Original Article

Access this article online
Quick Response Code:
Website: www.jehp.net
DOI: 10.4103/jehp.jehp_542_20

Educating nursing staff regarding infection control practices and assessing its impact on the incidence of hospital-acquired infections

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Received: 22-05-2020
Accepted: 22-07-2020
Published: 28-01-2021

Abstract:

CONTEXT: Hospital-acquired infections (HAIs) are a global problem. One of the common causes of HAI is through the health-care workers, mainly because of failure to comply with the recommended infection control guidelines.

AIMS: The aim of our study was to educate and train the nurses regarding infection control practices and assess the impact of training and assess whether this training actually made any change in the incidence of catheter-associated urinary tract infection (CAUTI) and intravenous (IV) line-related infections.

MATERIALS AND METHODS: Baseline knowledge, attitude, and practices study of willingly participating 105 nurses regarding infection control was done. The incidence of CAUTI and IV line-related infection was calculated in the areas of their postings. They were trained via an educational module regarding infection control practices. We again assessed the incidence of CAUTI and IV line-related infections in the same areas 2 months after training. Data analysis was done using SPSS version 20.0. Student's *t*-test was used to analyze the difference in the prevalence of CAUTI and IV line-associated HAIs pre intervention and post intervention.

RESULTS: There was reduction in the incidence of IV line-related infection, though it was not significant (*P* 0.15) and no change in the incidence of CAUTI after intervention.

CONCLUSION: Single educational module though improved nurses' knowledge and attitude regarding infection control but failed to result in significant improvement in practices and incidence of HAIs.

Keywords:

Catheter-related infections, infection control, nosocomial infections

Introduction

Hospital-acquired infections (HAIs) are a worldwide problem. These infections are associated with delivery of care in contrast to infections that are present at the time of care and are leading cause of death and morbidity among patients receiving health care.[1] HAI is defined as a localized or systemic infection acquired in a hospital or any other health-care facility by a patient admitted for a reason other than that infection. It may also include an infection acquired in a health-care facility that may manifest 48 h after the patient's admission into the health-care facility, 3 days after discharge, or 30 days after a surgical operation. The pathogens should not be present or incubating prior to the patient's admission into health-care facility. HAIs add to functional disability and emotional stress of the patient and may in some cases, lead to disabling conditions that reduce the quality of life.[2] A study conducted at National Health Service

How to cite this article: Kakkar SK, Bala M, Arora V. Educating nursing staff regarding infection control practices and assessing its impact on the incidence of hospital.acquired infections. J Edu Health Promot 2021;10:40.

hospitals in England estimated that approximately 0.32 million patients per annum acquire one or more HAI which add to a burden of 930.62 million pounds per year.[3] Surveys on the incidence of HAIs have shown that 5%–10% of all hospitalized patients are affected by these infections.[4] In the United States, HAIs were found to be responsible for significant morbidity and nearly 80,000 deaths annually.[5,6] The most common types of hospital-acquired infections are pneumonias, urinary tract infections, respiratory tract infections, surgical site infections, and bloodstream infections.

There are many causes of HAIs, but they are most commonly caused by contaminated hands of health-care workers, contaminated medical devices, and failure of staff to comply with procedures and guidelines. Unfortunately, not all HAIs can be prevented, but with good practice and careful hygiene, the incidence of HAIs can be reduced.

Poor compliance with recommended infection control guidelines by health-care personnel is one of the main reasons for the transmission of pathogens.[7] The pathogens may be transmitted from one patient to another by way of health-care workers who have not washed their hands or health-care workers who do not practice hand disinfection, glove use, etc.[8] Although Semmelweis demonstrated more than a century ago that handwashing itself was sufficient in reducing the incidence of health-care-associated infections, compliance of health-care workers with the recommended handwashing practices remains low.[9,10] The spread of multidrug resistant pathogens has not still compelled health-care workers to adopt recommended infection control practices.[11]

Nurses are the largest group in the health-care system. They provide services in hospitals 7 days a week round the clock for the full year and work in close relation to patients. Nurses aim to provide complete nursing care to the patients with respect to promotion of health and well-being, prevention of various diseases, and healing nursing care to the patients in a health-care organization and the community. The nursing professionals are the foundation of any quality-related program in a hospital since they monitor and deliver almost all the health-care activities. Nurses working in different areas of a hospital play an important role in the prevention of HAIs.

