

Introduction of infection control module for undergraduate medical students: experience at a rural medical college in India

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Abstract

Health care associated infections are preventable by following Infection Control protocols which are not taught to medical student. Poor state of knowledge and practices in medical students about infection control has been shown in various studies. "Patient Safety Module" by WHO strongly recommends incorporation of infection control module in curriculum of medical schools as, the future doctors need to understand these concepts at an early stage to be able to incorporate them in practice. We designed and implemented such a module to improve the knowledge, skills and attitude of medical students towards infection control practices through a formal teaching program.

This educational intervention of four and a half hours, was designed and implemented for students in their final phase of medical education. The module focused on standard precautions, sterilisation and disinfection, spillage, biomedical waste management and sharp injury. Student's feedback was taken immediately (April 2012) as well as during internship (September 2013) in the form of anonymous structured questionnaire along with the written assessment in the form of multiple choice questions. Descriptive analysis of the responses was done.

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The module was rated as excellent by 96.1% (n=90) of the students. The topics included were perceived of immediate importance, usefulness and relevance by all the students. Majority of the students felt that such session must be conducted at regular interval particularly during internship when they can have direct application of the infection control practices. Thus, inclusion of infection control module in undergraduate medical curriculum is strongly recommended by the authors.

Key words: Students, medical; Infection control and education; Rural health

Introduction

Healthcare associated infection (HAI) is the biggest challenge being faced by the health care industry today.¹ At any given moment nearly 5-10% of patients admitted to hospital suffer from HAI, resulting in millions of deaths and huge burden on the economy that can range from 5-70% of health care budget in various countries worldwide as found by WHO prevalence survey study conducted in 55 hospitals of 14 countries.^{1,2} The risk of infection increases by 2-20% in developing countries and almost half of these infections can be prevented by following Infection Control protocols.^{1,3} Medical students, the future health care professionals are not well prepared to prevent infections as shown by their poor state of knowledge and skills in various studies across the globe.⁴⁻¹⁶ Formal teaching of infection control protocols in the curriculum of medical school is variable, even in developed countries like the UK and the Republic of Ireland.⁸

It has been shown in studies that group of students who receive education about universal precautions have a higher level of knowledge and performance than the group that receives no such education.⁹ Various studies along with "Patient Safety Module" by WHO strongly recommends incorporation of infection control module in curriculum of medical schools as medical students, the future doctors need to understand these concepts at an early stage to be able to incorporate them in their practice.¹⁻¹⁶ We designed and implemented such a module for undergraduate students.

Method

Study design

This observational study was planned as an educational intervention. It was exempted from review by the institutional ethics committee. A four and half hour

module on infection control for 90 medical students in their final phase of medical education was designed and implemented in March-April 2012. The module was conducted in three sessions, at weekly interval. The sessions focused on standard precautions, sterilisation and disinfection of environment & patient care instruments, spillage management, biomedical waste management and needle stick injury. The specific learning objectives for the sessions were identified after discussion amongst members of hospital infection control committee and clinicians. These objectives were communicated to the students at the beginning of the session. Combinations of teaching methods were used so as to make students participate actively in the sessions. The methods used were interactive lectures, video show, discussion and demonstration.

Data Collection

Data was collected in the form of anonymous self administered written structured questionnaire to gather perceptions of knowledge, skills and attitude. The main themes around which questions were framed were to find out the overall conduct, and usefulness of module and their perceptions towards infection control practices. Response to questionnaire was considered as consent. In the written feedback forms perception of students towards prior knowledge about infection control, increase in knowledge after the module and such knowledge being essential for them was asked and the responses were elicited on a three point scale (1 = not at all, 2 = to some extent and 3 = to a great extent). Immediate importance, usefulness & relevance of the topics included in the module were also asked. After these students entered internship in April 2013, their perceptions towards infection control training conducted during undergraduate course, infection control practices that they have observed and their compliance to these practices along with the support

they received from colleagues was ascertained in September 2013, on five point likert scale (1=strongly agree, 2=agree, 3=neutral, 4=disagree, 5=strongly disagree). Free space at the end of feedback form was provided for any comments and suggestions by the students.

Five MCQs focusing on knowledge component of infection control were asked after completion of the module that was repeated at the time of taking feedback during internship to assess the retention of knowledge after the module.

Descriptive analysis of the data was performed. Responses of all the students were pooled for each statement in the feedback and expressed as percentage. Performance in the MCQ was also averaged out to find out the overall performance of the group.

