ORIGINAL PAPER

Impact of Educational Interventions on the Awareness Regarding Hospital Infection Control Practices Among the Medical Students

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Abstract

Background: More than 1.4 million people all over the world are suffering from infections acquired during hospital stays . Awareness regarding infection prevention and control techniques are important to reduce the burden of such infections, ensuring better quality healthcare. Infection control education is a core component of infection control programs. **Objectives:** To assess the knowledge and awareness of Medical students in a tertiary care teaching hospital in Central India and to evaluate the impact of educational interventions in eliminating any existing gaps in the same. **Methods:** This interventional study based on self-administered questionnaires (Google forms) involved fifty medical Students who were administered a pre-structured validated questionnaire as pre-test and post-test before and after an induction training program on infection prevention & control measures. The impact of the educational intervention was evaluated by determining the learning gain. **Result:** The study reveals a highly significant improvement in knowledge levels after training sessions ($p<0.0001$). Before training most of the study subjects (68%) showed poor levels of knowledge, 22% exhibited moderate levels while only 10% were found to have good levels of knowledge. After training 36% of trainees showed good levels of knowledge, 40% exhibited moderate levels while only 24% were left with poor knowledge. **Conclusion:** While evaluating the impact of training in this study, we have found a statistically significant absolute learning gain and a medium level of class average normalized learning gain. These findings prove the effectiveness of such targeted training sessions as an important strategic tool in preventing healthcare-associated infections.

Keywords: hospital infection control, educational interventions, medical students, questionnaire, pre-test, post-test, knowledge, learning gain.

Rezumat

Istoric: Peste 1,4 milioane de oameni din întreaga lume suferă de infecții dobândite în timpul internărilor. Conștientizarea cu privire la tehnicile de prevenire și control a infecțiilor este importantă pentru a reduce povara acestor infecții, asigurând o asistență medicală de calitate mai bună. Educația pentru controlul infecțiilor este o componentă de bază a programelor de control a infecțiilor. **Obiective:** Evaluarea cunoștințelor și a conștientizării studenților la medicină într-un spital cu predare a îngrijirii terțiare din India Centrală și evaluarea impactului intervențiilor educaționale în eliminarea oricăror lacune existente. **Metode:** Acest studiu intervențional bazat pe chestionare (formulare Google) a implicat cincizeci de studenți la medicină cărora li s-a oferit un chestionar validat prestructurat ca pre-test și post-test, înainte și după introducerea unui program de instruire privind prevenirea și controlul infecțiilor. Impactul intervenției educaționale a fost evaluat prin determinarea surplusului de cunoștințe. **Rezultat:** Studiul relevă o îmbunătățire semnificativă a nivelurilor de cunoștințe după sesiunile de formare ($p < 0.0001$). Înainte de pregătirea

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profesională, majoritatea subiecților de studiu (68%) au prezentat niveluri slabe de cunoștințe, 22% au prezentat niveluri moderate, în timp ce doar 10% s-au dovedit a avea niveluri bune de cunoaștere. După instruire 36% dintre cursanți au prezentat niveluri bune de cunoștințe, 40% au prezentat niveluri medii în timp ce doar 24% au mai avut cunoștințe slabe. **Concluzie:** În timp ce am evaluat impactul instruirii am găsit un câștig de învățare semnificativ statistic și un nivel mediu de câștig de învățare normalizat în medie. Aceste constatări dovedesc eficiența unor astfel de sesiuni de instruire ca instrument strategic important în prevenirea infecțiilor asociate asistenței medicale.
Cuvinte cheie: controlul infecțiilor spitalicești, intervenții educaționale, studenți la medicină, chestionar, pre-test, post-test, cunoștințe, câștig de învățare.

INTRODUCTION

Nosocomial infections are localized or systemic infections that are not present or incubating at the time of admission of a patient in a health care center[1]. More than 1.4 million people all over the world are suffering from infections acquired during hospital stays[2]. Among patients admitted to health care centers[3-5] in India, studies reveal that 10–20% of the patients admitted had acquired nosocomial infections.

Standard precautions including infection control measures, if used strictly by the healthcare workers, can significantly contribute to a reduction in the spread of pathogens[6].

Infection control is a dynamic process, stretching throughout the patient's hospital stay addressing a multitude of factors related to healthcare care services, aimed at preventing infectious complications[7].