Earlier studies have shown poor compliance among nurses regarding infection control practices.[12,13] Hence, a huge emphasis is currently being laid on educating and training health-care workers, especially nurses, to reduce HAIs. The knowledge and attitude of nurses can make a considerable positive difference in the delivery of health care. Studies claim continuing education to have resulted in an improvement in nurses' professional behavior and knowledge with respect to patient care activities.[14] Continuing education for nurses is also necessary for them to remain up to date with latest practice issues, perform competently, and respond positively to advanced medical and technology changes and this is also necessary for patient safety as well. Thus, keeping in mind the importance of nurses in prevention of HAI as well as importance of educational intervention in influencing the nurses' behaviour regarding infection control practices, we planned our study.

In this study, we tried to assess the basic knowledge, attitude, and practices (KAP) of nurses regarding HAIs, educated and trained them, and again assessed their KAP with the final aim to assess the impact of training on the actual change in the rate of HAIs, particularly catheter-associated urinary tract infections (CAUTIs) and intravenous (IV) line-related infections.

Materials and Methods

This was a prospective interventional study conducted in a tertiary care hospital in India. Institutional ethical committee approval was obtained prior to the study. The participants of the study were Grade 1 and Grade 2 nurses posted in different wards. Prior consent of the willing participants was obtained. The identity of the participants was kept confidential and they had the right to refuse participation at any stage of the study.

A self-administered, structured questionnaire was developed. For this, a validated questionnaire was selected from the reviewed literature.[15] This questionnaire was then modified and redesigned conforming to the settings of the institute and the final tool was thus developed. This questionnaire consisted of 35 questions with 15 questions on knowledge, 10 on attitude, and 10 on practices regarding HAIs. Responses to questions on knowledge were as marked as 1 or 0 for correct and incorrect responses, respectively, while responses to attitude and practices were marked on a Likert scale from 1 to 5.

After a brief introduction, the participants were explained the nature and purpose of the study. The participants were given the preintervention questionnaire which was supposed to be completed within 20 min. This was followed by 1 h of educational lecture module supplemented with PowerPoint presentations on HAIs, its prevention, care of urinary catheter, and IV line. A discussion and interactive session for the next 40 min was conducted. After that, an information booklet was delivered to the participants to enhance their knowledge and modify beliefs regarding HAIs.

The researcher approached the same participants twice after the aforementioned intervention, i.e., first after a week and then after a month of intervention and distributed the same questionnaire again. This postintervention questionnaire was filled by the participants in the given 20 min. The responses made were checked and entered into an Excel sheet and data were compiled.

To check the rationality of impact of the educational interventions in influencing the prevalence of CAUTI and IV line-associated infections, data were collected about these two infections 2 months prior and 2 months after the training of nurses in study areas using standard CDC guidelines and evaluated. The HAI reporting pro forma was used for the same.

For the purpose of this study, CAUTI has been defined as the presence of indwelling urinary catheter for two or more than two calendar days and isolation of significant count ($\geq 10^5$/ml) of pathogen from urine and presence of any one symptom of UTI such as fever, suprapubic tenderness, costovertebral tenderness, urgency, frequency, or dysuria.

For the purpose of this study, IV line-associated HAI has been defined as:

a. IV catheter in place for two or more than 2 calendar days
b. Signs of localized infection at the vascular access site.

The demographic details comprised the particulars pertaining to age, gender, ward, date of admission, and primary diagnosis. A pro forma was used for the collection of the above data. Data were entered into Excel sheet for further analysis. We measured the incidence of CAUTI or IV line-related infection by calculating the number of patients fitting in the above-mentioned criteria and dividing that with total number of patients on indwelling catheter or IV line. This way, we tried to assess whether educational intervention made any difference in the rate of HAI.

$$\text{Prevalence of CAUTI} = \frac{\text{Total no of patients with Catheter associated UTI}}{\text{Total no patients on indwelling catheter}}$$

$$\text{Prevalence of IV line associated HAI} = \frac{\text{Total no of patients with IV line associated HAI}}{\text{Total no of patients on IV line}}$$

Data analysis

Collected data were entered in the MS Excel spreadsheet, coded appropriately, and later cleaned for any possible errors. The analysis was carried out using Statistical Package for the Social Sciences (SPSS) for Windows version 20.0 (IBM Corporation, Armonk, NY, USA). During data cleaning, more variables were created so as to facilitate association of variables. Clear values for various outcomes were determined before running frequency tests. All statistical tests were two sided and performed at a significance level of $\alpha = 0.01$. Consolidated scores pertaining to all the domains were calculated. Difference in the mean scores pertaining to KAP was analyzed using Student's *t*-test (paired). Normality of quantitative data was checked by measures of Kolmogorov–Smirnov tests. Student's *t*-test was used to analyze the difference in the prevalence of CAUTI and IV line-associated HAI pre intervention and post intervention. $P < 0.05$ was taken as significant for this study.