Unpaired T test was applied using MedCalc to calculate difference in the performance of students after the module and during internship.

Result

Out of 90 students, 54 (60%) students attended all three sessions, attendance was seen to increase gradually from first session to third session as 60, 78.9 and 86.70%. Feedback forms were submitted by 77 (85.55%) students immediately after the completion of module. Thirty three (36.67%) students during their internship turned up for feedback. The module was rated as very good to excellent by 74 (96.10%) students. The topics included were perceived of immediate importance, useful and relevant by all the students. Sixty five (84.42%) students felt that their knowledge and attitude towards infection control has improved after attending the sessions. Majority of the students felt that such session must be conducted at regular interval more so during internship when they can have direct application of the infection control practices.

Performance in MCQs was an average of 3.25 (65%) after the module and 3.10 (62%) marks out of five during internship with no statistical difference in the performance of the students immediately after the module and during internship.

Perceptions of students and interns on various aspects of knowledge, attitude and skill have been shown in table I-III. As can be seen in table I, majority (33.76-51.94%) of students felt that they had no prior knowledge on various aspects of infection control, particularly in relation to steps of hand hygiene and spillage management. Forty five to sixty three percent of students had knowledge to some extent, which was maximum for standard precaution. Only 5.19% of student felt they had knowledge to a great extent in biomedical waste management. More than 60% of students have felt that their knowledge had increased to a great extent after the session, this was maximum (76.62%) for standard precautions. More than 70% of students have felt that such knowledge is essential for them and this was maximum (85.71%) for occasions of hand hygiene.

Table II shows perceptions of internee students on various aspects of training and behavioural aspects of infection control, in terms of their agreement or disagreement.

Themes on which internee students agreed to strongly agreed were those of being adequately trained (78.79%) for infection control and this training being helpful to them in following infection control protocols in a better way (60.60%) as they felt more knowledgeable (69.69%), skilful (54.55%) and their attitude towards infection control being changed for better (63.63%). Majority felt all waste generated in the hospital should be considered infectious and should be properly disposed (63.63%) and adherence to infection control practices by all of them can greatly reduce the pain and sufferings of patients (69.69%).

Themes on which internee students disagreed to strongly disagreed were segregation of biomedical waste in different colour bags at the site of generation being impractical and useless exercise (63.64%), hand hygiene being unnecessarily hyped as an important preventive measure for Infection in hospitalised patients (78.79%) and holding nurses and other paramedical staff responsible for any HAI in their patient (57.57%). It can be seen that there are certain issues that need to be emphasised again and again to make them understand the significance of adhering to infection control practices e.g. 51.51% interns felt that hand hygiene before examining each patient is

Table I. Perception of students towards knowledge about Infection Control (N=77)

Session Subtopics	Not at all, n (%)	To some extent, n (%)	To a great extent, n (%)
1. Hospital acquired or healthcare associated infection (HAI)			
I had knowledge about this earlier	31(40.25)	44 (57.14)	2 (2.59)
My knowledge increased after the session	0	21 (27.27)	56 (72.72)
I feel such knowledge is essential	0	12 (15.58)	65 (84.41)
2. Standard precautions			
I had knowledge about this earlier	27 (35.06)	49 (63.63)	1 (1.29)
My knowledge increased after the session	1 (1.29)	17 (22.07)	59 (76.62)
I feel such knowledge is essential	1 (1.29)	22 (28.57)	54 (70.12)
3. Steps of hand hygiene			
I had knowledge about this earlier	39 (50.64)	38 (49.35)	0
My knowledge increased after the session	0	25 (32.46)	52 (67.53)
I feel such knowledge is essential	0	15 (19.48)	62 (80.51)
4. Occasions of hand hygiene			
I had knowledge about this earlier	37 (48.05)	39 (50.64)	1 (1.29)
My knowledge increased after the session	2 (2.59)	22 (28.57)	53 (68.83)
I feel such knowledge is essential	2 (2.59)	9 (11.68)	66 (85.71)
5. Personal Protective Equipments			
I had knowledge about this earlier	26 (33.76)	47 (61.03)	4 (5.19)
My knowledge increased after the session	1 (1.29)	21 (27.27)	55 (71.42)
I feel such knowledge is essential	0	16 (20.77)	61 (79.22)
6. Cleaning and Disinfection of hospital environment & patient care instruments			
I had knowledge about this earlier	31 (40.25)	43 (55.84)	3 (3.89)
My knowledge increased after the session	0	23 (29.87)	54 (70.12)
I feel such knowledge is essential	0	18 (23.37)	59 (76.62)
7. Spillage Management			
I had knowledge about this earlier	40 (51.94)	35 (45.45)	2 (2.59)
My knowledge increased after the session	1 (1.29)	27 (35.06)	49 (63.63)
I feel such knowledge is essential	1 (1.29)	31 (40.25)	45 (58.44)
8. Biomedical Waste Management			
I had knowledge about this earlier	34 (44.15)	39 (50.64)	4 (5.19)
My knowledge increased after the session	2 (2.59)	28 (36.35)	47 (61.03)
I feel such knowledge is essential	1 (1.29)	19 (24.67)	57 (74.02)

