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Awareness of medical students in a medical college in Mangalore, Karnataka, India concerning infection prevention practices

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Abstract
Background: Healthcare-associated infections (HCAIs) are an important public health problem. It is estimated that approximately 1 out of every 20 hospitalized patients will contract an HCAI. The risk is substantial not only to patients but also to health-care workers, who may contract deadly blood-borne infectious diseases. Hence, it is essential for healthcare professionals to have adequate knowledge regarding infection prevention practices (IPPs) to reduce the burden of these illnesses among patients seeking care.
Methods: This cross-sectional study was conducted among 268 medical students at Kasturba Medical College, Mangalore. Information regarding important IPPs such as hand hygiene (HH), needle-stick injuries (NSIs), and standard precautions (SPs) was collected using a semi-structured questionnaire. The collected information was analyzed using SPSS v.11. Fisher's exact test was used to test the association between variables of interest.
Results: Overall, knowledge levels regarding HH were low in aspects such as health-care workers' hands as sources of infection (40%) and the minimum time needed to apply hand rubs (45.7%), whereas knowledge levels were high in aspects such as indications for using HH. Regarding NSI prevention, knowledge levels were low in aspects such as activities with the highest NSI risk (56%). However, knowledge levels were high in relation to SPs.
Conclusion: The knowledge levels regarding infection practices were not adequate among the participants, particularly in the case of hand hygiene methods. Other

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important aspects, such as needle-stick injuries and use of standard precautions, were better understood, although many aspects still require improvement. These findings suggest the need to consider strengthening the training related to IPPs as a separate entity in the existing curriculum.

Introduction

Healthcare-associated infections (HCAIs) are infections caused by a wide variety of common and unusual bacteria, fungi, and viruses during the course of receiving medical care. Hospital employees can transfer infections to patients and other office workers. The estimated HCAI incidence rate in the USA was 4.5% in 2002, corresponding to 9.3 infections/1000 patient-days and 17 million affected patients. The burden of HCAIs is even higher in developing countries such as India, where the hospital-wide prevalence of HCAIs varies from 5.7% to 19.1%, with a pooled prevalence of 10.1% [1]. Simple measures such as hand hygiene (HH) can lead to effective control of these infections in varied healthcare settings.

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 B virus (HBV) and hepatitis C virus (HCV). Exposure to infectious diseases is one of the most frequently identified occupational hazards facing healthcare workers. According to WHO estimates, among the 35 million healthcare workers worldwide, nearly 3 million experience percutaneous exposure to blood-borne pathogens each year, 2 million of those to HBV, 0.9 million to HCV and 170,000 to HIV. These injuries may result in 15,000 HCV, 70,000 HBV and 1000 HIV infections. It is also important to note that >90% of these infections occur in developing countries such as India [2]. Risk reduction must be undertaken for all blood-borne pathogens through adherence to standard precautions, using personal protective equipment (PPE), appropriate use of safety devices and providing a needle disposal system in the work place. Due to lack of training and experience in performing invasive procedures, medical students are at increased risk of exposure to blood-borne pathogens. 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 [3]. 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 [4,5].

Despite detailed guidelines, the knowledge and understanding of standard precautions and compliance to these precautions among physicians has been found to be inadequate, even in developed countries [6]. In developing countries, including India, the situation is worse, and the occupational safety of healthcare workers remains a neglected issue [7]. The weakest aspects reported include not practicing hand decontamination [8], not using barrier protection, and the practice of recapping needles [9]. To improve compliance, it is important to understand how medical students think about infection control, and the first step is to identify the strengths and weaknesses of their education. Further research is required to determine the knowledge levels among medical students because many studies have been performed on professional healthcare workers, and few studies have involved undergraduate medical students.

This study was conducted to determine the awareness of medical students in relation to hospital infection prevention measures.