Results

The study population consisted of 105 participants. All the participants completed preintervention, 1 week postintervention, and 1 month postintervention questionnaire.

questionnaire. Regarding demographic characteristics, of these 105 participants, 21 (20%) were male and 84 (80%) were female. Fifty-eight (55.2%) were graduates, 46 (43.8%) were undergraduates, and 1 (1%) participant was postgraduate. The age range of participants was between 22 and 57 years. Maximum participants 53 (50% were in younger age group of 22–31 and there were less participants 6 (6%in older age group of 52–61 years.

The mean score of knowledge increased from 9.42 to 12.98 1 week post intervention and from 9.42 to 12.18 1 month post intervention. The analysis showed statistically significant increase in knowledge between 1 week post intervention and pre intervention and it remained significantly high till 1 month after intervention (*P* 0.000). There is a statistically significant decrease in knowledge between 1 week post intervention and 1 month post intervention (*P* 0.001), but still it was higher than the preintervention knowledge score [Table 1].

The comparison of mean scores of attitude showed a statistically significant improvement at 1 week post intervention and 1 month post intervention as compared to pre intervention score (*P* 0.000) [Table 2]. Comparison of mean scores of attitude 1 week post intervention and 1 month post intervention also showed a significant improvement (*P* 0.026) [Table 2]. Most importantly, change in attitude persisted even 1 month post intervention.

Table 1: Comparison of difference in knowledge pre intervention, 1 week post intervention, and 1 month post intervention

Knowledge	Difference in mean	*n*	CI	*t*	*P*
Preintervention and 1 week postintervention	−3.562	105	−4.125-−2.998*	−12.534	0.000
Preintervention and 1 month postintervention	−2.762	105	−3.382-−2.142*	−8.835	0.000
1 week postintervention and 1 month postintervention	0.800	105	0.233-0.126*	3.43	0.001

*Indicates highly significant *P* value. CI=Confidence interval

Table 2: Comparison of difference in attitude score pre intervention, 1 week post intervention, and 1 month post intervention

Attitude	Difference in mean	*n*	CI	*t*	*P*
Pre intervention and 1 week post intervention	−1.77	105	−2.632-−0.91*	−4.084	0.000
Pre intervention and 1 month post intervention	−2.696	105	−3.665-−5.51*	−5.51	0.000
1 week post intervention and 1 month post intervention	−0.924	105	0.1.731-−0.110	−2.252	0.026

*Indicates highly significant *P* value. CI=Confidence interval

The comparison of mean scores of practices between pre intervention, 1 week post intervention, and 1 month post intervention showed an improvement in practices, but this improvement was not statistically significant [Table 3]. Although improvement was seen in all the parameters, the maximum improvement was seen toward practice of recapping of needles after use in which 26.6% of nurses, who were often or always doing that, stopped doing that altogether and this practice continued even 1 month after intervention.

As shown in Table 4, the overall incidence of CAUTI remained the same post intervention as it was during preintervention (*P* 0.375), though a slight decrease incidence of CAUTI can be seen in female patients.

As shown in Table 5, there has been a decrease in the incidence of the IV line-associated infection post intervention from 13% to 10%, though this was not statistically significant (*P* 0.15).

Discussion

The present study was conducted keeping in mind the role of nurses in the prevention of HAIs. In this study, we assessed the baseline KAP of nurses regarding HAIs, educated them, and assessed the impact of education on KAP toward infection control. We also assessed that whether our education or intervention actually made an impact on the incidence of HAIs, which we measured by monitoring and comparing the incidence of CAUTI and IV line-associated infections in inpatients 2 months before the intervention and 2 months after the intervention.

HAIs not only lead to increased morbidity and mortality but also increase cost as well as burden on patient's family[16-19] Nurses are the largest group in health-care system. They provide services to the patients round the clock throughout the year. They have the most opportunities for contact with patients. Poor compliance with recommended guidelines among the nurses is one of the factors responsible for the transmission of HAIs, and this adds to the burden on health-care system. The importance of education as a measure to prevent HAIs is implied in numerous studies. Studies exploring the KAP of health-care workers toward the transmission of HAIs in different patient groups suggest that education plays an important role in prevention and spread of HAIs.

