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Impact of structured training program about Hospital Infection Control practices on Knowledge and Perception of nursing students at public and private nursing teaching institute of Northern India- An interventional study

Sukhbir Singh, Kiran Kaur[1], Ravinder Singh Saini[2], Sunita Singh[3], Hari Kishan Aggarwal[4], Hem Chandra[5]

Department of Hospital Administration, Pandit Bhagwat Dayal Sharma, Post Graduate Institute of Medical Sciences, Rohtak, Haryana, India, [1]College of Nursing, Pandit Bhagwat Dayal Sharma, UHS, Rohtak, Haryana, India, [2]Department of Hospital Administration, Himalyan Institute of Medical Sciences, Swami Rama Himalayan University, Dehradun, Uttarakhand, India, [3]College of Nursing, Pandit Bhagwat Dayal Sharma, UHS, Rohtak, Haryana, India, [4]Department of General Medicine, Pandit Bhagwat Dayal Sharma, Post Graduate Institute of Medical Sciences, Rohtak, Haryana, India, [5]HN Bahuguna Uttarakhand Medical Education University 4th Floor, Administrative Block, Govt. Doon Medical College Campus, Dehrakhas, Patel Nagar, Dehradun, Uttarakhand, India

Address for correspondence:
Dr. Sukhbir Singh, Department of Hospital Administration Pt. B. D. Sharma Postgraduate Institute of Medical Sciences Rohtak, Haryana - 124 001, India.
E-mail: drbrar1980@gmail.com

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Abstract:

BACKGROUND: Hospital-acquired infections (HAIs) are a primary cause of illness and death and increased expenditure due to prolonged hospitalization and poor prognosis. HAI is a global safety concern, according to World Health Organization (WHO). This study assesses the current level of knowledge and perception regarding hospital infection control practices among nursing students and evaluates the impact of structured training interventions on their baseline knowledge and perception level.

METHODS AND MATERIALS: It was a single group, a pre-post interventional study done on nursing students of one government and one private nursing college in the year 2021. A pretested questionnaire consisting of was used as a study tool. Various statistical tests like one repeated-measure ANOVA, Mauchly's Test of Sphericity, and Greenhouse-Geisser correction were used.

RESULTS: The mean knowledge was minimum in the pretest group (Mean = 79.4430, SD = 17.49746) and maximum immediately after the training group (Mean = 96.5443, SD = 25.42322). But after one month, knowledge decreased; however, it was more than pre-training Knowledge (Mean = 84.4937, SD = 22.40313).

CONCLUSIONS: Annual educational/training modules help retain knowledge in hospital infection control practices and HAI prevention. All healthcare workers need regular training.

Keywords:

Health care workers (HCWs), HAIs, hospital infection control practices, knowledge, nursing professionals, perception, training program, World Health Organization (WHO)

Introduction

Healthcare priorities continue to include preventing hospital deaths brought on by nosocomial infections. Hospital-acquired infections cause morbidity, mortality, increased costs, hospitalization, and poor prognosis.[1] The World Health Organization (WHO)[2] considers HAI a global safety issue. Over 1.4 million people get hospital-acquired infections.[3] HAI affects 5%–15% of hospitalized patients[4] and 50% of ICU patients[5] in developing countries. Nurses who lack sufficient knowledge and engage in poor infection control and prevention procedures put

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patient safety at risk. The knowledge gap in nursing is the research problem. HAIs are influenced by knowledge, attitudes, and practices related to infection prevention and control. Doctors and nurses in India[6] lacked knowledge and practice in infection control. In a similar study,[7] nurses knew standard precautions but rarely used them. South Africa[8] nursing students lacked standard precautions knowledge. Standard precautions and safety compliance need a training program. In another study,[9] attitudes caused poor compliance with standard precautions. Nursing staff contributes to or prevents and controls hospital infection transmission. A Zimbabwe[10] study found that nurse ignorance can increase hospital-acquired infections. Few studies[11,12] found healthcare worker knowledge gaps and a negative attitude toward infection control. Different studies[13-16] recommend educating healthcare workers on infection control and developing hospital-specific guidelines. The finding of a study carried out at the Kerman University of Medical Sciences[17] suggested that educational workshops may enhance self-efficacy among nurses. Nurses must know hospital infection control practices. These skills help HCWs begin clinical practice.

In light of the above context, it is evident that training plays a crucial role in boosting healthcare workers' knowledge and application of infection control methods. Nursing practitioners are closely involved in all patient care activities and serve as the backbone of patient care services. In addition, they oversee the activities of other HCWs assigned to their areas. The nursing students will become future nurses. This study was conducted among nursing students from a public and a private nursing college to assess their baseline knowledge and perception of hospital infection control practices. This study also assessed the effect of structured training interventions on their knowledge and perception at the outset.