Materials and methods

This cross-sectional study was conducted from May 1 to May 31, 2012. The study participants included students in the 2nd, 3rd, and 4th years of their MBBS at Kasturba Medical College (KMC), Mangalore. These students were included in the study because the clinical postings for the medical students at our institute and various other institutes

in India start from the 2nd year onwards until the 4th MBBS year. The sampled population consisted of students in the 2nd to 4th MBBS years, which at any point in time includes 750 students (250 students per MBBS class). A sample size of 268 was calculated considering a power of 80%, an absolute precision of 6% and a confidence level of 95%, assuming the awareness levels for infection prevention practices to be 50% among medical students. The convenience sampling technique was used to select students for the purpose of enrollment into the study. A semi-structured questionnaire was used to collect information in relation to the awareness of participants about various domains of IPPs such as HH, NSI prevention and standard precautions (SPs). Each question among the domains was equally weighted and was given a score of one. The questionnaire was pretested before the data collection, and necessary modifications were made in terms of content and language. The information obtained from the questionnaires was entered and analyzed using SPSS ver. 11. The analysis was performed in terms of descriptive statistics (proportions and means), and associations between variables of interest were tested using Fisher's exact test. Ethical clearance was obtained from the Institutional Ethics Committee (IEC) of KMC, Mangalore, prior to the onset of the study.

Results

A total of 268 students participated in our study, including 149 females (55.6%) and 119 males (44.4%). The distribution of students belonging to different years of the MBBS was almost proportional, with 82 (30.6%) 2nd-year students, 91 (34%) 3rd-year students and 95 (35.4%) 4th-year students. The mean age of the study participants was 21.3 ± 1.5 years.

Awareness regarding hand hygiene (HH) practices

The majority of the participants ($n = 240$, 89.6%) felt that HCAIs are a significant problem in today's healthcare practice. A statistically significant difference was noted across students of different MBBS years, with all students from the final MBBS year answering affirmatively to this question. However, only 40% ($n = 106$) of the participants identified unclean hands of healthcare workers as the main route of cross-transmission of infections in a health facility. The knowledge regarding this aspect appeared to be greater among students of the 3rd MBBS year compared to others ($p < 0.001$). Regarding the use of alcohol-based hand rubs during their day-to-day clinical activities, 76% ($n = 204$) of the participants agreed to use them. In contrast, only 45.7% ($n = 122$) of the participants correctly identified the minimum time needed to apply hand rubs as 15 seconds. Additionally, only 16.4% ($n = 44$) of the participants knew the correct sequence of the HH technique. Regarding this aspect, the knowledge appeared to be higher among 4th-year MBBS students ($p < 0.001$).

Regarding HH during day-to-day clinical practice, the majority of the participants mentioned that HH using alcohol-based hand rubs should be practiced in the following scenarios: before touching the patient ($n = 220$, 82%), before a clean procedure ($n = 197$, 73.5%), after touching a patient ($n = 217$, 81%) and after exposure to a bodily fluid ($n = 210$, 78.4%) (Table 1).

Needle-stick injury (NSI) prevention

The knowledge of the study participants regarding the prevention of NSIs was higher compared to HH. The manipulation of a needle stick after its use was identified as the activity running the highest risk of NSIs by 56% of the students ($n = 151$). Almost all of the participants ($n = 250$, 93%) identified blood as the most infectious body fluid that can transmit infections through occupational exposure. HBV was identified as the infectious agent with the highest rate of transmission post-NSI by 68.7% ($n = 184$) of the study participants. Additionally, 81.3% ($n = 218$) of the participants knew that post-exposure prophylaxis (PEP) against HIV infection should be taken within 72 h after an NSI. The knowledge levels in relation to various aspects of NSIs appeared to be higher among 3rd-year MBBS students compared to others. A statistically significant difference was observed across the knowledge levels of students of different MBBS years in almost all aspects of NSIs except in identifying the blood-borne pathogen with the highest risk of transmission following an NSI (Table 2).

Standard precautions (SPs)

The knowledge of the study participants was high regarding SPs, as 70.5% ($n = 189$) of the participants were able to identify all of the components. The indications for the use of SPs were correctly identified by 75% ($n = 201$) of the study participants. The proper use of surgical masks was known to almost all of the students ($n = 248$, 92.5%). The knowledge levels were also high regarding the scenarios in which

Table 1 Knowledge of study participants in relation to hand hygiene practices ($n = 268$).

