-item questionnaire was used to collect participants' sociodemographics (5 items) and explore their knowledge about IPC across six aspects (40 items). A score of > 24 (62%) indicates satisfactory knowledge. **Results:** The majority of the participants were female (74.9%), and 34% were from the Faculty of Pharmacy. Medicine students had the highest level of IPC knowledge with a mean score of 29.3 (n = 52), which was significantly different from Allied Health Science students (M = 25.6, n =55, $p < 0.001$). Other faculties students had similar IPC knowledge with no significant differences (Pharmacy: M = 27.5, n = 80; Nursing: M = 27.4, n = 29; Dentistry: M = 27.2, n = 19). IPC components that need to be improved are knowledge about sharp disposals and sharp injuries, as well as respiratory hygiene and cough etiquette. **Conclusion:** IPC knowledge was adequate among health science students at IIUM, although certain IPC components still require improvement. Additional IPC educational materials and workshops should be added to all faculties' syllabi to address this issue.

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*Corresponding author's email: abd_mfn@hotmail.com, abd_mfn@iium.edu.my

Introduction

Infection prevention and control (IPC) measures have been implemented to prevent and control infectious diseases spread among patients, healthcare workers (HCWs), and visitors to healthcare institutions (Lowe et al., 2021). Hospital-acquired infections (HAIs) are among the major infectious causes of death and morbidity that pose a considerable risk to the health and safety of patients and HCWs, leading to rising healthcare costs (Li et al., 2022). The prevalence of nosocomial infections is estimated to be 7% and 10% in developed and developing countries, respectively. This is associated with prolonged hospital stay, reduced quality of life, and increased cost (Khan et al., 2017). The transmission of these illnesses occurs when HCWs handle and discard medical equipment, gather, process, and discard certain samples, and come into direct contact with patients (Alhassan et al., 2021). Therefore, infection prevention must be a top priority for healthcare facilities and organizations (WHO, 2016). Although hospitals have defined regulations and procedures, the IPC is inadequate. There is a global problem with a lack of standard precautions (SP) compliance, understanding, and attitudes among HCWs and health science students (Geberemariyam et al., 2018; Haile et al., 2017).

Education and training on IPC are becoming important, not only for healthcare professionals but also for students majoring in healthcare sciences. Undergraduate study is the ideal time to acquire the knowledge base and practical abilities necessary for future practice (Xiong et al., 2017; Ibrahim et al., 2016). Even so, it is unclear how effectively healthcare students understand IPC concepts. According to research conducted in 2012 in Saudi Arabia; IPC knowledge was limited and self-directed learning among medical students at King Faisal University. In addition, informal bedside practice served as the primary source of knowledge (Amin et al., 2013). However, a study at University in Albania found that students in four fields (medicine, physiotherapy, radiography, and nursing) had a moderate understanding of IPC and that classroom education was their primary source of information (Petrit et al., 2014). A recent study in Uganda revealed that health professional students at Makerere University possessed a high level of IPC knowledge; nevertheless, their IPC knowledge in various sections, such as hand hygiene, requires further improvement (Nalunkuma et al., 2021). Other study results showed that Saudi Arabian health science students had a satisfactory understanding of SPs and IPC, with no discernible gaps in knowledge between the sexes or between the Faculty of Medicine and other faculties (Khubrani et al., 2018).

The lack of knowledge and proper practice regarding IPC among HCWs may have an impact on healthcare students' behavioural practices when it comes to adopting IPC. Healthcare students should be equipped with IPC knowledge for a better practices during their clinical studies and future work. Therefore, in this study, we assessed the knowledge of healthcare students studying medicine, dentistry, pharmacy, nursing, and allied health science at International Islamic University of Malaysia (IIUM) about fundamental infection control measures, such as standard precautions, hand hygiene, respiratory hygiene, and the use of personal protective equipment. The assessment of IPC knowledge among healthcare students shall provide the basis for curriculum revision required to equip them with the necessary information and skills related to IPC, which in turn can improve their IPC practice during their future jobs as healthcare professionals.

