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Infection Control and Standard Precautions: Knowledge, Attitude and Practice Among Undergraduate Medical Students

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Abstract

Medical students can be exposed to threatening healthcare-associated infections if they are not strictly adhered to the infection control and standard precautions measures. There is limited information regarding knowledge, attitude, and practice among medical students regarding infection control and standard precautions. Our aim is to evaluate the knowledge, attitude, and practice among healthcare students about infection control and standard precautions. A cross-sectional study was conducted among 211 undergraduate Bachelor of Medicine and Bachelor of Surgery (MBBS) students from Year 3 till Year 5 at Melaka Manipal Medical College, Malaysia. We purposively selected 250 students attending Year 3 till Year 5 in MBBS course in September 2018. A total of 211 students who were willing to provide written informed consent were included in this study. We collected the data using a validated, self-administered, structured questionnaire which included 37 questions about knowledge regarding infection control and standard precautions, 9 questions about practice regarding infection control and standard precautions and 10 questions about attitude regarding infection control and standard precautions. Data were analysed using descriptive statistics and Chi-square. Among the students, 70.6% students need to improve their knowledge regarding infection control and standard precautions, 66.8% students have a good practice regarding infection control and standard precautions, 79.6% students have a good attitude regarding infection control and standard precautions. Regarding knowledge, there is a significant association between Chinese gender and Year 4 with knowledge regarding infection control and standard precautions. In attitude, there is a significant association between gender and attitude regarding infection control and standard precautions. For practice, there is a significant association between gender and practice regarding infection control and standard precautions. Even though the students have positive practice and attitude towards infection control and standard precaution, a supportive and positive environment is needed to improve knowledge to infection control and standard precautions.

Keywords

Infection Control, Precautions, Knowledge, Attitude, Practice, Undergraduate Medical Students

1. Introduction

Infection prevention and control (IPC) is a scientific and practical solution designed to prevent harm caused by infection to patients and health workers. It is grounded in infectious disease, epidemiology, social science, and health system strengthening. IPC occupies a unique position in the field of patient safety and quality universal health coverage since it is relevant to health workers and patients at every single health-care encounter. [1] Standard precautions are a set of measures formulated to prevent transmission of bloodborne pathogens when providing health care. [2] In previous studies have reported that hospitalization, at least

five percent of patients become infected. Similarly, a study carried out by the Centres for Disease Control and Prevention in the United States estimates that roughly 1.7 million hospital-associated infections, from all types of bacteria, combined, cause or contribute to 99,000 deaths each year. In Europe, the deaths estimated are 25000 each year. [3] The Occupational Health Unit of Ministry Of Health Malaysia reported an incidence rate of 4.7 needlestick injuries per 1,000 health care workers. [4] Hospitals provide a favourable transmission pathway for the spread of nosocomial infections, owing partly to poor infection control practices among health workers on one hand and overcrowding of patients in most clinical settings on the other. [5] Healthcare workers, particularly medical students, are at risk of acquiring infection through occupational exposure, including needle-stick injuries (NSIs) and other invasive procedures that carry a risk of acquiring human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS), hepatitis virus (HBV) and hepatitis C virus (HCV). [6] Standard precautions are designed to prevent healthcare staff from being exposed to blood and body fluids by applying the basic principles of infection control through hand washing; utilization of appropriate protective barriers, such as gloves, masks, gowns, and eyewear; and safe handling of needles. [7] Surveys have shown that the use of these standard precautions significantly decreases the number of incidents of occupational exposure to blood and decreases the incidence of nosocomial infection. [8, 9] Studies monitoring occupational injuries and infection control practices among student and health care workers are necessary to assess the efficacy of infection control training and facilitate the development of educational interventions to improve adherence to guidelines and reduce injuries. [10] Assessing medical students' knowledge towards standard precautions will aid in the prevention of nosocomial infections and can provide the foundations for curricular reform necessary to provide them with adequate knowledge and skills. [11] Few studies [12-15] have reported on medical students' knowledge of SPs or sharp injuries and noted a lack of adequate knowledge of SPs. Thus, this study was to investigate non-sterile occupational injuries and compliance with recommended infection control procedures reported by undergraduate medical students in Melaka Manipal Medical College. This cross-sectional study will serve as a need's assessment for the development of interventions to improve infection control practices at this institution.

2. Methodology

2.1. Study Design, Study Place and time and Study Population

This analytical cross-sectional study on Knowledge, Attitude and Practice Among Healthcare Students on Infection control and standard precautions was conducted among the MBBS students of Melaka Manipal Medical College from September 2018 to October 2018 at Melaka Manipal Medical College, Malaysia. The study population is approximately 600 medical students of semester 7, semester 8, semester 9 and semester 10 of Melaka Manipal Medical College.

2.2. Sample Size

The sample size was calculated using the formula stated below.

$$n = \frac{z^2 \times \hat{p}(1-\hat{p})}{\varepsilon^2}$$

Our sample size was generated from the values of a previous research entitled "Knowledge and information sources on standard precautions and infection control of health sciences students at King Saud bin Abdulaziz University for Health Sciences, Saudi Arabia, Riyadh" [16]

"*n*" indicates the population size

"*p*" indicates the prevalence of sufficient knowledge on infection control and standard precautions taken from the previous study. [16]

p = 73.6%.

z^2= *1.96*^{2} -desired confidence level is 95%

e^2= precision- 5% (0.05)

p = 1-0.736 = 0.264

$$n = \frac{1.96^2 \times 0.736 \times 0.264}{0.05^2} = 152.3 = 153$$

non- response = 30%

$$n = \frac{n_{\text{calculated}}}{1 - \text{non} - \text{response}\%} = \frac{153}{1 - 0.3} = 218.5 = 220$$

A sample size of 220 was calculated considering confidence level 95%, type 1 error 5%, assuming the knowledge and practice among healthcare students 73.6% and non-response less than 30%

2.3. Sampling

A self-administered questionnaire was distributed among undergraduate medical students. The participants in semester 7 were given the questionnaire during the lecture. They completed the questionnaires on their own, and the completed questionnaires were collected after lectures. The questionnaires for the participants of Semester 8, 9 and 10 were distributed and collected through the respective batch leaders after they completed the questionnaire on their own. Our inclusion criteria composed of undergraduate medical students who had provided their written informed consent. Our exclusion criteria were those who did not provide their written informed consent and the students who were absent on the day data collection was done. The purposive sampling technique (Non-probability sampling) was used to select students for the purpose of enrolment into the study. The sample consists of all undergraduate medical students' semester 7 till semester 10.