The most important and effective component of this protocol is hand hygiene, which suggests basic practices of hand washing, hand sanitization, and the use of gloves[8]. Therefore, it is vital for health care professionals, students, patient attendants, and the patient themselves to be sensitized to the principles of nosocomial infection.

Infection control education is a core component of infection control programs since they were established and they remain a constant feature in the modern healthcare context[9]. Healthcare professionals and students should be equipped with the requisite knowledge, skill, and attitude for good infection control practices[10]. A variety of educational strategies are evaluated for their effectiveness as a measure of infection control[11]. Some of the most practiced methods are quasi-experimental settings where control and target groups are subjected to both didactic and practical sessions[12], scenario-based simulation training[13], face to face seminars delivered by health care experts on an annual basis[14], e-learning followed by a questionnaire, focused group discussions and computer-assisted learning (CAL) in infection control education[15,16].

A single most well-recognized, effective, and simple way of decreasing HAIs is hand hygiene, yet healthcare professionals worldwide are not compliant with it. World Health Organization (WHO) estimates this compliance to be between 5% and 81%, with less than 40% on average[17]. This indicates the need for the education of healthcare professionals by various means regarding hand hygiene.

Medical students are considered the future health care professionals in training. As they are in direct contact with the patients during their clinical posting, they can serve as vehicles for cross-contamination within the hospital. The medical teachers should train students inappropriate infection control practices during clinical postings, for improving compliance. The various factors affecting the compliance of medical students should be assessed to design the training modules intended to address gaps in knowledge and practices before the students complete their medical course and enter the medical profession[18].

In this COVID-era it is increasing recognized by all those involved in the health care delivery system that a small outbreak can be transmitted globally and become a pandemic if not appropriately mitigated[19].

Awareness regarding infection prevention and control techniques are important to reduce the burden of such infections, ensuring better quality healthcare. Therefore, we planned a study to assess the existing knowledge of healthcare students regarding infection control practices and the impact of educational interventions on the awareness regarding the same.

MATERIALS & METHOD

This interventional study based on self-administered questionnaires (Google forms) was carried out to assess the knowledge and awareness of Medical students in

Table 1. Response wise Knowledge levels regarding Hospital Infection control practices amongst Medical Students before training & after training

S.No	Question/item	Correct Responses				p-value
		Before training		After training		
		n	%	n	%	
K1	Definition of Hospital-acquired infections	28	56	38	74	0.035*
K2	ESKAPE Pathogens	10	20	20	40	0.03*
K3	Body fluids to which Universal Work Precautions apply	26	52	36	68	0.04*
K4	Body fluids to which Universal Work Precautions don't apply	23	46	33	68	0.044*
K5	Components of Universal Precautions	30	60	40	80	0.03*
K6	Main route of transmission of harmful germs between patients	25	50	35	70	0.04*
K7	A most frequent source of germs responsible for healthcare-associated infections	23	46	33	60	0.044*
K8	No. of Steps of Handwashing as per WHO	32	64	42	86	0.023*
K9	The minimum time needed for an alcohol-based hand rub to kill most germs on your hands?	29	70	39	76	0.032*
K10	Routes of entry of infectious pathogens	38	76	39	78	NS
K11	The right practice of discarding the used needles	10	20	21	44	0.02*
K12	Action to be taken immediately after a needle stick injury	32	64	41	82	0.043*
K13	Needle stick injury leads to risk of transmission of	37	74	38	80	NS
K14	Disinfectant for cleaning Blood spills	41	80	44	88	NS
K15	Contact period of a disinfectant in Spills management	31	60	34	64	NS
K16	The maximum acceptable limit of bacterial count in the air in the conventional operation theatres	5	10	13	26	0.008*
K17	Moments of Hand hygiene laid down by WHO	26	54	36	72	0.04*
K18	Type of precautions requiring Negative pressure room	23	50	33	62	0.044*
K19	For device-associated infection, the device should be present in place for how many days	12	16	12	26	NS
K20	Aerosol generating procedures	25	48	26	52	NS

Significance calculated using Pearson's chi-square test
*p<0.05(Significant), **p<0.001(Highly significant), p>0.05(NS: Not significant)

Table 2. Comparison of Mean Pre-test & Post-test Scores

Mean Test Score ± SD		Absolute learning gain	Class Av. Normalised Gain (g)	Cohen's d	df	t-value	p-value
Pre-test	Post-test						
9.78 ± 3.65	12.86 ± 3.8	3.08	0.3	0.8266	49	10.95	0.0001**

Significance calculated using paired t-test.
*p<0.05(Significant), **p<0.001(Highly significant), p>0.05 (NS:Not significant)

a tertiary care teaching hospital in Central India and to evaluate the impact of educational interventions in eliminating any existing gaps in the same.