Materials and methods

Study Design and Setting

This cross-sectional study was conducted at a Malaysian public university; i.e., IIUM – Kuantan Campus, from October 2022 to January 2023, using online approach.

Participants

The target sample was final year students in medicine, dentistry, pharmacy, nursing and allied health sciences undergraduate programs. Those who can read and understand English were included, and those who refused to participate were excluded from the study.

Study Questionnaire

The study self-administered questionnaire consisted of two parts. The first one included participants' sociodemographics (Table 1), while the second one was adopted from a recent study at Uganda's Makerere University's College of Health Science (Nalunkuma et al., 2021). The second part is divided into six sections (40 statements/questions) that measure participants' knowledge of several IPC aspects; i.e., general concept of IPC, hand hygiene, personal protective equipment (PPE), sharps disposal and sharp injuries, respiratory hygiene and cough etiquette, as well as care of healthcare providers (Table 2). A correct response to a statement or a question receives a score of one, whereas a false one receives a score of zero. A mean percentage score for each section was then obtained from the ratio between the number of correctly answered items and the total number of items. The questionnaire was piloted on 25 students to test its reliability among study population, which showed an acceptable reliability (Vaz et al., 2013), with a Cronbach's alpha values > 0.7 for all different IPC sections.

Study Size and Sampling

The minimum sample size determined for our study was 223, with a margin of error of 5%, and a level of confidence of 95%. The sample size was calculated using the Raosoft online sample size calculator (Raosoft Inc., Seattle, WA, USA). Convenience sampling was used to recruit participants.

Statistical Methods

Data collected were imported from Google Sheets to IBM SPSS software, version 21 for analysis. The descriptive statistics of means, standard deviations and percentages were used to summarize the responses of sociodemographics. Age, sex, study program, the sources of information on IPC and the number of these sources were all considered independent variables in the analysis. The percentage of all questions with the correct answers served as the dependent variable. Using multiple linear regression analysis, we investigated the relationship between sociodemographics and the mean percentage score of all questions. A $p < 0.05$ was set for the significance of the analysis.

Ethical Consideration

The study was approved by the IIUM Research Ethics Committee (IREC 2023-004). The questionnaire was prepared in Google Forms and a link was distributed to the students via text messages and class WhatsApp groups. The questionnaire started with an informational page that explained the study followed by consent section. Those who checked the "yes" box indicated their consent in participating in the study. There was no compensation for participation.

Results

Demographic Characteristics

A total of 235 students participated in the study, with a mean age of 22.98 ± 1.26. Most participants were female (176, 74.9%). Eighty out of 235 (34%) students were from the Faculty of Pharmacy. There were 199 out of 235 students (84.7%) reported that classroom instructions were their primary source of knowledge regarding IPC, while another 33.6% (n = 79) claimed they used three different sources (Table 1).

Knowledge of IPC Components

The statement "All body fluids except sweat should be viewed as sources of infection" had the lowest percentage of correct answers (67.2%; n = 158) in the section on the general concept of IPC. The least accurate response in the hand hygiene section was "Hand washing is indicated between tasks and procedures on the same patient," scoring only 45.5% (n = 107) of the total points. The least accurate response for the PPEs section was "PPEs are exclusively suitable to laboratory and cleaning staff for their protection," scoring 32.8% (n = 77). In the sharps disposal and sharp injuries section, the least correct answer was related to the statement "Soiled sharp objects should be shredded (cut into tiny pieces) before final disposal" with 10.2% (n = 24). For respiratory hygiene and cough etiquette, only half of the participants got all three correct answers (52.8%, n = 124). The least accurate response for the section of care for healthcare providers was on "The risk for a health provider to acquire HIV infection following a needle-stick injury is less than 0.5%," coming in at 16.6% (n = 39) correct response (Table 2).