	Component	M.B.B.S. 2nd year *N* (%)	M.B.B.S. 3rd year *N* (%)	M.B.B.S. 4th year *N* (%)	Total *N* (%)	Fisher's exact (*p*-value)
1	HCAI significant problem	70 (85.4)	75 (82.4)	95 (100)	240 (89.6)	23.27 (<0.001)
2	Healthcare workers hands main route of cross transmission	37(45)	50(55)	19 (20)	106 (40)	46.54 (<0.001)
3	HH most effective method to prevent HCAI	61 (74.4)	69 (76)	77 (81)	207 (77.2)	6.23 (0.614)
3	Use of alcohol based hand rubs	60 (73.2)	71 (78)	73 (76.8)	204 (76)	2.597 (0.682)
4	Minimum time needed for use of hand rubs	33 (40)	37 (41)	52 (54.7)	122 (45.7)	3.69 (0.161)
5	HH before touching the patient	66 (80.5)	74 (81.3)	80 (84.2)	220 (82)	0.50 (0.796)
6	HH before a clean procedure	54 (65.9)	65 (71.4)	78 (82.1)	197 (73.5)	6.38 (0.041)
7	HH after touching a patient	62 (75.6)	75 (82.4)	80 (84.2)	217 (81)	2.23 (0.334)
8	HH after exposure to a bodily fluid	61 (74.4)	72 (79.1)	77 (81.1)	210 (78.4)	3.09 (0.546)
9	Correct HH sequence identification	3 (3.7)	3 (3.7)	38 (40)	44 (16.4)	61.11 (<0.001)

HH, hand hygiene; HCAI, health care associated infections.

the use of surgical gloves is warranted, including when there is a risk of contact with the blood or body fluid of a patient ($n = 236$, 88%) and when healthcare workers have cutaneous lesions ($n = 217$, 81%) (Table 3).

Infection prevention practices (IPPs) in relation to pulmonary tuberculosis

Regarding IPPs in relation to tuberculosis (TB) transmission, the participants had better responses, as most knew that the patient should be advised to cover his/her mouth while coughing ($n = 232$, 86.6%) and to spit into a narrow-mouthed container ($n = 218$, 81.3%) and that healthcare workers should wear a mask ($n = 215$, 80%).

Source of information and need for training with regards to IPPs

Only 19% ($n = 51$) of the participants mentioned academic textbooks as the source of information in relation to IPPs compared to other sources, such as friends/seniors ($n = 56$, 21%), medical journals ($n = 52$, 19.4%) and Internet sites such as blogs and health-related websites ($n = 45$, 16.8%). The majority of the participants ($n = 238$, 88.8%) felt that there is a need for further training in relation to

Table 2 Knowledge of study participants in relation to needle stick injury prevention ($n = 268$).

	Component	M.B.B.S. 2nd year *N* (%)	M.B.B.S. 3rd year *N* (%)	M.B.B.S. 4th year *N* (%)	Total *N* (%)	Fisher's exact (*p*-value)
1	Activity having highest risk of NSI	50 (61)	62 (68)	39 (41)	151 (56)	23.87 (<0.001)
2	Most infectious body fluid in relation to NSI	74 (90)	87 (96)	89 (94)	250 (93)	12.76 (0.011)
3	Blood-borne pathogen with highest risk in NSI	51 (62)	67 (73.6)	66 (69.5)	184(68.7)	9.75 (0.088)
4	Washing NSI wound with soap & water	61 (74.4)	81 (89)	39 (41%)	181(67.5)	59.18 (<0.001)
5	Take ART within 72 h following NSI	67 (81.7)	81 (89)	70 (73.7)	218 (81.3)	12.12 (0.005)

NSI, needle stick injuries; ART, anti retroviral therapy; ELISA, enzyme linked immuno sorbent assays.