2.4. Data Collection

A questionnaire consists of 5 parts. Part I consists of participant information sheet and informed consent. Part II is on sociodemographic details. Sociodemographic details include of age in years, gender (male or female), race (Malay, Chinese, Indian or Others), and academic year (semester 6, semester 7, semester 8, semester 9, semester 10). Part III consists of 37 questions on knowledge in infection control and standard among medical students. There are five main domains which are general concept of standard precautions that consists of three questions, hand hygiene consists of nine questions, personal protective equipment (PEP) consists of nine questions, disposal of and injuries consists of seven questions and care of health-care providers consists of nine questions. The questions were answered as "True/False". As for Part IV, it is about practice on infection control and standard precaution which consists of 10 questions. They are answered as always, sometimes and never. As for part V, there were 10 statements on attitude on infection control and standard precaution. All of the questions were answered on scale of 1-5 where 5 (strongly agree), 4 (agree), 3 (neutral), 2 (disagree) and 1 (strongly disagree).

2.5. Data Processing and Data analysis

Data is collected and tabulated by using Excel software and was analysed using Epi Info™ 7th version. Regarding knowledge, the correct answer was scored one and wrong answer was scored zero (higher score indicates better knowledge). Regarding practice, always was scored two, score one for sometimes, and score zero for never (higher score indicates better practice). For attitudes, for positive items, strongly agree was scored five and strongly disagree was scored one (higher score indicates better attitude). The total score and percentage for each participant about their knowledge, attitude and practice towards infection control and standard precautions was calculated. We categorized knowledge, practice, and attitudes into two categories such as good (≥80% of the maximum possible total score), and need to improve (<80% of the maximum total score). The data look again for any duplication, missing and accuracy of the data. Frequency and percentage were used to calculate the age, gender, ethnicity and academic year. The frequency and percentage of correct answers for each question on knowledge were also calculated to assess the knowledge about infection control and standard precautions. The association between knowledge, attitude, and practice of infection control and standard precautions with age, different academic year of MBBS students were analysed using Chi-square test. Odds ratio and its confidence interval 95% were also calculated. Level of significance was set at 5%. (0.05). Visual tools like bar charts were also included with the aid of Microsoft Excel.

2.6. Ethical Consideration

Ethical consideration is critical in a research study. To ensure this study is conducted ethically, research participants are briefed about the study and written informed consent is obtained from the participants prior to the study. The protection of privacy of the research participants and confidentiality of research data is ensured as well. Besides that, any type of misleading information, as well as the representation of primary data findings in a biased way is avoided. Lastly, the study is approved by the Research Ethics Committee, Faculty of Medicine of Melaka Manipal Medical College, Malaysia Campus.

3. Results

A total of 211 MBBS students participated in this study and the response rate was 95.91%. Among them, 52.6% of the participant were from Year 3, 34.6% from Year 4 and 12.8% from Year 5. Most of the participant were Female 55.5%, Indian 37.4% and most of the participant age was more than 22 58.8%.

Table 1. *Demographic characteristic among medical students. (n=211).*

Variables	Frequency (%)
Gender (n=211)	
Male	94 (44.6%)
Female	117 (55.5%)
Age	
≤22	87 (41.2%)
>22	124 (58.8%)
Race (n=211)	
Chinese	65 (30.8%)
Indian	79 (37.4%)
Malay	43 (20.4%)
Others	24 (11.4%)
Academic years (n=211)	
Year 3	111 (52.6%)
Year 4	73 (34.6%)
Year 5	27 (12.8%)

Table 2 show the percentage of correct answers of the general concept (knowledge) on infection control and standard precaution among medical students. 71.09% agree that all patients are sources of infection regardless of their diagnose. 61.14% agree that all body fluids except sweat should be viewed as infection sources and 93.84% agree that all health- care providers are at risk of occupational infection.

Table 2. *Percentage of correct answers of general concept (knowledge) on infection control and standard precaution among medical students.*

No.	Statements	Frequency (%)
1	All patients are sources of infection regardless of their diagnose. True	150 (71.09)
2	All body fluids except sweat should be viewed as infection sources. True	129 (61.14)
3	All health-care providers are at risk of occupational infection. True	198 (93.84)

Table 3 depicts the correct response to the statement related to the domain on hand hygiene on infection control

and standard precaution among medical students. In this study, 94.31% strongly agree that hand washing minimizes microorganisms acquired on the hands if soiled. 97.16% agree that hand washing reduces the incidence of healthcare-related infections. 94.31% stated that standard hand washing includes washing of both hands and wrists. 75.36% agree that in standard hand washing, the minimum duration should be 30 seconds. 56.40% does not agree that alcohol hand rubs substitute's hand washing even if the hands are soiled. 72.04% believed that hand washing is indicated between tasks and procedures on the same patient. 76.30% does not agree that the use of gloves replaces the need for hand washing. 89.57% agree that hand washing is indicated after removal of gloves and 90.52% agree that hand washing is needed with patients with respiratory infections.