Materials and Methods

Study setting

It was a pre-post single group intervention study conducted in the year 2021 among the nursing students of one government nursing college and one private nursing college in Haryana state.

Study participant and sampling

All nursing students in the study institutions (n = 481) were recruited [Table 1]. The participants who did not furnish informed consent or failed to attend the Training were excluded from the study.

Data collection and tools

After a thorough literature review, a structured questionnaire was created to assess hospital infection control knowledge and perception. The survey had three parts. The first part included the participant's sociodemographic details like age, gender, education level, residence, etc. The second part tests hospital infection control knowledge. The third part used a five-point Likert scale to measure respondents' perceptions of the study topic. There were 32 knowledge questions and 10 perception questions. The knowledge-based questions covered general information about HAI, hand hygiene, nosocomial infection prevention, cleaning, disinfection, sterilization, biomedical waste management, and occupational health safety. Multiple-choice questions assessed knowledge, while a 5-point Likert scale assessed Perception. We examine if all group items/questions are closely related. For reliability, we used Cronbach's alpha. Cronbach's alpha measures internal consistency. It's utilized when multiple choice and Likert questions form a scale in a survey/questionnaire, and we want to test its reliability.

Table 1: Sample size as per participants' category and institutions

Nursing class	Total number of Students at Govt. Nursing College (*n*)	Total number of Students at Pvt. Nursing College (*n*)
Post Basic	29	16
BSc Nursing (2, 3 & 4th-year students)	210	189
MSc Nursing	25	12
Total	264	217

Dimension	Reliability	Number of items
Knowledge	0.862	32
Perception	0.829	10

Cronbach's alpha in all groups is over 0.80, indicating strong internal consistency for our scale with this sample. Ten experts pilot-tested the questionnaire's content, applicability, comprehension, and validity.

Tool administration

Before the training session, the study tool was administered digitally to evaluate nursing students' baseline knowledge and perceptions of the study topic. The training program included IEC material and audio-visual classroom lectures. The researcher and other faculty trained participants using the Zoom platform. The same study tool was digitally administered immediately and one month after training to evaluate its impact. Before each study, participants gave digital informed consent.

Data analysis

All knowledge-assessment questions were scored. Correct answers were worth five points. Incorrect answers weren't penalized. The Likert scale for assessing participants' perceptions scored 05 to 01 for

a strongly agree to disagree response. There were three groups based on three different periods, i.e., pre-training, immediately after training, and post-one month after training. Three-time periods' knowledge and perception scores were calculated. Overall mean and question-by-question pretest, post-test, and one month after post-test differences were calculated. We used one repeated-measure ANOVA to compare knowledge and perception scores across periods. To use one-way repeated measure ANOVA, we checked its assumption as sphericity or equality of variance between each pair of three time periods. Mauchly's Test of Sphericity tests sphericity formally. Mauchly's W = 0.980983 & P = 0.022985 for knowledge and W = 0.927459 & P = 0.00002 for perception. Mauchly's Sphericity Test showed sphericity was violated ($p < 0.05$). As our data violated sphericity, we used one-way repeated measure ANOVA with Greenhouse-Geisser correction. Pairwise comparisons used Bonferroni corrections.

Ethical consideration

Ethical clearance was taken from the Institute Ethical Committee and informed consent was taken from participants for this study.

Results

This study included 395 total respondents. Table 2 shows the respondents' age, sex, education, residence, institution, and family type. About 58% of participants were 21–30 years old, 96% were female, 77% were pursuing BSc, and 70% were from govt. Of institutions, 51% were from urban areas, and 73% were from nuclear families [Table 2].

In most questions, the correct percentage increases immediately after training and decreases after one month of training. Some questions had different patterns. Pre-training, immediately after, and post-one-month training groups were created. All three time periods had knowledge and perception scores. The pretest group had the lowest mean knowledge (79.4430, SD = 17.49746), and then immediately after training group had the highest (96.5443, SD = 25.42322). After one month, knowledge decreased but was still higher than pre-training (Mean = 84.4937, SD = 22.40313). Mean knowledge scores differed significantly (f = 89.424683, P = 0.0001). Similarly, the mean perception score was lowest in the pretest group (Mean = 42.6937, SD = 4.17204), and immediately after training group had the highest mean perception (44.3291, SD = 4.12717). After one month, Perception decreased but was more than the pre-training level (Mean = 42.9139, SD = 5.21153). The mean perception score differed significantly (f = 21.981940, P = 0.000011) [Table 3].