Table 1: Demographic characteristics of the participants (N = 235)

	Frequency (n)	Percentage (%)
Sex		
Male	59	25.1
Female	176	74.9
Study Program		
Faculty of Medicine	52	22.1
Faculty of Dentistry	19	8.1
Faculty of Pharmacy	80	34
Faculty of Allied Health Science	55	23.4
Faculty of Nursing	29	12.3
Sources of Information on IPC		
Self-learning	148	63
Informal practical learning	142	60.4
Formal curricular teaching	199	84.7
Infection control courses	105	44.7
Media and/or internet	75	31.9
Number of sources of information		
1	24	10.2
2	71	30.2
3	79	33.6
4	39	16.6
5	22	9.4

IPC: Infection prevention and control

Table 2: Proportions of correct responses in the knowledge domain of various IPC aspects (N = 235)

	Proportion of Correct Response (n)
Section A: General Concept of Infection IPC	
The main goal of infection control is: (1 option)	94.9 (223)
Definition of standard precautions: (1 option)	97.4 (229)
All patients are sources of infections regardless of their diagnoses. (true)	75.3 (177)
All body fluids except sweat should be viewed as sources of infection. (true)	67.2 (158)
Section B: Hand Hygiene	
Hand washing minimizes microorganisms acquired on the hands if hands are soiled (true)	95.3 (224)
Handwashing reduces the incidence of healthcare-related infections (true)	97.4 (229)
In standard handwashing: the minimum duration should be. . . (1 option)	74.9 (176)

Hand decontamination: includes washing the hands with antiseptic soap for 30 seconds (1 option)	74.9 (176)
Alcohol hand rub substitutes hand washing even if the hands are soiled (false)	55.3 (130)
Hand washing is indicated between tasks and procedures on the same patient (true)	45.5 (107)
The use of gloves replaces the need for handwashing (false)	77 (181)
Hand washing is indicated after removal of gloves (true)	93.2 (219)
Hand washing is needed with patients with respiratory infections including COVID-19 (true)	98.7 (232)
Section C: Personal Protective Equipment (PPE)	
PPEs such as masks and head caps provide protective barriers against infection (true)	97.4 (229)
Use of PPEs eliminates the risk of acquiring occupational infections (true)	86 (202)
PPEs are exclusively suitable to laboratory and cleaning staff for their protection (false)	32.8 (77)
PPEs should be used only whenever there is contact with blood (false)	91.1 (214)
Gloves and masks can be re-used after proper cleaning (false)	96.6 (227)
Used PPEs are to be discarded through regular dust bins (false)	90.6 (213)
Gloves should be changed between different procedures on the same patient (true)	41.7 (98)
Masks made of cotton or gauze are most protective (false)	44.7 (105)
Masks and gloves can be re-used if dealing with same patient (false)	53.6 (126)
Section D: Sharps disposal and sharp injuries	
Used needles should be recapped after use to prevent injuries (false)	38.7 (91)
Used needles should be bent after use to prevent injuries (false)	77.9 (183)
Sharps container is labelled with. . .(1 option)	61.7 (145)
Soiled sharps objects should be shredded (cut into tiny pieces) before final disposal (true)	10.2 (24)
Sharps injuries should be managed with no need of reporting (false)	88.5 (208)
Needle-stick injuries are the least commonly encountered in general practice (false)	72.8 (171)
Post-exposure prophylaxis is used for managing needle stick injuries from an HIV-infected patient (true)	60.9 (143)
Immediate management of sharps injuries includes. . . (1 option)	51.5 (121)
Section E: Respiratory hygiene and cough etiquette	
Cough/sneeze on a disposable napkin and wash your hands (true)	1 correct: 12.3 (29)
Cough/sneeze over the shoulder if a napkin is not available (true)	2 corrects: 34.9 (82)

Keep a distance of 3 feet from others when coughing (true)	3 corrects: 52.8 (124)
Wipe your hands on the inside of your white coat after you cough or sneeze (false)	
Section F: Care of healthcare providers	
Immunization history of health care providers should be obtained before recruitment (true)	96.6 (227)
The risk for a health provider to acquire HIV infection after a needle-stick injury is. . . (option)	16.6 (39)
Post-exposure immunization prevents the risk of hepatitis B infection following exposure (true)	52.3 (123)
For the prevention of hepatitis B, immunizations are recommended for all healthcare workers (true)	91.1 (214)
Following exposure to a patient with flu, antibiotics are required for the prevention of infection (false)	57.9 (136)
Health providers with the highest risk of exposure to tuberculosis include radiologists (true)	45.5 (107)