Table 3. *Percentage of correct answers of hand hygiene (knowledge) on infection control and standard precaution among medical students.*

No.	Statement	Frequency (%)
1	Hand washing minimizes microorganisms acquired on the hands if soiled. True	199 (94.31)
2	Hand washing reduces the incidence of health care-related infections. True	205 (97.16)
3	Standard hand washing includes washing of both hands and wrists. True	199 (94.31)
4	In standard hand washing, the minimum duration should be 30 seconds. True	159 (75.36)
5	Alcohol hand rub substitutes hand washing even if the hands are soiled. False	119 (56.40)
6	Hand washing is indicated between tasks and procedures on the same patient. True	152 (72.04)
7	Use of gloves replaces the need for hand washing. False	161 (76.30)
8	Hand washing is indicated after removal of gloves. True	189 (89.57)
9	Hand washing is needed with patients with respiratory infections. True	191 (90.52)

Table 4 depicts the correct responses to the statements related to the domain of Personal Protective Equipment (PPE) on infection control and standard precaution among medical students. In this study about 93.4% strongly agree that the use of PPE such as masks and head caps provide protective barriers against infection. And of the surveyed students 71.6% identified the role of PPE in absolute elimination of the risk of acquiring infections, 37.9% stated that PPE should be exclusively used by laboratory and cleaning staff, and should be used only in the presence of contact with blood (in 69.7%), 75.4% believed that gloves and masks can be reused after proper cleaning. About 70.1% agreed that gloves should be changed between different procedures on the same patient, 64.5% correctly respond about re-using masks and gloves if dealing with the same patient and believed that masks made of cotton or gauze are most protective (in 59.7%).

Table 4. *Percentage of correct answers of personal protective equipment (knowledge) on infection control and standard precaution among medical students.*

Statements	Frequency (%)
PPE such as masks and head caps provides protective barriers against infection. True	197 (93.4%)
Use of PPE eliminates the risk of acquiring occupational infections. True	151 (71.6%)
PPE is exclusively suitable for laboratory and cleaning staff for their protection. False	80 (37.9%)
PPE should be used only whenever there is contact with blood. False	147 (69.7%)
Gloves and masks can be reused after proper cleaning. False	159 (75.4%)
Used PPE are to be discarded through regular municipal disposal systems. False	59 (28.0%)
Gloves should be changed between different procedures on the same patient. True	148 (70.1%)
Masks made of cotton or gauze are most protective. False	126 (59.7%)
Masks and gloves can be reused if dealing with same patient. False Mean (SD)= 63.40% (18.43)	136 (64.5%)

Table 5 demonstrates the correct responses of disposal of sharp objects and injuries (knowledge) on infection control and standard precaution among medical students. About 67.3% and 71.1% respectively correctly responded to the false statements that used needles should be recapped or bent after use in order to prevent injuries. Around 58.8% responded correctly where soiled sharp objects should be shredded before final disposal, only 19.2% agreed that sharps injuries should be managed without reporting and about 77.7% responded correctly to a false statement that needle-stick injuries are least commonly encountered in general practice. Also, 86.7% of the students correctly answered that post-exposure prophylaxis is used in managing accidental sharp injuries from an HIV-infected patient and 93.8% correctly stated that the immediate management of sharp injuries including washing in running water and soap.

Table 5. *Percentage of correct answers of disposal of sharp objects and injuries (knowledge) on infection control and standard precaution among medical students.*

Statements	Frequency (%)
Used needles should be recapped after use to prevent injuries. False	69 (67.3%)
Used needles should be bent after use to prevent injuries. False	150 (71.1%)
Soiled sharp objects should be shredded before final disposal. True	124 (58.8%)
Sharps injuries should be managed without reporting. False	167 (19.2%)
Needle-stick injuries are least commonly encountered in general practice. False	164 (77.7%)
Post-exposure prophylaxis is used for managing injuries from an HIV-infected patient. True	183 (86.7%)
Immediate management of sharps injuries includes hand washing with antiseptic. Tru	192 (91.0%)

Table 6 show out of the 211 medical students who participated, 94.8% of them thought that the Immunization history of health-care providers should be obtained before they enter the healthcare system. Only 38.9% agreed to include HIV, rubella, and rabies in the routine immunization schedule for healthcare providers. 82% of the participants thought that health-care providers should receive annual influenza vaccination and 87.7% believed that the risk of acquiring HIV after a needle stick injury is higher. 74.4% of the medical students also believed that post-exposure immunization prevents the risk of acquiring hepatitis B and 93.8% thought that immunization for the prevention of hepatitis B should be recommended. When asked about administering antibiotics to a patient with flu only 54.5% agreed on giving antibiotics following exposure. 75.4% of them believe that the health-care providers at the highest risk of exposure to tuberculosis include radiologists.

Table 6. *Percentage of correct answers of care of health-care providers (knowledge) on infection control and standard precaution among medical students.*

Statements	Frequency (%)
Immunization history of health-care providers should be obtained before recruitment. True	200 (94.8%)
Routine immunizations for health-care providers include HIV, rubella, and rabies. False	82 (38.9%)
Health-care providers should receive annual influenza vaccination. True	174 (82.5%)
Health-care providers should be tested annually by tuberculin skin test. True	173 (82.0%)
The risk of a health-care provider to acquire HIV infection after a needle-stick injury is increased. True	185 (87.7%)
Post-exposure immunization prevents the risk of hepatitis B infection following exposure. True	157 (74.4%)
For the prevention of hepatitis B, immunizations are recommended for all health-care workers. True	198 (93.8%)
Following exposure to a patient with 'flu, antibiotics are required to prevent infection. False	115 (54.5%)
The health-care providers at the highest risk of exposure to tuberculosis include radiologists. True	159 (75.4%)

Table 7 demonstrates when asked about washing their hands with soap and water after taking a sample 79.2% of the participants said they always practice this, whereas 19.9% sometimes follows this and 0.9% never practices this. 82.9% of participants said they always wash their hands after coming in to contact with blood, body fluids or contaminated items. 16.1% sometimes washes their hands whereas 0.9% never does. 73% of the medical students always practice rules of alcohol-based hand rubbing in clinical practices whereas 25.1% practices are sometimes and 1.9% said they never follow rules of alcohol-based hand rubbing. When questioned about the frequency they wash their lab coats 72.5% of them said they wash it regularly and 26.1% sometimes and 1.4% admitted to never washing their lab coat. On cleaning tools like the stethoscope, knee hammer and tuning forks, 46.9%, highest percentage said "Sometimes". 42.2% said they always wash their equipment and 10.9% said they never clean their equipment. For every procedure 74.4% said they always wear a lab coat, 24.6% said they sometimes wear and only 2% never wear a lab coat during procedures. 64.5% of the participants always, 29.4% sometimes and 6.2% never, cover wounds and cuts on their skin before they start work. 71.6% of the participants are always vaccinated against commonest pathogens, whereas 23.7% are sometimes vaccinated and 4.7% of them have never been vaccinated.