Table 2: Distribution of participants as per their socio-demographic profile

Parameter		Count
College	Govt. Nursing College	275 (70%)
	Pvt. Nursing College	120 (30%)
Age	<=20	163 (41%)
	21–30	227 (58%)
	31–40	5 (1%)
Gender	Female	380 (96%)
	Male	15 (4%)
Class	BSc	304 (77%)
	MSc	45 (11%)
	PB MSc	46 (12%)
Place of residence	Rural	195 (49%)
	Urban	200 (51%)
Type of family	Joint	105 (27%)
	Nuclear	290 (73%)
Educational status of father	<10th	16 (4%)
	10th	92 (23%)
	12th	117 (30%)
	Graduate	121 (31%)
	Post Graduate	18 (5%)
	Diploma/others	31 (8%)
Educational status of mother	<10th	85 (22%)
	10th	128 (32%)
	12th	85 (22%)
	Graduate	62 (16%)
	Post Graduate	23 (6%)
	Diploma/others	12 (3%)

Table 3: Table depicting mean knowledge and perception score in different time period groups

	Descriptive statistics			
Parameter	Mean	Std. Deviation	*n*	*F*, *P*
Mean knowledge (Pre-training)	79.4430	17.49746	395	89.424683, 0.0001
Mean knowledge (immediate after training)	96.5443	25.42322	395	
Mean knowledge (one month post training)	84.4937	22.40313	395	
Mean perception (Pre-training)	42.6937	4.17204	395	21.981940, 0.000011
Mean perception immediate (immediate after training)	44.3291	4.12717	395	
Mean perception post (one month post training)	42.9139	5.21153	395	

The pairwise comparison of mean knowledge was made using Bonferroni corrections. There was a significant difference in mean knowledge score when the pretest group was compared with the immediate after training (mean difference = 17.10127, SE = 1.23847, P = 0.00001), post-one-month training group (mean difference = −5.05063, SE = 1.30453, P = 0.00038). The immediate after the training group was compared with the pretest (mean difference = 17.10127, SE = 1.23847, P = 0.00001), post-one month after

Table 4: Pairwise comparison of mean difference in knowledge and perception score

Pairwise comparisons				
Measure: Knowledge				
(I) Time	**(J) Time**	**Mean difference (I-J)**	**Std. Error**	***P***
Pre-training	Immediate after training	−17.10127	1.23847	0.00001
	Post-training	−5.05063	1.30453	0.00038
Immediate after training	Pre-training	17.10127	1.23847	0.00001
	Post-training	12.05063	1.39426	0.00002
Post-training	Pre-training	5.05063	1.30453	0.00038
	Immediate after training	−12.05063	1.39426	0.00002
Measure: Perception				
Pre-training	Immediate after training	−1.63544*	0.23378	0.0001
	Post-training	−.22025	0.29676	0.99999
Immediate after training	Pre-training	1.63544*	0.23378	0.0001
	Post-training	1.41519*	0.26884	0.00002
Post-training	Pre-training	0.22025	0.29676	0.99999
	Immediate after training	−1.41519	0.26884	0.00002

Adjustment for multiple comparisons: Bonferroni

Table 5: To compare the knowledge score time differences with respect to different demographical variables using testing of between subjects effects

With gender					
Descriptive statistics					**Tests of between-subjects effects**
Mean knowledge	**Gender**	**Mean**	**Std. Deviation**	***N***	***F*, *P***
Pre-training	Female	79.0921	17.51455	380	10.583204, 0.001240
	Male	88.3333	14.96026	15	
	Total	79.4430	17.49746	395	
Immediately after training	Female	95.6711	25.09107	380	
	Male	118.6667	24.52889	15	
	Total	96.5443	25.42322	395	
One month post training	Female	84.1711	22.33493	380	
	Male	92.6667	23.36562	15	
	Total	84.4937	22.40313	395	
With age					
Mean knowledge	**Age**	**Mean**	**Std. Deviation**	***N***	***F*, *P***
Pre-training	<=20	76.6258	17.36396	163	4.894847, 0.007949
	21-30	81.2115	17.42771	227	
	31-40	91.0000	10.83974	5	
	Total	79.4430	17.49746	395	
Immediately after training	<=20	91.7178	25.79226	163	
	21–30	99.8018	24.87723	227	
	31–40	106.0000	9.61769	5	
	Total	96.5443	25.42322	395	
One month post training	<=20	83.4663	23.04271	163	
	21–30	85.1982	22.17350	227	
	31–40	86.0000	8.94427	5	
	Total	84.4937	22.40313	395	

Contd...

Table 5: Contd...