IPC: Infection prevention and control; *PPE:* Personal protective equipment

Table 3: Mean percentage score and standard deviation of total scores of each IPC section (N = 235)

Total score of:	**Mean percentage score (SD)**
General Concept of IPC	83.7 % ± 73.3%
Hand Hygiene	79.2% ± 19.1%
PPE	70.5% ± 26.6%
Sharps disposal and Sharp Injuries	57.8% ± 24.7%
Respiratory hygiene and cough etiquette	57.8% ± 20.3%
Care of healthcare providers	60.0% ± 29.9%
The average for all total scores for each parameter	68.2% ± 5.52%

SD: Standard deviation; *IPC:* Infection prevention and control; *PPE:* Personal protective equipment

Table 3 shows that mean percentage score of sharp disposals and sharp injuries section (57.8% ± 24.7%), as well as respiratory hygiene and cough etiquette section (57.8% ± 20.3%), were the lowest of all IPC sections.

Factors Affecting Health Science Students' Score of Correct Answers

Multiple regression analysis was run to assess the relationship between students' socio-demographics and the total score of correct answers for all questions. There was a significant relationship between the number of information sources and the total score of IPC knowledge (p = 0.03). There was no significant relationship between other sociodemographics and the score of IPC knowledge.

We also run one-way ANOVA analysis to gauge differences in the mean total score among different study programs. Faculty of Medicine had the highest mean total score (29.3 ± 3.48), while faculty of Allied Health Science had the lowest (25.6 ± 4.24). Other faculties had similar mean total scores; i.e., Pharmacy: M = 27.5 ± 3.56; Nursing: M = 27.4 ± 5.51; Dentistry: M = 27.2 ± 2.92. Post Hoc test revealed a statistically significant difference only between faculties of Medicine and Allied Health Science (p < 0.001).

Discussion

In this study, we assessed knowledge of IPC among final year health science students from Faculties of Medicine, Dentistry, Pharmacy, Allied Health Science and Nursing at a Malaysian public university, and found that students from Faculty of Medicine had the highest level of knowledge of IPC, and that among all faculties, students IPC knowledge needs to be improved.

We discovered that students at the Faculty of Medicine had better knowledge of the various components of IPC than students at other faculties, which was significantly better than those from Faculty of Allied Health Sciences. In comparison, a study conducted at King Saud bin Abdulaziz University for Health Sciences found that nursing students had the highest percentage of people displaying appropriate knowledge (Geberemariyam et al., 2018). Our findings showed that although the health science students' IPC knowledge was deemed good, there were knowledge gaps in sharps disposal and sharps injuries, respiratory hygiene, and cough etiquette. Nevertheless, Khubrani and colleagues reported that respiratory hygiene, cough etiquette, and care of healthcare providers were the least well-known sections among their participants (Khubrani et al., 2018). Although the lack of understanding of the indication of handwashing between task and procedure on the same patient was evident, all 235 students in the present study demonstrated a fair understanding of hand hygiene. In contrast, a study by Makerere University Faculty of Health Science revealed that only 60.4% of participants knew that hand washing is necessary between tasks, even when attending to the same patient (Haile et al., 2017). This suggests that a lack of understanding about the importance of handwashing increases the risk of infection and illness transmission by healthcare professionals among patients.