Table 7. *Practice on Infection Control and Standard Precaution Among Healthcare Students.*

Statements	Always	Sometimes	Never
Do you wash your hands with soap and water after taking a sample?	167 (79.2%)	42 (19.9%)	2 (0.9%)
Do you wash your hands immediately when you come into contact with blood, body fluids or contaminated items?	175 (82.9%)	34 (16.1%)	2 (0.9%)
Do you follow the 6 steps of hand washing?	104 (49.3%)	99 (46.9%)	8 (3.8%)
Do you follow rules of alcohol based hand rubbing in clinical practices?	154 (73.0%)	53 (25.1%)	4 (1.9%)
Do you wash your lab coat often/regularly?	153 (72.5%)	55 (26.1%)	3 (1.4%)
Do you clean your tools (e.g.: stethoscope, knee hammer, tuning forks, dental materials)?	89 (42.2%)	99 (46.9%)	23 (10.9%)
Do you wear a gown/ lab coat properly for every procedure?	157 (74.4%)	52 (24.6%)	2 (0.9%)
Do you cover wounds and cuts on your skin before you start your work?	136 (64.5%)	62 (29.4%)	13 (6.2%)
Are you vaccinated for common pathogens (e.g. Influenza virus, Hepatitis virus, etc.)?	151 (71.6%)	50 (23.7%)	10 (4.7%)

Table 8 demonstrates depicts the attitudes of medical students on infection control and standard precaution. Of the included students, 63.9% strongly agreed that a new pair of gloves should be used for each new patient visiting the hospital while 0.95% of them think it was not necessary. 60.2% of students believed that following standard operating procedures decreases the risk of contamination. 58.3% of students strongly agreed with the efficiency and necessity of the 6 steps hand washing. From the questionnaire, 53.6% of them strongly agreed with the statement of vaccination decreases hospital-acquired infection and 50.7% of them strongly agreed that prophylaxis decreases hospital-acquired infection. 55.5% of them strongly agreed that cover their own wounds and cuts on skin before they start their work decreases the risk of transmission. Out of the 211 participants, 66.8% believed that keeping proper personal hygiene decreases the risk of contamination. 62.6% of them believed that overcrowding of the working area increases transmission of infection. When asked about the attitude of them towards the patient's awareness about the transmission of microorganisms decreases the risk of hospital-acquired infection, 52.6% of them strongly agreed while only 0.5%

strongly disagreed. 56.4% believed their lab coat increases the risk of transmission.

Table 8. *Attitude on Infection Control and Standard Precaution among Healthcare Students.*

No.	Statements	Strongly agree, frequency (%)	Agree, frequency (%)	Neutral, frequency (%)	Disagree, frequency (%)	Strongly disagree, frequency (%)
1	I think that a new pair of gloves should be used for each new patient visiting the hospital.	135 (63.98)	47 (22.27)	26 (12.32)	1 (0.47)	2 (0.95)
2	I believe that following standard operation procedures decreases the risk of contamination.	127 (60.19)	61 (28.91)	21 (9.95)	1 (0.47)	1 (0.47)
3	I think 6 step hand washing is effective and necessary.	123 (58.29)	66 (31.28)	18 (8.53)	3 (1.42)	1 (0.47)
4	I think that vaccination decreases hospital acquired infection.	113 (53.55)	64 (30.33)	27 (12.80)	6 (2.84)	1 (0.47)
5	I think that prophylaxis decreases hospital acquired infection.	107 (50.71)	78 (36.97)	24 (11.37)	1 (0.47)	1 (0.47)
6	I cover my own wound and cuts on skin before I start my work decreases the risk of transmission.	117 (55.45)	58 (27.49)	33 (15.64)	3 (1.42)	0 (0)
7	I believe that keeping proper personal hygiene decreases the risk of contamination.	141 (66.82)	52 (24.64)	16 (7.58)	2 (0.95)	0 (0)
8	I believe that overcrowding of the working area increases transmission of infection.	132 (62.56)	52 (24.64)	26 (12.32)	1 (0.47)	0 (0)
9	I think that a patient's awareness about transmission of microorganisms decreases the risk of Hospital acquired infection.	111 (52.61)	61 (28.91)	32 (15.17)	6 (2.84)	1 (0.47)
10	I believe my lab coat increases the risk of transmission.	119 (56.40)	55 (26.07)	31 (14.69)	4 (1.90)	2 (0.95)

Table 9 demonstrates only 29.4% of the students had good knowledge while 70.6% need to improve their knowledge. The mean of the total knowledge scores among the participants was 73.6 with a standard deviation of 10.9. Nearly 66.8% of the students had good practice while 33.2% need to improve their practice. The mean of the total practice scores of the responses was 82.1 with a standard deviation of 16.3. The majority (79.4%) had a good attitude and 20.4% of the students need to improve their attitude. The mean of attitude was 88.4 with a standard deviation of 12. (higher score indicates a better attitude).