Table II. Perception of students towards knowledge about Infection Control (N=77)

Sr No	Statement	Strongly Agree n (%)	Agree n (%)	Neutral n (%)	Disagree n (%)	Strongly Disagree n (%)	Non Responders n (%)
1.	I was adequately trained about Infection Control.	8 (24.24)	18 (54.5)	1 (3.03)	2 (6.06)	1 (3.03)	3 (9.09)
2.	We needed to learn more in infection control.	9 (27.27)	10 (30.3)	2 (6.06)	4 (12.12)	2 (6.06)	6 (18.18)
3.	Infection control training has helped me to follow infection control protocols in a better way.	9 (27.27)	11 (33.33)	7 (21.21)	0	2 (6.06)	4 (12.12)
4.	I feel more knowledgeable about infection control due to the teaching sessions.	5 (15.15)	18 (54.55)	3 (9.09)	1 (3.03)	2 (6.06)	4 (12.12)
5.	I feel more skilful about infection control due to the teaching sessions.	4 (12.12)	14 (42.42)	8 (24.24)	4 (12.12)	0	3 (9.09)
6.	My attitude towards infection control has changed for better due to the teaching sessions.	6 (18.18)	15 (45.45)	8 (24.24)	0	1 (3.03)	3 (9.09)
7.	All waste generated in the hospital should be considered infectious and should be properly disposed.	7 (21.21)	14 (42.42)	7 (21.21)	1 (3.03)	1 (3.03)	3 (9.09)
8.	Segregation of biomedical waste in different color bags at the site of generation is impractical and useless exercise	1 (3.03)	2 (6.06)	5 (15.15)	4 (12.12)	21 (63.64)	0
9.	Hand hygiene before examining each patient is just impossible.	3 (9.09)	7 (21.20)	5 (15.15)	11 (33.33)	7 (21.21)	0
10.	No hospital can strictly enforce adherence to infection control practices & implement hand hygiene.	2 (6.06)	7 (21.27)	7 (21.21)	9 (27.27)	6 (18.18)	2 (6.06)
11.	Hand hygiene is unnecessarily hyped.	1 (3.03)	3 (9.09)	3 (9.09)	11 (33.33)	15 (45.45)	0
12.	I personally do everything that I should do for the prevention of infection in my patient.	2 (6.06)	14 (42.42)	4 (12.12)	6 (18.18)	4 (12.12)	3 (9.09)
13.	I would hold nurses and other paramedical staff responsible for any hospital acquired infection in my patient.	4 (12.12)	2 (6.06)	8 (24.24)	16 (48.48)	3 (9.09)	0
14.	Adherence to infection control practices by all of us can greatly reduce the pain and sufferings of patients.	15 (45.45)	8 (24.24)	4 (12.12)	3 (9.09)	1 (3.03)	2 (6.06)

Table III. Perception of internee students towards their compliance to Infection Control practices and support from colleagues (n=33)

Sr. No	Statement	Never n (%)	Sometimes n (%)	Most of the time n (%)	All the time n (%)	Non responders n (%)
1.	I wash my hands/use hand-disinfectant before examining a patient	1 (3.03)	9 (27.27)	14 (42.42)	7 (21.21)	2 (6.06)
2.	I use personal protective equipments while doing any procedure.	1 (3.03)	2 (6.06)	18 (54.54)	10 (30.30)	2 (6.06)
3.	I segregate biomedical waste properly at the time of generation.	1 (3.03)	0	9 (27.27)	20 (60.60)	3 (9.09)
4.	I hand over the sharps to my subordinates for disposal after use.	13 (39.39)	2 (6.06)	10 (30.30)	6 (18.18)	2 (6.06)
5.	I insist my colleagues/subordinates to follow Infection control practices.	4 (12.12)	12 (36.36)	10 (30.30)	6 (18.18)	1 (3.03)
6.	I am motivated to follow infection control practices by my seniors/consultants	5 (15.15)	9 (27.27)	9 (27.27)	8 (18.18)	2 (6.06)
7.	I have seen consultants and residents adhere to infection control practices	2 (6.06)	14 (42.42)	11 (33.33)	4 (12.12)	2 (6.06)
8.	I am instructed /guided by the nurse to follow infection control practices	1 (3.03)	10 (30.30)	11 (33.33)	7 (21.21)	4 (12.12)
9.	I listen to the nurses when instructed to follow infection control practices	1 (3.03)	1 (3.03)	11 (33.33)	17 (51.52)	3 (9.09)