With college					
Mean knowledge	**College**	**Mean**	**Std. Deviation**	***N***	***F*, *P***
Pre-training	Govt. Nursing College	78.1091	16.94955	275	58.224705, 0.00001
	Pvt. Nursing College	82.5000	18.40259	120	
	Total	79.4430	17.49746	395	
Immediately after training	Govt. Nursing College	88.9091	22.83092	275	
	Pvt. Nursing College	114.0417	22.27875	120	
	Total	96.5443	25.42322	395	
One month post training	Govt. Nursing College	82.0545	21.65288	275	
	Pvt. Nursing College	90.0833	23.17257	120	
	Total	84.4937	22.40313	395	
With place of residence					
Mean knowledge	**Place of residence**	**Mean**	**Std. Deviation**	***N***	***F*, *P***
Pre-training	Rural	77.9231	17.53257	195	12.373710, 0.000486
	Urban	80.9250	17.37900	200	
	Total	79.4430	17.49746	395	
Immediately after training	Rural	92.4359	25.72334	195	
	Urban	100.5500	24.53482	200	
	Total	96.5443	25.42322	395	
One month post training	Rural	81.6154	24.29587	195	
	Urban	87.3000	20.05545	200	
	Total	84.4937	22.40313	395	

the training group (mean difference = 12.05063, SE = 1.39426, *P* = 0.00002). The post-one-month after the training group was compared with the pretest (mean difference = 5.05063, SE = 1.30453, *P* = 0.00038), immediately after the training group (mean difference = −12.05063, SE = 1.39426, *P* = 0.00002) [Table 4].

Similarly, on pair-wise comparison using Bonefferoni corrections, a significant difference in mean perception score was observed, when the pretest group was compared with the immediate after training (mean difference = −1.63544, SE =0.23378, *P* = 0.0001), post-one-month training group (mean difference = −0.22025, SE =0.29676, *P* = 0.99999) and the Immediate after the training group was compared with pretest (mean difference = 1.63544, SE = 0.23378, *P* = 0.0001), post one month after training group (mean difference = 1.41519, SE = 0.26884, *P* = 0.00002) and post one month after training group was compared with the pretest (mean difference = 0.22025, SE = 0.29676, *P* = 0.99999), immediately after training group (mean difference = −1.41519, SE = 0.26884, *P* = 0.00002) [Table 4].

The researcher tested between-subjects effects to compare knowledge score time differences across demographic variables. F = 10.583204 and *P* = 0.001240

Table 6: To compare the perception score time differences with respect to different demographical variables using testing of between subjects effects

With gender					
Descriptive statistics					Tests of between-subjects effects
	Gender	Mean	Std. Deviation	N	F, P
Pre-training	Female	42.6079	4.22537	380	6.614439, 0.010482
	Male	44.8667	1.12546	15	
	Total	42.6937	4.17204	395	
Immediately after training	Female	44.2211	4.11299	380	
	Male	47.0667	3.61478	15	
	Total	44.3291	4.12717	395	
One month post training	Female	42.8526	5.20547	380	
		44.4667	5.30319	15	
	Male	42.9139	5.21153	395	
	Total	42.6079	4.22537	380	
With educational qualification					
	Age	Mean	Std. Deviation	N	F, P
Pre-training	BSc	43.1151	3.70931	304	4.135490, 0.016698
	MSc	40.9556	5.86188	45	
	PB MSc	41.6087	4.55328	46	
	Total	42.6937	4.17204	395	
Immediately after training	BSc	44.5296	4.16798	304	
	MSc	43.4889	3.87077	45	
	PB MSc	43.8261	4.03487	46	
	Total	44.3291	4.12717	395	
One month Post-training	BSc	43.0461	5.18355	304	
	MSc	42.1333	5.60681	45	
	PB MSc	42.8043	5.04037	46	
	Total	42.9139	5.21153	395	
With college					
	College	Mean	Std. Deviation	N	F, P
Pre-training	Govt. Nursing College	42.4582	4.14881	275	28.127529, 0.00001
	Pvt. Nursing College	43.2333	4.19230	120	
	Total	42.6937	4.17204	395	
Immediately after training	Govt. Nursing College	43.4182	3.87624	275	
	Pvt. Nursing College	46.4167	3.93558	120	
	Total	44.3291	4.12717	395	
One month post-training	Govt. Nursing College	42.3564	5.16624	275	
	Pvt. Nursing College	44.1917	5.10938	120	
	Total	42.9139	5.21153	395	
With place of residence					
	Place of residence	Mean	Std. Deviation	N	F, P
Pre-training	Rural	42.5282	4.15213	195	4.156866, 0.042135
	Urban	42.8550	4.19547	200	
	Total	42.6937	4.17204	395	

Contd...