Table 9. *Knowledge, Practice and Attitude on infection control and standard precautions among medical students。*

Variables	Frequency (%)
Knowledge (n=211)	
Good	62 (29.4%)
Need to improve	149 (70.6%)
Mean (SD)	73.6 (10.9)
Practice (n=211)	
Good	141 (66.8%)
Need to improve	70 (33.2%)
Mean (SD)	82.1 (16.3)
Attitude (n=211)	
Good	168 (79.6%)
Need to improve	43 (20.4%)
Mean (SD)	88.4 (12.0)

Table 10 demonstrates the association between gender, age, race and academic year with knowledge on infection control and standard precaution among medical students. In terms of gender, around 29 (29.8%) of the males have a good knowledge and 66 (70.2%) of them need to improve on their knowledge, whereas 34 (29.1%) females have good knowledge and around 83 (70.9%) have to improve their knowledge. The odds ratio (with 95%CI) was 0.93 (0.52-1.68), Chi-square of 0.05 and the p-value was 0.816 which is not significant. The association between age was also calculated where those aged ≤22 about 27 (31.08%) have good knowledge and 60 (69%) of the need to improve, whereas those aged >22 around 35 (28.2%) have good knowledge and 89 (71.8%) need to improve their knowledge. The odds ratio (with 95%CI) of this association was 0.87 (0.48 – 1.59) Chi-square of 0.194 and the p-value was 0.659 which is not significant. The association of race with knowledge on infection control and standard precaution was calculated in which the Malays around 8 (18.6%) have good knowledge and 35 (81.4%) need to improve, in Chinese about 25 (38.5%) have good knowledge and 40 (61.5%) need to improve, in Indians 22 (27.9%) have good knowledge and 57 (72.2%) need to improve and lastly Other races 7 (29.1%) have good knowledge and 17 (70.8%) need to improve in their knowledge. The Malay race was used as a reference when calculating the odds ratio. The odds ratio (with 95%CI) of Chinese was 2.73 (1.09-6.84), Chi-square of 4.81 and the p-value was 0.028 which is significant. So, knowledge of Chinese on infection control and standard precautions are 2.73 times better than the Malay participants. The odds ratio (with 95% CI) of Indians was 1.69 (0.68-4.21), Chi-square of 1.28 and the p-value was 0.257 which is not significant. The

odds ratio (with 95% CI) of other races was 1.80 (0.56-5.79), Chi-square of 0.99 and the p-value was 0.320 which is not significant. The association of academic year with knowledge on infection control and standard precautions was calculated by taking Year 3 as the reference, whereby in Year 3, 39 (35.1%) have good knowledge and 72 (64.9%) need to improve, in Year 4, 10 (13.7%) have good knowledge and 63 (86.3%) need to improve, and in Year 5, 13 (48.2%) have good knowledge and 14 (51.9%) need to improve. The odds ratio (with 95% CI) of Year 4 was 0.29 (0.14-0.63), Chi-square of 10.4 and the p-value was 0.001 which is significant. So, the knowledge of participants in Year 4 is 0.29 times less like to be good than participants in Year 3. No association between Year 5 and knowledge on infection control and standard precaution among medical students.

Table 10. *Association between gender, age, race and academic year with knowledge on infection control and standard precautions among medical students.*

Independent variables	Good n (%)	Need to improve n (%)	OR (95%CI)	Chi-square	P value
Gender					
Male	29 (29.8%)	66 (70.2%)	1 (Reference)	0.05	0.816
Female	34 (29.1%)	83 (70.9%)	0.93 (0.52-1.68)		
Age					
≤22	27 (31.0)%	60 (69%)	1 (Reference)	0.194	0.659
>22	35 (28.2%)	89 (71.8%)	0.87 (0.48 – 1.59)		
Race					
Malay	8 (18.6%)	35 (81.4%)	1 (Reference)		
Chinese	25 (38.5%)	40 (61.5%)	2.73 (1.09-6.84)	4.81	0.028
Indian	22 (27.9%)	57 (72.2%)	1.69 (0.68-4.21)	1.28	0.257
Others	7 (29.1%)	17 (70.8%)	1.80 (0.56-5.79)	0.99	0.320
Academic Year					
Year 3	39 (35.1%)	72 (64.9%)	1 (Reference)		
Year 4	10 (13.7%)	63 (86.3%)	0.29 (0.14-0.63)	10.36	0.001
Year 5	13 (48.2%)	14 (51.9%)	1.71 (0.73-4.00)	1.57	0.211

Table 11 demonstrates when considering practices, 54 (57.5%) of the males are good in their practices and 40 (42.6%) needed to improve. In females, 87 (74.4%) are good and only 30 (25.6%) of them needed to improve. Using Females as the reference, the odds ratio is 2.15 (1.20 – 3.85), Chi-square value is 6.72 (95%) and P value is 0.009. Therefore, there is a significant association between gender and practices where males were 0.47 times less likely to have a good health-care practice on standard precautions and infection control. According to age, 61 (70.1%) of the participants who were ≤22 had a good practice whereas 26 (29.9%) of them have to improve. 80 (64.5%) of the participants who were >22 had a good practice and 44 (35.5%) of them still needed to improve. Age ≤22 was taken as the reference. Odds ratio was 0.78 (0.43 – 1.40) chi-square value is 0.72 and P value is 0.395. Therefore, age has no significant association with practices among medical students. 50 (63.3%) of the Indians have a good practice and 29 (36.7%) needs to improve. 28 (66.1%) of the Malay participants had a good practice and only 15 (34.9%) needed to improve. The odds ratio was 1.08 (0.50-2.35), chi-square value was 0.04 and p-value was 0.841.47 (72.3%) of the Chinese participants had a good practice and 18 (27.7%) still needed to improve. The odds ratio was 1.51 (0.74-3.08), chi-square value was 1.31, the p-value was 0.251. 16 (66.7%) of the "Others" had a good practice and 8 (33.3%) needed to improve. The odds ratio was 1.16 (0.44-3.04), chi-square value was 0.09 and p-value was 0.763. There was no significant association between any of the races and practices on infection control and standard precaution among medical students. When practices were compared among academic years, 77 (69.4%) of the Year 3 participants had a good practice and 34 (30.6%) needed to improve. Year 3 is taken as the reference. In year 4, 63% of the participants had a good practice and 37% still needed to improve. The odds ratio was 0.75 (0.40-1.40), chi-square value was 0.80 and p-value was 0.370. In Year 5 also 18 (66.7%) of participants had a good practice and 9 (33.3%) needed to improve. Odds ratio is 0.88 (0.36-2.16), chi-square value is 0.07 and p-value is 0.786. Therefore, there is no association between Academic Year and practices on infection control and standard precaution among medical students.