In our study, 105 participants took part in the study and 100% participants completed 1 week postintervention and 1 month postintervention questionnaire. This shows nurses' keen interest in continuing nursing education (CNE) activities. Studies on CNE programs of registered nurses have shown that hospitals with nurses involved in CNE activities had a better patient outcome with improved quality of health care.[20]

In the present study, there was a significant increase in the knowledge score from preintervention score in the first postintervention response as well as in the second postintervention response [Table 1]. However, the improvement in answers significantly declined in the second postintervention as compared to the first postintervention response. Similar results have been demonstrated in a previous study.[21]

The attitude of the health-care workers regarding HAIs is equally important than just knowledge about the same. In the present study, there was a significant increase in attitude score from preintervention level both during first post intervention response and in the second postintervention response. The practices of nurses towars infection control also improved after intervention, though it was not statistically significant. An earlier study suggested that education has a positive impact on KAP of the nursing staff, and there is a need to develop a system of continuous education to reduce the prevalence of HAIs.[21]

There was a decrease in incidence of IV catheter-associated HAI between pre intervention and post intervention in

Table 3: Comparison of difference in scores of practices, pre intervention, 1 week post intervention, and 1 month post intervention

Practices	Difference in mean	*n*	CI	*t*	*P*
Pre intervention and 1 week post intervention	−0.086	105	−1.126-0.954	−0.163	0.87
Pre intervention and 1 month post intervention	−0.943	105	−2.063-0.178	−1.669	0.098
1 week post intervention and 1 month post intervention	−0.857	105	−1.756-0.041	−1.893	0.061

CI=Confidence interval

Table 4: Comparison of incidence of pre- and postintervention catheter-associated urinary tract infection

Gender	Preintervention			Postintervention			*P*
	n (%)	Patients on indwelling catheter, *n* (%)	CAUTI, *n* (%)	*n* (%)	Patients on indwelling catheter, *n* (%)	CAUTI, *n* (%)	
Female	263 (47)	28 (10)	4 (14)	223 (55)	43 (19)	4 (9)	
Male	294 (53)	61 (20)	8 (13)	180 (45)	65 (36)	10 (15)	
Total	556	89 (16)	12 (13)	403	108 (26)	14 (13)	0.375

CI=Confidence interval

Table 5: Comparison of incidence of pre- and postintervention IV line-associated infection

	Preintervention			Postintervention			*P*
Gender	*n*	IV line	Local infection, *n* (%)	*n*	IV line	IV line associated HAI, *n* (%)	
Female	262	259	39 (15)	223	223	26 (11)	
Male	294	288	31 (11)	180	179	16 (9)	
Total	556	547	70 (13)	403	402	42 (10)	0.15

male as well as female patients. However, the change in incidence of CAUTI was only observed in female patients. This is probably due to the practice that resident doctors catheterize male patients; while female patients were catheterized by nurses as per protocol in our institute, and these resident doctors were not the part of the study population and nurses performed better because of intervention. This shows the fact that CNE in nursing professionals targeting increasing their awareness of protocols aimed at reducing HAIs could play a significant role in reducing the occurrence of HAIs. Findings from similar studies also suggest that HAIs can be prevented if hospital personnel are well informed and regularly updated about these infections.[22,23]

A similar study that examined the association between nurses' level of education and patient outcomes had shown that surgical patients have a better outcome when treated in hospitals with a higher proportion of nurses whose nursing education level was higher. It was found in the same study that there is a 5% decrease in the risk of patient mortality with HAIs in proportion to 10% increase in the knowledge.[24]

In our study, probably increase in postintervention knowledge score pertaining to IV cannulation and hand hygiene has led to a change in attitude with regard to the role of health-care workers in spreading HAI, which has subsequently led to an improvement in hand hygiene practices. This may have resulted in the decreased prevalence of IV cannulation-related infection in the study area. A study conducted by Lam *et al*. looked at health-care workers' compliance with hand hygiene pre and post intervention reported that increased hand hygiene compliance has led to a marked decrease in HAIs.[7] In our study, we not only assessed the change in KAP with our educational intervention but also assessed the actual impact of this in reducing the health-care-associated urinary tract- and IV cannulation-related infections. Although we did not see any significant reduction in HAI, it was a single session of training and if such CNE activities are done at regular intervals, it will definitely bring down the incidence of preventable HAIs significantly.

Conclusion

It can be concluded from the findings of this study that single educational module on prevention of HAIs helped in reducing the incidence of IV line-related infections, though it was not significant. Education and training of health-care workers play an important role in implementation of strategies and protocols aimed at reducing the incidence of HAIs. Although our study was a small study over a short period of time not sufficient to see the retention of knowledge or practices or to capture all pertinent concepts related to infection control, still, it reemphasized the importance of regular educational programs in decreasing the incidence of HAIs.

Ethics

Ethical approval was obtained from the ethical committee of Post Graduate Institute of Medical Education and Research, Chandigarh, India.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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