just impossible and 45.45% agreed to the fact that no hospital can strictly enforce adherence to infection control practices and implement hand hygiene.

Perceptions towards practices of internee students on various aspects of infection control are shown in Table III, and it is evident that 21-29 (63-87%) interns felt that they follow hand hygiene, use appropriate PPE and segregate biomedical waste most or all of the times when working in hospitals. Only 16 (48%) interns felt they are motivated to follow infection control practices by others in hospital. Consultants and residents only sometimes adhering to infection control practices was reported by 14 (42%) of them. Nurses guide them and they listen to them most to all of the times has been reported by 84% on interns.

Discussion

Preventing HAI is the biggest challenge for infection control teams and hospital administrators. Lack of a structured infection control curriculum for training

the medical students has been recognised and efforts to train the undergraduate students in all health care disciplines like dental, nursing and physiotherapy has been reported with variable results.^{3-5,9}

Medical schools that have a formal curriculum also need to review as was shown in a review of medical education on HAI throughout medical schools in the UK and the Republic of Ireland.⁸

O'Brien *et al.* reported 97% and 100% of medical schools, respectively, having a formal curriculum but only 60% of them emphasised the importance of infection control in quality and safety issue.⁸ The status of formal curriculum in Indian medical schools is not known.

Students tend to acquire knowledge and skills from different sources.^{11,12} The important sources of information can be self-learning, formal or informal training in wards, and teaching during the curriculum

with main source of information being material taught during the curriculum as has been revealed by responses from the students in a study by Tavolacci *et al.*¹¹ Insufficient emphasis on infection control in their course has been identified by students in studies done by various workers.^{3,12}

We collected feedback from 85.55% and 36.67% students and interns respectively and found that 48.05% & 50.64% students reported no knowledge about occasions and steps of hand hygiene, respectively, this was similar to findings by Mann *et al.* where 58% of medical students did not know the correct indications for using alcoholic hand gel and 35% did not know the correct use of gloves.¹² We had 42.42% students who washed their hands most of the times and 21.21% washed their hands all the time which is similar to findings by Afreen Ayub *et al.* where 31.25% students always followed hand hygiene procedure.³ Disposal of hazardous material into designated containers has been reported low i.e. 20- 25% by them and we had 27.27% students who said they disposed waste appropriately and 60% disposed waste appropriately all the time.³ These findings of poor knowledge and skills of medical students raise concerns and indicate inadequate training.

Students enjoy participating in the special modules prepared to develop their knowledge, skills and attitude in infection control with positive outcome as has been demonstrated in various studies, though the long term outcome may remain questionable.¹⁰

Different investigators have developed, implemented and assessed both online as well as conventional infection prevention and control programme for medical students with statistically significant improvement ($P < 0.0001$) in the knowledge.^{13,14} This is similar to our experience where 33.76-51.94% students had no knowledge on various aspects of infection control before the module which had increased to a great extent as reported by 61-76.62% students. Majority of students (58.44-85.71%) who completed the module felt that such knowledge was essential for them indicating a positive attitude about the learning experience similar to the finding of other investigators.¹³

Along with teaching, assessment of these module improves the learning by students even further as was demonstrated by Milward *et al.* for dental students where they observed significant improvements in awareness and knowledge of the infection control protocols following introduction of formal infection control course and its assessment with increase in the number of students passing the course at their initial attempt i.e. 42% and 78%, in the consecutive academic years, respectively, with their better performance in clinical years in terms of infection control practices.¹⁵ Kim *et al.* found a weak correlation in their study to identify the knowledge of universal precautions and their performance in practice among the nursing and medical students in Korea but they found that the group which received education about universal precautions had a higher level of knowledge and performance of the universal precautions than the group that received no such education, emphasising the need for a formal training module of students in all health care discipline including nursing and dental across all nations.^{3,9,16}