Table 11. *Association between gender, age, race and academic year with practice on infection control and standard precaution among medical students.*

Independent variables	Practices Good (%)	Need toImprove (%)	Odds Ratio (95% CI)	Chi-Square	P-Value
Gender					
Male	57 (74.4%)	40 (42.6%)	1 (Reference)	6.72	0.009
Female	87 (74.4%)	30 (25.6%)	2.15 (1.20-3.85)		
Age					
≤22	61 (70.1%)	26 (29.9%)	1 (Reference)	0.72	0.395
>22	80 (64.5%)	44 (35.5%)	0.78 (0.43-1.40)		
Race					
Malay	28 (66.1%)	15 (34.9%)	1 (Reference)		
Chinese	47 (72.3%)	18 (27.7%)	1.40 (0.61-3.21)	0.63	0.427
Indian	50 (63.3%)	29 (36.7%)	0.92 (0.43-2.01)	0.04	0.841
Others	16 (66.7%)	8 (33.3%)	1.07 (0.37-3.08)	0.02	0.898

Independent variables	Practices Good (%)	Need toImprove (%)	Odds Ratio (95% CI)	Chi-Square	P-Value
Academic Year					
Year 3	77 (69.4%)	34 (30.6%)	1 (Reference)		
Year 4	46 (63.0%)	27 (37.0%)	0.75 (0.40-1.40)	0.80	0.370
Year 5	18 (66.7%)	9 (33.3%)	0.88 (0.36-2.16)	0.07	0.786

Table 12 demonstrates the association between gender, age, race and academic year with attitude on infection control and standard precaution among medical students. By using gender, around 67 men (71.3%) have a good attitude and 27 (28.7%) of them need to improve on attitude, whereas 101 (86.3%) females had good attitude and around 16 (13.7%) had to improve their attitude. Male was used as the reference for calculating the odds ratio. Female was 2.54 times more likely to have a good attitude than the male with a 95% confidence interval of 1.27 and 5.08, Chi-square value of 7.27 and p-value of 0.007 which is significant. The association between age and attitude on infection control and standard precautions were also calculated where those aged ≤22 was 72 (71.3%) have good attitude and 15 (17.2%) of them need to improve, whereas those aged >22 around 96 (77.4%) have good attitude and 28 (22.6%) need to improve their attitude. Age of ≤22 was used as the reference in calculating the odds ratio. Student of >22 years old was 1.4 times more likely to have a good attitude than those of ≤22 years old with Chi-square of 0.89 and p-value of 0.343 which was not significant. The association of race with attitude on infection control and standard precaution was calculated in which the Malays around 36 (83.7%) have good attitude and 7 (16.3%) need to improve, in Chinese about 53 (81.5%) have good attitude and 12 (18.5%) need to improve, in Indians 60 (75.9%) have good attitude and 19 (24.1%) need to improve and lastly Others 19 (79.2%) have a good attitude and 5 (20.8%) need to improve in their attitude. The Malay race was used as a reference when calculating the odds ratio. By using the odds ratio (with 95% CI), Chinese was 0.86 times less likely to have a good attitude than Malays with Chi-square of 0.09 and p-value of 0.771 which is not significant. Indian was 0.61 times less likely to have a good attitude than Malays with Chi-square of 1.00 and the p-value of 0.317 which is not significant. For other races, they were 0.74 times less likely to have a good attitude than Malays with Chi-square of 0.22 and p-value of 0.641 which was not significant. The association of academic year with attitude on infection control and standard precautions was calculated. Year 3 was used as the reference to calculate the odds ratio (with 95% CI). The results have shown that Year 4 students were 0.55 times less likely to have a good attitude than Year 3 students with the 95% confidence interval of 0.27 and 1.12, Chi-square value of 2.79 and p-value of 0.095 which was not significant. When compared with Year 5 students, they were 1.19 times more likely to have a good attitude than Year 3 students, Chi-square value of 0.08 and not significant p-value of 0.773.

Table 12. *Association between gender, age, race and academic year with attitude on infection control and standard precaution among medical students*

Independent variables	Attitude Good	Attitude Need to improve	Odds ratio (95% CI)	Chi-square	P value
Gender					
Male	67 (71.3%)	27 (28.7%)	1 (Reference)	7.27	0.007
Female	101 (86.3%)	16 (13.7%)	2.54 (1.27 – 5.08)		
Age					
≤22	72 (71.3%)	15 (17.2%)	1 (Reference)	0.89	0.343
>22	96 (77.4%)	28 (22.6%)	1.4 (0.70-2.81)		
Race					
Malay	36 (83.7%)	7 (16.3%)	1 (Reference)		
Chinese	53 (81.5%)	12 (18.5%)	0.86 (0.31-2.39)	0.09	0.771
Indian	60 (75.9%)	19 (24.1%)	0.61 (0.24-1.60)	1.00	0.317
Others	19 (79.2%)	5 (20.8%)	0.74 (0.21-2.64)	0.22	0.641
Academic year					
Year 3	92 (82.9%)	19 (17.1%)	1 (Reference)		
Year 4	53 (72.6%)	20 (27.4%)	0.55 (0.27-1.12)	2.79	0.095
Year 5	23 (85.2%)	4 (14.8%)	1.19 (0.37-3.83)	0.08	0.773