This study was undertaken in Dept. of Microbiology involving fifty, Second Prof. MBBS Students in May 2021 after obtaining clearance from the institutional ethics committee. The content, purpose, scope, and nature of the study were very well explained to the study participants, who were told that participation was voluntary and that their responses would be anonymous. Only those who volunteered to participate were included in the study after obtaining verbal consent. To ensure subjects understood the questions, instructors were available to provide explanations. All of the study participants completed the pre-test questionnaire.

They then participated in an educational intervention (an induction training program on infection prevention & control measures through a multimodal approach) in the form of 2 blended sessions of interactive lectures, videos & demonstrations. Each session lasting for 2 hours was conducted by the principal investigator. After completion of training, study participants were administered a post-test questionnaire that was the same as the pre-test questionnaire. To evaluate the student's learning, pre-test and post-test were conducted for all the students through Google Form. The time allocated for pre-test / post-test was 15 minutes each.

The self-administered pre-structured questionnaire was designed based on related and relevant literature based on standard guidelines framed by the World Health Organization, Center for Disease Control and Prevention's Perspectives in Disease Prevention and Health Promotion Update, and the Ministry of Health & Family Welfare, Govt. of India. Questions were checked for their relevance, clarity, and understandability, and requisite changes were made to make them easily understandable. The entire teaching module and the questionnaire were reviewed by senior subject experts to assess the relevance of their contents and were modified accordingly.

The questionnaire consisted of 20 questions covering different aspects of the Infection control practices mainly the universal precautions focused on assessing the awareness of study participants regarding the same in the form of multiple-choice questions (objective-type questions having only 1 correct response among 4 options). Assessment of the knowledge was done based on a scoring system in which 2 points were given for each correct response. There was no negative marking for incorrect responses. A score of 75% or greater was considered good, 50% to 74% as moderate, and less than 50% as poor.

Whenever the subjects felt difficulty in understanding the questions their doubts were cleared and questions were explained properly. Due care was taken to maintain confidentiality regarding the identity and personal details of the study participants.

STATISTICAL ANALYSIS

The responses to the questionnaire from the voluntary participants were tabulated, and data were compiled using Google forms and Microsoft Office Excel 2010 software. Appropriate statistical tools were used as per requirement. p values for the chi-squared distribution (for various values of χ^2 and degrees of freedom) were calculated for pre-test and post-test responses to each question by using the Pearson chi-square test. Subjects' pre-test and post-test scores were compared using paired t-tests, and the significance level was set to $P < 0.05$.

To study the effectiveness of the intervention, learning gain was calculated as follows:

1) Absolute learning gain: (post-test) – (pre-test)

2) Class average normalized gain (g) was calculated by Hake's criteria.

$$g = \frac{\text{(Post-test)} - \text{(Pre-test)}}{\text{Max. score} - \text{(Pre-test)}}$$

Where brackets indicate Class averages.

[Class average normalized gain is categorized as 0.1 to 0.29 as low gain, 0.3 to 0.69 as medium gain, and 0.7 to 1.0 as high gain.]

3) Effect size metrics by Cohen's d

$\text{Cohen's } d = (M_2 - M_1)/SD_{pooled}$

$SD_{pooled} = \sqrt{((SD_1^2 + SD_2^2)/2)}$

M_1= Mean score of Pre-test

M_2= Mean score of Post-test

SD_1=Standard deviation in the pre-test

SD_2=Standard deviation in post-test

SD_{pooled} = pooled standard deviation.