Table 6: Contd...

With place of residence					
Descriptive statistics					Tests of between-subjects effects
	Place of residence	Mean	Std. Deviation	N	F, P
Immediately after training	Rural	43.7487	4.21013	195	
	Urban	44.8950	3.97403	200	
	Total	44.3291	4.12717	395	
One month post-training	Rural	42.6256	4.99364	195	
	Urban	43.1950	5.41327	200	
	Total	42.9139	5.21153	395	

indicated a gender difference in knowledge. Males had more knowledge in all periods. F-value = 4.894847 and *P* value = 0.007949 indicated age-related differences in knowledge. Knowledge increased with age in all three time periods. With study institution, F = 58.224705 and *P* = 0.00001 implied a difference in knowledge. Private institution students have more knowledge in all periods. F = 12.373710 and *P* = 0.000486 indicated that residence-affected knowledge. All periods have more knowledge of urban than rural participants. F = 1.851566 and *P* = 0.174381 imply no differences in knowledge by family type. [Table 5].

Using between-subjects effects, the mean perception score was compared to demographic variables. F = 6.614439 and *P* = 0.010482 for gender, indicating a significant difference in Perception. Males had higher perception scores throughout different periods. F = 0.329229 and *P* = 0.719677 for age indicated no difference in perception due to age. With college, F = 28.12752 and *P* = 0.00001 indicated a difference in perception score. Private nursing institute had higher perception scores in all periods. F = 4.156866 and *P* = 0.042135 indicated a significant difference in Perception by residence. In all three periods, urban respondents had higher perception scores. With class, F = 4.135490 and *P* = 0.016698, indicating a significant difference in perception due to education level. In all three periods, BSc nursing students had higher perception scores. [Table 6].

Discussion

All nurses must understand hospital infection control. Nursing students are future nurses, so understanding this topic will help them when they start practicing. Few studies exist on nursing students in India. This study was conducted at a government and private nursing institute in Haryana. The response rate of this study was 82%. The overall mean knowledge and perception score was highest after training, followed by one month

after training, and was lowest before training. This study shows that structured training improved nursing students' knowledge and perception of hospital infection control. The current study's findings are supported by other studies,[18-21] which found a positive impact of training on disinfectant knowledge, infection control knowledge and compliance among nurses, and standard precaution knowledge and application in labor. Another Nigeria[22] study found that education improves nurses' knowledge and perception of infection control practices. The current study found significant knowledge score differences. About 31- to 40-year-old respondents, males, urban residents, and private nursing college students scored higher than younger, females, rural residents, and government nursing college students. Better scores in some categories may be due to greater subject exposure. Better teaching and training or practical exposure can increase exposure. In the current study, nursing students performed well in various infection control practices, such as biomedical waste management, contact precautions, droplet precautions, standard precautions, strategies to reduce ventilator-associated pneumonia (VAP), preventing horizontal transmission of infection, common healthcare-associated infections, and surgical attire.

Training had a moderate impact in other areas, such as hand-washing duration, surgical site infection prevention, and sodium hypochlorite surface cleaning concentration. This finding reveals infection control knowledge gaps. Our study found that the participant's knowledge and perception were highest immediately after training and declined after one month. It was still above pre-training. This finding is consistent with another KAP study[16] on the impact of education on HAI in India, which found an increase in good and excellent performance immediately after the intervention. After participants were exposed to the training modules, questionnaires were administered at 6, 12, and 24 months, and a score decline was observed. Over time, people forget what they've learned, so retraining and reawakening are needed.

Limitation and recommendation

The study only included nursing students, so the impact of Training on other HCWs cannot be evaluated.

1. Annual educational/training modules help retain knowledge in hospital infection control practices and HAI prevention. All healthcare workers need regular training.
2. Infection prevention and control training/workshops.
3. All hospitals should have a written infection control manual for HCWs.

Conclusion

Regular educational and training programs are needed to retain Knowledge of infection control practices and reinforce standard precautions and hand hygiene. These students' training will reduce HAI morbidity and mortality as future nurses. Sensitization and reinforcement will increase hospital infection control compliance. It will also change attitudes and practices, reducing HAIs. Such studies involving multiple centers and with different categories of HCWs i.e., medical, nursing and paramedical, etc., shall be planned by the researchers.

Multicenter study with a representative sample of nursing students. Private and government nursing students of all ages and seniorities participated. This study evaluated a training program's immediate and long-term impacts to determine the student's future training needs.

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Conflicts of interest

There are no conflicts of interest.

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