Table 3 Knowledge of study participant regarding standard precautions in healthcare ($n = 268$).

	Component	M.B.B.S. 2nd year *N* (%)	M.B.B.S. 3rd year *N* (%)	M.B.B.S. 4th year *N* (%)	Total *N* (%)	Fisher's exact (*p*-value)
1	Components of SP	61 (74.4)	60 (66)	68 (71.6)	189(71.5)	1.54 (0.464)
2	Indications for SP	68 (83)	80 (88)	53 (56)	201 (75)	35.90 (<0.001)
3	Proper usage of surgical masks	72 (88)	86 (94.5)	90 (94.7)	248 (92.5)	4.57 (0.243)
4	Use of gloves when risk of contact with patients' blood	65 (79.3)	82 (90)	89 (93.7)	236 (88)	8.60 (0.013)
5	Use of gloves when HCW has a skin lesion	60 (73)	78 (85.7)	79 (83)	217 (81)	4.63 (0.098)

SP, standard precautions.

IPPs to reduce HCAIs apart from the current academic teaching, and most ($n = 140$, 58.8%) preferred that the training be imparted during the 2nd MBBS year, followed by the 1st MBBS year ($n = 87$, 36.5%) (Table 4).

Discussion

This study was conducted to assess the awareness of medical students in relation to day-to-day IPPs. There was higher female participation in our study (55.6%) compared to male participation (44.4%). This finding can be attributed to the higher female enrollment in our institution.

It was encouraging to note that nearly 90% of the participants affirmed HCAIs as a major public health problem leading to considerable economic burden on the patient. This is in contrast with a study conducted in Italy [10], in which only 14.3% of participants felt that HCAIs constituted a significant problem. The difference may be due to the better knowledge of students in relation to various types of hospital-acquired infections due to the student's day-to-day clinical activities. Additionally, there was a statistically significant difference between participants across different MBBS phases, with all students (100%) in the final MBBS year answering affirmatively. This finding is similar to a study conducted by Scheithauer et al. [11]. This difference may be due to the higher and more frequent exposure of students to the subject of HCAIs throughout the course, leading to better knowledge by the time they reach their final year. However, only 40% of students identified unclean healthcare workers' hands as the major source of infection. Additionally, only 46% of students

Table 4 Source of information and need for training regarding Health care associated infections (HCAI) ($n = 268$).

	Component	M.B.B.S. 2nd year *N* (%)	M.B.B.S. 3rd year *N* (%)	M.B.B.S. 4th year *N* (%)	Total *N* (%)	Fisher's exact (*p*-value)
1	Source of information regarding IPP, other than academic books	65 (79.3)	59 (64.8)	93 (98)	217 (81)	38.26 (<0.001)
2	Need for further training in relation to IPP	72 (83)	86 (94.5)	80 (84.2)	238 (88.8)	5.25 (0.070)
3	MBBS, 2nd phase as the most preferred phase for imparting training in relation to IPP	34 (41.5)	38 (41.8)	68 (71.6)	140 (52.2)	46.37 (<0.001)

IPP, infection prevention practices.

correctly mentioned the minimum time required for hand washing. However, 76% agreed to use alcohol-based hand rubs daily. These findings are in contrast to a study conducted by Ergin et al. [12], in which participants had higher knowledge about these aspects of hand hygiene. This finding highlights the probable impact of the imitation of HH practices undertaken by students after watching senior professionals, such as a post-graduates or consultants, practicing HH during their clinical activities. The use of alcohol-based hand rubs by such a high proportion of students in the presence of low awareness regarding the major source of hospital-acquired infections demonstrates the absence of the necessary knowledge, even though participants continued to follow the right action. These findings are of concern because a health-related behavior such as HH requires the right mix of knowledge and practice to be sustainable. Regarding the scenarios in which one should follow HH practices, participants had better knowledge, as they mentioned that HH should be followed before touching the patient (82%), before a clean procedure (73.5%) and after exposure to bodily fluids (78.4%). Similar findings were observed in a study conducted by Tavolacci et al. [13]. The higher knowledge levels of students regarding the scenarios in which one is required to practice HH techniques compared to their lower knowledge regarding hand-washing techniques stresses the need for further training in this aspect.