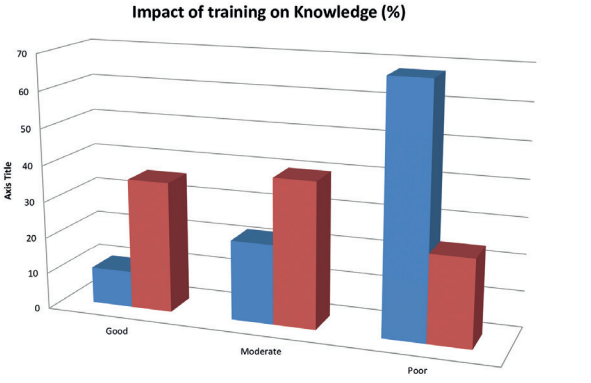
[d=0.2 Small effect size, 0.5 Medium effect size, 0.8 Large effect size][6,9,18,20-24].

RESULT

The assessment of Knowledge regarding Hospital Infection control practices through pre-test and post-test questionnaires with the same set of questions

administered before and after educational intervention reveals a highly significant improvement in knowledge levels after training sessions ($p<0.0001$).

Before training most of the study subjects (68%) showed poor levels of knowledge, 22% exhibited moderate levels while only 10% were found to have good levels of knowledge (Fig.1).



	Good	Moderate	Poor
Pre-Test	10	22	68
Post-Test	36	40	24

Fig. 1 Assessment of Impact of training on Knowledge and awareness regarding Universal work precautions amongst Laboratory Technicians

After training 36% of trainees showed good levels of knowledge, 40% exhibited moderate levels while only 24% were left with poor knowledge levels (Fig.1).

In our study out of the 20 questions asked to assess the Knowledge levels of study subjects, there was a significant increase in the number of correct responses to 14 questions after the educational intervention. However there was no significant effect of training on the questions about Routes of entry of infectious pathogens, Risk of transmission of Needlestick injury, spills management, device-associated infection & Aerosols generating procedures wherein there was no remarkable difference in the number of correct responses to these questions between the pre-test and post-test. This lack of statistical improvement was due to an already modest level of knowledge in these areas during the pre-test. There was less room for improvement even after the intervention except for the last two questions where the responses were poor before and after the intervention.

While evaluating the effectiveness of educational intervention in this study, we have found statistically significant absolute learning gain and a medium level of class average normalized learning gain regarding Hospital infection control practices. The learning observed a Large effect size metrics (Cohen's $d > 0.8$). These findings support the effectiveness of the induction program in increasing the awareness levels regarding infection control practices amongst medical students.

DISCUSSION

This study showcased the importance of educational intervention in controlling nosocomial infections by creating awareness among medical students regarding infection control practices. For this purpose firstly their existing level of knowledge was assessed with the help of a pre-test questionnaire and then two sessions of interactive teaching were held. Significant changes were observed in the knowledge level of students after completing the teaching sessions.

In our study, initially, only 10% of students showed a good level of knowledge, 22% were average whereas 68% showed poor knowledge concerning infection control practices. After the teaching session, about 36% of students showed a good level of knowledge, 40% moderate while 24% of students still showed a poor level of knowledge. The average pre-test score was 9.78 which increased to 12.86 in the post-test.

Like our study, a significant post-interventional learning gain as evident from the mean test scores was observed in a number of studies[1,9,16,25-30].

Similar results were obtained in a study by Gaikwad et. al. (2018) where the pre-test score was 3.94 which increased to 15.33. The class average normalized gain was also quite similar[9].

Similarly, a study by Dogra et al. 2015, showed marked improvement in the post-test score of students in comparison to pre-test scores. They also emphasize the importance of various modalities of teaching including practical demonstration being responsible for the significant increase in knowledge as well as behavioral changes in infection control practices[26].

In their study, Suchitra and Lakshmi Devi (2007) also emphasized the importance of continuous education programs. They suggest that these programs should be innovative, educational and motivational, and tailored to the need of specific health personnel. In their study, they also found significant differences in the pre-education and post-education responses[16].

The Study by Mohit Goyal et al (2019), also suggests that there is a positive impact on Health care

students' knowledge and compliance by timely training them with hands-on practice despite only giving one-way lectures. In their study, the impact of the training session was significant and maximum on BDS students with a 15.46% increase in knowledge status followed by BSc Nursing students (15.12% increase) and MBBS students (10.31% increase)[1].

Similar to our study, a study by Shubhada Avachat et al (2012) also suggested that conducting sensitization workshops on knowledge, and awareness of hospital infection control practices for nurses played an important role in decreasing the risk of hospital-acquired infections[27].