4. Discussion

The main objective of this study is to assess knowledge, attitude and practice and information sources on infection control and standard precaution as well as a need assessment for the development of interventions to improve infection control practices at this institution. [8] Out of 211 participants, a score of 80% and above of the knowledge on infection control and standard precaution (29.4%) is considered good and below 80% (70.6%) falls under need to improve category. The participants of this study demonstrated knowledge of (73.6%) which is similar to participants of the study conducted in King Saud bin Abdulaziz University for Health Sciences, Saudi Arabia, Riyadh [16]. In this study, the primary information source reported by students was formal curricular teaching, consistent with the findings of Tavolacci et al., Bello et al. and Mann CM, Wood A. [5, 15, 17] Participant scored highest on knowledge of standard precautions, hand hygiene, and care of health-care providers. The current study revealed that many misconceptions related to the PPE indications, uses, and their role in preventing nosocomial infections are present. This domain showed the least level of knowledge

with several misconceptions. In a study of King Saud bin Abdulaziz University for Health Sciences, Saudi Arabia, Riyadh [16] general concept of SPs, hand hygiene, and PPE were the most well-known domains, whereas disposal of and injuries from sharp objects and health-care providers' care were the least well-known. Tavolacci et al. (2008) reported in their study that the highest scores were achieved for knowledge of standard precautions and hand hygiene. Knowledge of hand hygiene should be improved because it is the most effective measure for interrupting the transmission of microorganisms that cause nosocomial infection (Tavolacci et al., 2008). [17] An intervention is needed to increase the knowledge in the domains of sharp management and injuries and PPE among our students. In this study, the level of knowledge was significantly correlated with a year at college; this can be explained by the fact that those at advanced years are more exposed to clinical practices. It is also noticed that 4th-year students' knowledge is relatively lower, this may be due to the smaller number of participants from 4th year. The curriculum should be also amended to increase its emphasis on infection control and standard precaution on a yearly basis. As for attitude, participants demonstrated 79.6% of good attitude and 20.4% of need to improve. This gives a mean of 88.4%, highlighting the good attitude overall. That's almost double the percentage of the study of Assessment of knowledge, attitudes, and practices towards infection prevention among healthcare workers in Trinidad and Tobago [20] in which (46.7%) participants had an affirmative attitude towards infection prevention. This finding is higher than that of a study conducted in Bahir Dar [19, 20] (Ethiopia) in which 55.6% had a positive attitude to infection prevention. Only 63.98% participant agreed that new gloves should be used for each new patient visiting the hospital indicating its importance in infection control while the vast majority of participants (87.7%) of Assessment of knowledge, attitudes, and practices towards infection prevention among healthcare workers in Trinidad and Tobago [18] agreed to it. The WHO [21] states that the same pair of gloves should not be worn when caring for more than one patient, it should be noted that the use of gloves does not replace hand washing with soap and water/using an alcohol-based hand sanitizer. Despite the fact (60.19%) respondents believed that following standard operating procedure decreases the risk of contamination, only 50.17% of participant agreed prophylaxis decreases hospital-acquired infection, which relatively poor attitude compared to the study in 87.7% for both statements. As for practice, participants have demonstrated 66.8% of good practice and 33.2% of need to improve. This gives a mean of 82.1. In general, substandard practices towards infection prevention, about 79.2% of a participant having good practices to prevent hospital-acquired infections and contamination which is about only 44% of participants in the study conducted in Ethiopia [20]. Over 82.9% of the participants responded that they washed their hands with soap and water after taking a sample and that they washed their hands immediately when they came into contact with blood, bodily fluids or contaminated items as compared to the participants in the study done in Ethiopia [20] where 29% of physicians along with 25% of nurses responded that there was no need to carry out any form of hand hygiene prior to conducting procedures that did not involve bodily fluids. This is may be due to better infection prevention in the healthcare setting compared the underdeveloped countries. [19, 23] Only 49.3% follow the 6 steps of hand washing despite a high percentage of knowledge on handwashing. This matter has to be looked upon. The practice of washing lab coat regularly is about 72.5% while health care workers in Mizan Aman General Hospital (49.7%), which indicates good clinical practice among the participants. In our study, 71.6% of participants are vaccinated for common pathogen whereas only 22.9% vaccinated in the study conducted in South West Ethiopia. [22] There is no significant association between knowledge and gender and age but on the other hand there's a significant association with the academic year. The knowledge of participants in Year 4 is 0.29 times less likely to be good compared participants in Year 3 while no association between Year 5 and knowledge on infection control and standard precaution among medical students. There is also a significant association between good practice and gender. The males were 0.47 times less likely to have a good health-care practice on standard precautions and infection control compared to females. No other significant association with practice is observed. There is a significant association between attitude and gender as well as the academic year. The study states females are 2.54 more likely to have a good attitude than males. As for the academic year, Year 4 students were 0.55 times less likely to have a good attitude than Year 3 whereas Year 5 students, they were 1.19 times more likely to have a good attitude than Year 3 students. Askarian et al. (2004) have found that despite the good knowledge of medical students, there was poor compliance, especially in hand hygiene. [13] It is also rational that knowledge and attitude should have an impact on practice. The found disparity between knowledge and practice could also be due to the unavailability of protective barriers, inadequate equipment, carelessness, and malpractice of senior colleagues or interference of devices with working skills (Kim et al., 2001).

This issue has to be addressed and more intervention should be done for better clinical practice despite the knowledge. [24] Increasing the emphasis on IPC in the undergraduate curriculum through frequent education and assessment, particularly in the clinical setting, and by peers and seniors acting as role models, may improve students' knowledge, attitude, and practices, and facilitate patient safety culture, thereby impacting HCAI acquisition rates and improving patient's outcome. Scenario-based learning, assessment, both summative and formative, reflections, and online teaching in conjunction with face-to-face learning (blended learning) are all suggested examples of effective methods of teaching practices. [25]

The study inherent a study design limitation for being a cross-sectional study, secondly, observation of students'

practices was not possible as the clinical rotations were carried out at facilities not affiliated to the College of Medicine and, a possible problem with the questionnaire design as most of the items had the options of true/false which may provide the opportunity for guessing. It is worth noting that many factors potentially influenced the response of participants in this study, ranging from the extent of physical contact with patients, training in hands-on techniques, and general patient handling practices since they are in different academic years. Our results must be interpreted with consideration of recall bias as self-reports of occupational exposures and infection control practices may not be accurate. In addition, information related to specific circumstances associated with injury was not collected, and more research is required to further investigate occupational exposures among students.