Most of our participants (67.2%, n = 158) correctly identified all body fluids as sources of infection except for sweat. However, this question received the lowest correct responses compared to the other questions in Section A, which was in line with a study conducted in Uganda (Haile et al., 2017). This demonstrates that students from different countries lack appropriate awareness of body fluids as a medium of infection transmission between patients and healthcare professionals. Of the 235 participants, 77 (32.8%) believed that PPEs were only appropriate for laboratory and cleaning staff which is untrue. In contrast, Nalunkuma and colleagues found that only 46.53% of the participants were aware that PPEs might also be used to lessen exposure to dangers that could result in significant illnesses and injuries in addition to being utilized in laboratories and for cleaning (Nalunkuma et al., 2021). The chance for a healthcare professional to contract human deficiency virus (HIV) following a needle-stick

injury question had the fewest accurate answers in the section on the care of healthcare providers, with just 39 students (16.6%) answering it correctly.

The health science students involved in this study had the lowest knowledge regarding sharps disposal, sharp injuries, respiratory hygiene, and cough etiquette, scoring only 57.8% for both sections. This partially contradicts the findings from a related study conducted among health science students in Uganda (Haile et al., 2017). where respiratory hygiene and cough etiquette received a higher score (80.2%), while disposal of sharps had the lowest score (61.55%), which is consistent with our study. In contrast, our study participants scored higher in the care of healthcare providers section compared to Uganda study participants, which could be a result of focusing on healthcare provider care in the curricula of our participants' study programs. The results of our study also showed that among all study programs, Faculty of Medicine has the highest level of IPC knowledge, followed by Faculty of Nursing, Faculty of Pharmacy, Faculty of Dentistry, and Faculty of Allied Health Science, which has the lowest score. These results align with research among Saudi Arabian students (Khubrani et al., 2018), where it was discovered that students who spend more time in clinical and medical environments are likely to have higher knowledge about IPC.

The inferior quality of healthcare delivery results has been attributed to healthcare professionals' ignorance of IPC (Khubrani et al., 2018). Numerous studies that demonstrate the need for more education and training support the fact that the majority of healthcare professionals admitted that they did not receive any training or orientation on IPC in their undergrad studies. They were also unsure if they had received insufficient knowledge and lower academic education and training on IPC (Alhassan et al., 2021). To ensure better performance in healthcare delivery as future healthcare professionals, health science students must be equipped with sufficient IPC knowledge (Ibrahim et al., 2016).

There were a few limitations to this study. The questionnaire used was not evenly distributed to all study programs, and the data collection instrument restricts the observation of behavior, skills, and student compliance during the survey. Future studies could be conducted with an equally recruited participants among different study programs for a more accurate representation of the population. Data acquisition from other universities could also be done for better analysis, but it requires more time and funding. Different syllabi and exposure to IPC knowledge across universities also restrict the generalization of results.

Conclusion

IPC demands adherence to standards to avoid and reduce the risk of infectious diseases spreading among health practitioners, residents and visitors. This makes IPC a vital component of healthcare system. Being future healthcare practitioners, health sciences students should be equipped by proper IPC knowledge. Our findings showed that although health sciences students have a good IPC knowledge, a few components of IPC need to be addressed; i.e., sharps disposal and sharps injuries, as well as respiratory hygiene and cough etiquette.

To improve IPC knowledge among health sciences students, educators should be aware about the importance of incorporating the IPC-related materials in the syllabi of different health sciences programs, with the availability of equipments needed for IPC and SPs lessons or training. Health educators should also provide formal clinical skills training, which is crucial; else, safety may rely on accidental learning from other healthcare professional (Grundgeiger et al., 2023). Health educator could also apply different approaches to facilitate their students' learning such as seminars and interactive workshops, which proofed to improve students knowledge (Mukurunge et al., 2021). Hands-on blended with e-learning might also be considered in IPC knowledge obtainment and had been resulted in improved knowledge while addressing the

problem of different learning paces (Grundgeiger et al., 2023).

Authors contributions

Conceptualization: A.R.F.N.; Data curation: H.Z.S.; Methodology/formal analysis/validation: A.F.N., H.Z.S. Project administration: A.R.F.N.; Writing–original draft: H.Z.S.; Writing–review & editing: A.R.F.N., M.E.A., T.E.S., M.H.E., N.H.M.T., A.M.A. All authors have read and agreed to the published version of the manuscript.

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Conflicts of interest

There are no conflicts of interest.

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