Similarly, Shreyas Burute et al (2014), when educating the nurses regarding the adequate use of disinfectants in routine practices, they found that there was a significant improvement in the knowledge of nurses concerning different aspects of the use of disinfectants[28].

Anuradha Malgaonkar et al (2016) conducted a similar study on urban health care workers. The pre-test and post-test scores were tabulated and statistically analyzed. The degree of improvement in scores after 3 days of training varied from marginal to statistically significant[29].

Muhammad Faheem Afzal (Lahore, 2019), analyzed the effect of an educational intervention to improve the knowledge of hand hygiene in pediatric residents and nurses and found that the mean pre-test score for doctors was 3.22 while for nurses, it was 3.14, whereas the post-test score was 4.51 and 4.00 for doctors and nurses respectively. Overall, there was a statistically significant increase in knowledge after the educational intervention[30].

Similarly in a study in Egypt (El-Gilany, 2017), laboratory technicians have assessed their knowledge of waste handling and safety measures in laboratories. Their post-test score after education intervention was found to be significantly higher than the pre-test score[31].

The Hospital Hygiene study group of the Italian Society of Hygiene, Preventive Medicine and Public Health conducted a study on teaching hospital infection prevention and control measures, focused on developing effective training material based on study inputs. A perception survey was conducted followed by a thorough literature review for developing an effective training module. Finally, the interventions were implemented and their effectiveness assessed[32].

The "Patient Safety Curriculum Guide" manual, designed by the WHO, contains a separate section for guiding the health educators regarding planning the training sessions esp. regarding infection prevention and control. For each training module, different teaching methods are illustrated, including the clinical cases, group tasks, etc. In a survey conducted in the UK, training sessions comprising of lectures, case discussions, and practical demonstrations were found to be useful by most trainees[33].

Although there are several guidelines on best practices regarding hospital infection prevention and control practices, these are hardly followed by healthcare professionals. To bring a change in the behavior of healthcare professionals and students for better adherence and compliance to these practices, a number of educational interventions based on extensive research in health training strategies involving multi-disciplinary motivational approach have to be implemented.

Safdar and Abad reviewed 26 studies involving different groups of healthcare workers subjected to a number of varied training programs and demonstrated a statistically significant drop in healthcare-associated infection rates after the educational intervention in 21 studies[34.]

However, unlike our findings, another study by Gould D et al. has reported no beneficial effect of the training course on hand hygiene compliance among the trainees, three months after the course. But this may be due to differences in the tools employed for assessing the output[12].

In a study by Suchitra et al, a significant difference in the mean test scores of pre-test and first post-test was seen. But the performance of trainees declined over time as evident from the scores of second and then third post-tests. A similar problem with knowledge retention was reported by Wagner et al. Therefore, it was suggested that such training programs have to be conducted regularly rather than occasionally[16].

This will result in better retention of knowledge, instilling a positive attitude, and better compliance to best practices through repetitive reinforcement. This would translate into behavioral changes which will be reflected in practices intended to reduce the incidence of healthcare-associated infections. A written manual of standard institutional guidelines with well-structured training modules for health care workers is an important strategy in this direction.

CONCLUSION

While evaluating the impact of training in this study, we have found a statistically significant absolute learning gain and a medium level of class average normalized learning gain. These findings prove the effectiveness of such targeted training sessions as an important strategic tool in preventing healthcare-associated infections.

However, the training modules have to be continually updated and improved with innovative techniques for further improvement in the learning gain and awareness levels amongst medical students and health care professionals which could be ultimately translated into better compliance and adherence to the infection control practices.

An important limitation of this study was it was restricted to the assessment of learning gain of the educational interventions in terms of knowledge thus covering only the cognitive domain leaving the psychomotor domain unattended. So, further studies can be planned to assess the impact of the training by assessing the change in attitude and practices through checklist-based direct observation at the workplace.

The study highlights the need for improving the existing ICP training programs to address the gaps in knowledge, attitude, and practices. It is an integral part of the competency-based course curriculum of MBBS students. But it will be better to incorporate this into the course curriculum for all health care students.

A multi-pronged approach of availing resources/ facilities, sensitization, regular training sessions, educational and motivational activities should be adopted for improving compliance to the Hospital infection control practices.