5. Conclusion

Based on our study, the academic year was recognized to be a significant variable in the knowledge aspect whereas, the gender and the academic year was recognized to be significant variables in practice and attitudes towards infection control and standard precaution. According to the results, medical students of MMMC do not have satisfying knowledge about infection control and standard precautions. It is necessary to improve the knowledge of standard precautions among medical students.

References

[1] Infection prevention and control. (2017, April 21). Retrieved from https: //www.who.int/infection-prevention/about/ipc/en/.

[2] Is, A., & Mo, A. (2012). Knowledge, Awareness and Compliance with Standard Precautions among Health Workers in North Eastearn Nigeria. *Journal of Community Medicine & Health Education, 02* (03).

[3] Essays, UK. (November 2018). Nosocomial Infections: Literature Review. Retrieved from https: //www.ukessays.com/essays/health-and-social-care/nosocomial-infections-review-of-literature-health-and-social-care-essay.php?vref=1.

[4] A, B., N, S., Mf, Y., Ah, M., Kmm, S., & Nk, S. (2014). The Prevalence of Accidental needle Stick Injury and their reporting among healthcare Workers in orthopaedic Wards in General hospital Melaka, Malaysia. *Malaysian Orthopaedic Journal, 8* (2), 6-13.

[5] Bello, A., Emannuel, B. O., Adegoke, B., & Bello, A. (2011). Nosocomial infections: Knowledge and source of information among clinical health care students in Ghana. *International Journal of General Medicine,* 571.

[6] Kulkarni, V., Papanna, M., Mohanty, U., Ranjan, R., Neelima, V., Kumar, N.,... Unnikrishnan, B. (2013). Awareness of medical students in a medical college in Mangalore, Karnataka, India concerning infection prevention practices. *Journal of Infection and Public Health, 6* (4), 261-268.

[7] Barikani A, Afaghi A. Knowledge, attitude and practice towards standard isolation and precautions among Iranian medical students. Global Journal of Health Science 2012; 4 (February (2): 142—6.

[8] Beltrami EM, Williams IT, Shapiro CN, Chamberland ME. Risk and management of blood-borne infections in healthcare workers. Clinical Microbiology Reviews 2000; 13 (July (3): 385—407.

[9] Motamed N, BabaMahmoodi F, Khalilian A, Peykanheirati M, Nozari M. Knowledge and practices of health care workers and medical students towards universal precautions in hospitals in Mazandaran Province. Eastern Mediterranean Health Journal 2006; 12 (September (5): 653—61.

[10] McCarthy, G. M., & Britton, J. E. (n. d.). A Survey of Final-Year Dental, Medical and Nursing Students: Occupational Injuries and Infection Control. *Journal of Canadian Dental Association*.

[11] P. B., M. G., & I. B. (july 2014). Knowledge and Source of Information among Health Care Students on Nosocomial Infections. *International Journal of Humanities Social Sciences and Education (IJHSSE), 1* (7), 46-51.

[12] Elliott, S. K. F., Keeton, A., & Holt, A. (2005). Medical students' knowledge of sharps injuries. J Hosp Infect, 60, 374-377.

[13] Askarian, M., Honarvr, B., Tabatabaee, H. R., & Assadian, O. (2004). Knowledge, practice and attitude toward standard isolation precaution in Iranian medical students. J Hosp Infect, 58, 292-296.

[14] Koenig, S., & Chu, J. (1993). Senior medical students' knowledge of universal precautions. Acad Med, 68, 372-374.

[15] Mann, C. M., & Wood, A. (2006). How much do medical students know about infection control? J Hosp Infect, 64, 366-370.

[16] Abdullah Khubrani, Meshal Albeshar, Abdulah Alkahtani, Faisal Alamri, Masjid Alshamrani, Emad Masuadi, Knowledge and information sources on precautions and infection control of health sciences students at King Saud bin Abdulaziz University for Health Sciences, Saudi Arabia, Riyadh, Journal of Infection and Public Health, Volume 11, Issue 4, 2018, 546-549.

[17] Tavolacci, M., Ladner, J., Bailly, L., Merle, V., Pitrou, I., & Czernichow, P. (2008). Prevention of Nosocomial Infection and Standard Precautions: Knowledge and Source of Information Among Healthcare Students. *Infection Control & Hospital Epidemiology, 29* (7), 642-647.

[18] Unakal CG, Nathaniel A, Keagan B, Alexandria B, Lauralee B, Varun C, et al. Assessment of knowledge, attitudes, and practices towards infection prevention among healthcare workers in Trinidad and Tobago. Int J Community Med Public Health 2017; 4: 2240-7.

[19] Tenna A, Stenehjem E, Margoles L, Kacha E, Blumberg H, Kempker R. Infection Control Knowledge, Attitudes, and Practices among Healthcare Workers in Addis Ababa, Ethiopia. Infect Control Hosp Epidemiol. 2013; 34 (12): 128996.

[20] MD (2008) Assessment of knowledge, attitude, practice of health care workers on universal precaution. Ethiopia public Association 4: 20-7.

[21] World Health Organization. Glove Use Information Leaflet, 2009.

[22] Yakob E, Lamaro T, Henok A (2015) Knowledge, Attitude and Practice towards Infection Control Measures among Mizan-Aman General Hospital Workers, South West Ethiopia. J Community Med Health Educ 5: 370.

[23] Hunt DCE, Mohammudally A, Stone SP, Dacre J. Hand hygiene behaviour, attitudes and believes in first year clinical medical students. J Hosp Infect. 2005; 59 (4): 371–373.

[24] Lehmann R, Bosse HM, Huwendiek S. Blended learning using virtual patients and skills laboratory training. Med Educ. 2010; 44 (5): 521–522.

[25] Pereira JA, Pleguezuelos E, Meri A, Molina-Ros A, Molina-Tomas MC, Masdeu C. Effectiveness of using blended learning strategies for teaching and learning human anatomy. Med Educ. 2007; 41 (2): 189–195.