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References

1. Topic 9: Minimizing infection through improved infection control WHO patient safety curriculum guide for medical schools. World Health Organization 2009 available at www.who.int/patientsafety/education/curriculum/Curriculum_Tools [Accessed May 3, 2011]
2. Burnett E, Phillips G, Ker JS. From theory to practice in learning about healthcare associated infections: reliable assessment of final year medical students' ability to reflect. *Med Teach* 2008; **30(6)**: 157-160. <http://dx.doi.org/10.1080/01421590802047299>
3. Ayub A, Goyal A, Kotwal A, Kulkarni A, Kotwal A, Mahen A. Infection control practices in health care: Teaching and learning requirements of medical undergraduates *MJAFI* 2013; **69(2)**: 107-112.
4. Van De Mortel TF, Kermode S, Prozano T, Sansoni J. A comparison of the hand hygiene knowledge, beliefs and practices of Italian nursing and medical students. *J Adv Nurs* 2012; **68(3)**: 569-579. <http://dx.doi.org/10.1111/j.1365-2648.2011.05758.x>
5. D'Alessandro D, Agodi A, Auxilla F, *et al.* Prevention of healthcare associated infections: Medical and nursing students' knowledge in Italy. *Nurse Educ Today* 2014; **34(2)**: 191-195. <http://dx.doi.org/10.1016/j.nedt.2013.05.005>
6. Colossi A, Ergasti G, Murzilli G, *et al.* Healthcare students and their knowledge of healthcare-associated infections. *Ann Ig* 2011; **23(3)**: 203-208.

7. Huang Y, Xie W, Zeng J, Law F, Ba-Thein W. Limited knowledge and practice of Chinese medical students regarding healthcare associated infections. *J Infect Dev Ctries* 2013; **7(2)**: 144-151. <http://dx.doi.org/10.3855/jidc.3099>
8. O'Brien D, Richard J, Walton KE, Phillis MG, Humphreys H. Survey of teaching/learning of healthcare-associated infections in UK and Irish medical schools. *J Hosp Infect* 2009; **73(2)**: 171-175. <http://dx.doi.org/10.1016/j.jhin.2009.07.006>
9. Kim KM, Kim MA, Chung YS, Kim NC. Knowledge and performance of the universal precautions by nursing and medical students in Korea. *Am J Infect Control* 2001; **29(5)**: 295-300. <http://dx.doi.org/10.1067/mic.2001.114837>
10. Wagner DP, Parker CJ, Mavis BE, Smith MK. An interdisciplinary infection control education intervention: necessary but not sufficient. *J Grad Med Educ* 2011; **3(2)**: 203-210. <http://dx.doi.org/10.4300/JGME-D-10-00120.1>
11. Tavolacci MP, Ladner J, Bailly L, Merle V, Pitrou I, Czernichow P. Prevention of nosocomial infection and standard precautions: knowledge and source of information among healthcare students. *Infect Control Hosp Epidemiol* 2008; **29(7)**: 642-647. <http://dx.doi.org/10.1086/588683>
12. Mann CM, Wood A. How much do medical students know about infection control? *J Hosp Infect*, 2006; **64(4)**: 366-370. <http://dx.doi.org/10.1016/j.jhin.2006.06.030>
13. O'Neill E, Stevens NT, Clarke E, Cox P, O'Malley B, Humphrey H. Use of e-learning to enhance medical students' understanding and knowledge of healthcare-associated infection prevention and control. *J Hosp Infect* 2011; **79(4)**: 368-370. <http://dx.doi.org/10.1016/j.jhin.2011.08.008>
14. Diekema DJ, Schuldt SS, Albanese MA, Doebbeling BN. Universal precautions training of preclinical students: impact on knowledge, attitudes, and compliance. *Prev Med* 1995; **24(6)**: 580-585. <http://dx.doi.org/10.1006/pmed.1995.1092>
15. Milward MR, Cooper PR. Competency assessment for infection control in the undergraduate dental curriculum. *Eur J Dent Educ* 2007; **11(3)**: 148-154. <http://dx.doi.org/10.1111/j.1600-0579.2007.00439.x>
16. Moradi Khanghahi B, Jamali Z, Pournaghi Azar F, Naghavi Behzad M, Azami-Aghdash S. Knowledge, attitude, practice, and status of infection control among Iranian dentists and dental students: a systematic review. *J Dent Res Dent Clin Dent Prospect* 2013; **7(2)**: 55-60.