Compliance with ethics requirements. The authors declare no conflict of interest regarding this article. The authors declare that all the procedures and experiments of this study respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008(5), as well as the national law. Informed consent was obtained from all the patients included in the study.

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References

1. Goyal M, Chaudhry D. Impact of Educational and Training Programs on Knowledge of Healthcare Students Regarding Nosocomial Infections, Standard Precautions and Hand Hygiene: A Study at Tertiary Care Hospital. Indian J Crit Care Med. 2019; 23 (2): 227–231.
2. Ducel G, Fabry J, Nicolle L. World Health Organization. Prevention of hospital-acquired infections: a practical guide. Geneva, Switzerland [cited 2021 May 10]. Available from: http://www.who.int/csr/ resources/publications/whocdscsreph200212.
3. Taneja N, Emmanuel R, Chari PS, Sharma M. A prospective study of hospital-acquired infections in burn patients at a tertiary care referral centre in North India. Burns. 2004 ; 30:665-69. doi: 10.1016/j. burns.2004.02.011
4. Mathur P, Kapil A, Das B. Nosocomial bacteraemia in intensive care unit patients of a tertiary care centre. Indian J Med Res. 2005;122: 305-308.
5. Kamat U, Ferreira A, Savio R, Motghare D. Antimicrobial resistance among nosocomial isolates in a teaching hospital in goa. Indian J Community Med. 2008; 33:89-92. doi: 10.4103/0970-0218.40875
6. Standard precautions in health care [Internet].1st ed. Geneva: WHO; 2016 [cited 2021 May15].Availablefrom:http://www.who.int/csr/resources/publications/EPR_AM2_E7.
7. Grosu-Bularda A , Lazarescu AL , Andrei MC, Lonescu DA , Frunza A, Grama S, et.al. Infectious Complications in Severely Burned Adult Patients-Diagnostic and Therapeutic Algorithm. Modern Medicine 2021; 28(1):25-40.
8. Boyce JM, Pittet D. Healthcare Infection Control Practices Advisory Committee.; HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. Society for Healthcare Epidemiology of America/ Association for Professionals in Infection Control/ Infectious Diseases Society of America. MMWR Recomm Rep. 2002;51:1–45.
9. Gaikwad UN, Basak S, Kulkarni P, Sande S. Educational intervention to foster best infection control practices. Int J Infect. 2018; 5 (3): 1-7. doi:10.5812/iji.8153.
10. WHO. Practical guidelines for infection control in health care facilities. WHO, SEARO regional publication; 2004. 41 p.
11. Kim LE, Evanoff BA, Parks RL, Jeffe DB, Mutha S, Haase C, et al. Compliance with Universal Precautions among emergency department personnel: Implications for prevention programs. American Journal of Infection Control. 1999;27(5):453–5. doi: 10.1016/s0196-6553(99)70014-3