Regarding the prevention of NSIs, the knowledge of study participants was higher in comparison to HH methods. The manipulation of needles after their use was identified as the activity with the highest risk of an NSI by 56% of the students. This is in contrast to other studies conducted in India and abroad [14,15]. Similar findings were observed in studies conducted elsewhere [16,17]. The available evidence [18—21] suggests that the NSI incidence rate ranges from 14% to 73% among healthcare providers. Hence, medical students need to be made aware of the activities that are associated with a high risk of NSIs. The participants had lesser knowledge in relation to taking post-exposure prophylaxis (PEP) against HIV/AIDS within the correct time frame (52%). This finding is similar to a study conducted by Chogle et al. [22]. Currently, India is experiencing a concentrated HIV/AIDS epidemic, and PEP against HIV/AIDS is one highly effective way to prevent the occurrence of this disease due to occupational exposure. Hence, awareness generation among medical students could go a long way toward preventing this occupational hazard.

More than two-thirds of participants (71.5%) were able to identify all of the components of standard precautions (SPs). Indications for the use of SPs were identified by 75% of the participants. Regarding the indications for the use of gloves, the participants identified scenarios such as risk of contact with blood or body fluid (88%) and when healthcare workers have cutaneous lesions (81%). These findings are similar to a study conducted by Tavolacci et al. [13], in which SPs and the use of gloves were correctly identified by 78% and 83% of participants, respectively.

It was surprising to note that only 16.4% of the participants were able to identify the correct sequence of the hand-washing technique. This finding indicated a lack of knowledge regarding the proper hand-washing technique among students. In contrast, participants had better knowledge with regards to IPPs in relation to pulmonary TB. However, the IPP questions in relation to TB were more hypothetical, and there was a chance of students identifying these answers more correctly than the hand-washing sequence, which was more direct and absolute. These factors might have influenced the responses of the participants to these questions.

Academic textbooks were mentioned as a source of information regarding IPPs by only 19% of the subjects, and other sources, e.g., consulting a senior/friend (21%), medical journals (19.4%) and internet sites (16.8%), were the preferred sources of information. This is in contrast to a study conducted by Tavolacci et al. [13], in which self-learning and teaching curricula were the major sources of information. This finding has an important implication, indicating that the role of seniors/friends and the Internet is now vital when teaching students important aspects of IPPs; a misinformed person/internet site can lead to a misinformed recipient. Hence, it is important to train students in relation to IPPs and awareness generation by providing genuine Internet sites/blogs that include the correct information.

The majority of the participants (88.8%) felt that they needed further training in relation to IPPs; among them, 58.8% felt that training should be imparted during the 2nd MBBS year. These findings indicate that the participants understood their need. The sources of information preferred by the participants clearly demonstrate the need for incorporating IPPs as a separate entity in the existing medical undergraduate curriculum in India.

Our study has some limitations. The assessment of HH practices by direct observation is a more direct and superior method, but we were unable to use this method due to its feasibility in terms of budget, time and the large sample size required.

There is also a possibility of social desirability bias as far as the assessment of awareness in relation to IPPs. Additionally, the study was conducted in only one medical college, which may not be representative of the settings at other colleges. Nevertheless, our study has some strengths in terms of assessing multiple IPPs in one study and assessing the needs that medical students feel are required for further training regarding IPPs.

Conclusion

The knowledge levels regarding infection practices were not adequate among the participants, particularly regarding hand hygiene methods. Other important aspects, such as needle-stick injuries and the use of standard precautions, were better understood, although improvements are still necessary. These findings suggest the need to consider strengthening training regarding infection prevention practices and including them as a separate entity in the existing curriculum because it is important to reduce the morbidity and mortality related to illnesses such as hepatitis-B and HIV/AIDS in both patients and healthcare workers. Further research needs to be conducted in this area to identify other important aspects of infection prevention to reduce healthcare-associated infections.

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