12. Gould D, Chamberlain A. The use of a ward-based educational teaching package to enhance nurses' compliance with infection control procedures. J Clin Nurs. 1997; 6 (1): 55–67.
13. Mikkelsen J, Reime MH, Harris AK. Nursing students' learning of managing cross-infections–scenario-based simulation training versus study groups. Nurse Educ Today. 2008; 28 (6): 664-71. doi: 10.1016/j.nedt.2007.11.003.
14. Cheng SM, Melanee EC, Rawson B. Infection prevention and control learning preferences of nurses sampled at a teaching hospital. Can J Infect Control. 2008; 23 (3): 168-71.
15. Columbine AM, Wharrad HJ. Using computer technology to deliver an infection control update on hand hygiene. British Journal of Infection Control. 2016; 8 (3): 14-19. doi: 10.1177/1469044607008003060
16. Suchitra JB, Lakshmi Devi N. Impact of education on knowledge, attitudes and practices among various categories of health care workers on nosocomial infections. Ind J Med Microbiol. 2007; 25(3) :181-87.
17. Quilab MT, Johnson S, Schadt C, et al. The effect of education on improving hand hygiene compliance among healthcare workers. Hos Pal Med Int Jnl.2019;3(2):66-71. DOI: 10.15406/hpmij.2019.03.00153
18. Mehta A, Tripathi K. Knowledge, attitude and practices of hand hygiene among nurses and nursing students in a tertiary health care center of central India: a questionnaire based study. Int J Community Med Public Health. 2019; 6: 5154-60.
19. Kuriakose S. Global Health: Issues and Challenges. Modern Medicine 2020; 27(1): 1-3.
20. 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 Infect. 2008; 29: 642-47.
21. Humphreys H, Richards J. Undergraduate and postgraduate medical education on the prevention and control of healthcare-associated infection. More progress is needed. Int J Infect Control. 2011; 7:12.
22. Centers for Disease Control and Prevention. Update: universal precautions for prevention of transmission of human immunodeficiency virus, hepatitis B virus, and other bloodborne pathogens in health-care settings. MMWR Morb Mortal Wkly Rep. 1988; 37(24):377-388.
23. Dubey A, Sonker A. Knowledge and practice of biosafety precautions in a developing tertiary care institute of North India. Asian J Transfus Sci. 2017;11(1):70-71. doi:10.4103/0973-6247.200776
24. Ansari SK, Gupta P, Jais M, et al. Assessment of the knowledge, attitude and practices regarding hand hygiene amongst the healthcare workers in a tertiary health care centre. Int J Pharm Res Health Sci. 2015;3(3):720-726.
25. Mehta A, Diwakar MK. Impact of educational intervention on Knowledge, attitudes and practices of laboratory technicians regarding universal work precautions at a tertiary health care center in central India. Applied Biosafety. 2021; 26:S1: 27-33. http://doi.org/10.1089/apb.21.902607
26. Dogra S, Mahajan R, Jad B, Mahajan B. Educational interventions to improve knowledge and skills of interns towards prevention and control of hospital-associated infections. Int J App Basic Med Res. 2015; 5: 54-7.
27. Avachat S, Phalke D, Zambare M, Phalke V.Impact of sensitization workshop on knowledge and awareness of hospital-acquired infection among nurses of a teaching hospital in India. South East Asia Journal of Public Health. 2012;2 (2): 77-79.
28. Burute SR, Murthy MB, Ramanand SJ, Pore SM, Karande VB, Akat PB. Immediate impact of an educational intervention on knowledge of use of disinfectants in nurses. Int J Basic Clin Pharmacol. 2014; 3: 507-11.
29. Malgaonkar AA, Kartikeyan S. Cross-sectional comparative study of the effect of refresher training on the knowledge, attitude and practices of urban primary health care providers. Int J Community Med Public Health. 2016; 3: 3207-211.
30. Afzal MF, Hamid MH, Parveen A, Hanif A. Educational intervention to improve the knowledge of hand hygiene in pediatric residents and nurses. Pak J Med Sci. 2019; 35 (3):771-74. doi: https://doi.org/10.12669/pjms.35.3.388
31. El-Gilany AH, El-Shaer S, Khashaba E, El-Dakroory SA, Omar N. Knowledge, attitude, and practice (KAP) of 'teaching laboratory' technicians towards laboratory safety and waste management: a pilot interventional study. J Hosp Infect. 2017 ; 96 (2): 192-94. doi: 10.1016/j.jhin.2017.02.007.
32. Pasquarella C, Ciorba V, Arnoldo L, Auxilia F, Baldovin T, Barchitta M, et. al. Hospital hygiene in Italy: the GISIO-SItI survey. Ann Ig. 2018 ; 30 (5):7-14. doi: 10.7416/ai.2018.2246.
33. Walton M, Woodward H, Van Staalduinen S, Lemer C, Greaves F, Noble D, Ellis B, Donaldson L, Barraclough B; Expert Group convened by the World Alliance of Patient Safety, as Expert Lead for the Sub-Programme. The WHO patient safety curriculum guide for medical schools. Qual Saf Health Care. 2010 ;19 (6): 542-6. doi: 10.1136/qshc.2009.036970.
34. Safdar N, Abad C. Educational interventions for prevention of healthcare-associated infection: a systematic review. Crit Care Med. 2008 ; 36 (3): 933-40. doi: 10.1097/CCM.0B013E318165FAF3.
35. Wagner P, Parker J, Mavis E, Smith MK. An interdisciplinary infection control education intervention: necessary but not sufficient. J Grad Med Educ. 2011; 3 (2): 203-210. doi:10.4300/JGMED-10-00120.1