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EFFECTIVENESS OF A STRUCTURED TEACHING PROGRAMME ON KNOWLEDGE REGARDING INFECTION CONTROL IN THE INTENSIVE CARE UNIT AMONG B.SC. NURSING STUDENTS: A PRE-EXPERIMENTAL STUDY

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ABSTRACT

Background: Intensive care unit (ICU)-acquired infections are a leading cause of preventable morbidity, mortality and cost in Indian hospitals, and undergraduate nursing students often enter clinical postings with limited formal preparation in infection control. This study evaluated the effectiveness of a structured teaching programme (STP) in improving knowledge regarding infection control in the ICU among B.Sc. Nursing Part-II students. **Methods:** A quantitative, pre-experimental one-group pre-test/post-test design was used. Seventy B.Sc. Nursing Part-II students in a selected college of nursing in Kota, Rajasthan, were enrolled through non-probability convenience sampling. A validated 30-item structured knowledge questionnaire was administered before and seven days after a 45-minute STP delivered by the investigator. Data were analysed using descriptive statistics, paired-samples t analysis and chi-square tests, with $p < 0.05$ taken as significant. **Results:** Mean pre-test knowledge score was 12.76 ± 1.59 (range 0–21; 68.57% inadequate) and mean post-test score was 24.91 ± 1.12 (range 19–30; 92.85% adequate); the mean gain of 12.15 points on a 30-point scale represented a large improvement across every content area. Area-wise mean percentage gains were greatest for general information regarding infection control (66.43%), followed by standard precautions (46.53%) and prevention and management (27.82%). Pre-test knowledge was significantly associated with age ($\chi^2 = 18.07$, df = 3), area of residence ($\chi^2 = 13.58$, df = 1), previous knowledge about infection control ($\chi^2 = 15.82$, df = 1), source of information ($\chi^2 = 42.33$, df = 3) and clinical exposure to ICU ($\chi^2 = 6.36$, df = 1), all $p < 0.05$; gender and religion were not associated with pre-test knowledge. **Conclusion:** A brief, focused STP produced a substantial and consistent gain in ICU infection-control knowledge among B.Sc. Nursing Part-II students. Embedding short structured modules within undergraduate nursing curricula is feasible and is likely to strengthen future infection-prevention practice in resource-limited ICUs.

KEYWORDS: Infection control; intensive care unit; nursing students; structured teaching programme; knowledge; India.

INTRODUCTION

Healthcare-associated infections (HAIs) remain one of the most frequent adverse events in hospital care and are disproportionately concentrated in the intensive care unit (ICU), where invasive devices, broad-spectrum antibiotic exposure and severely ill patients converge.[1] Globally, the pooled prevalence of HAIs is approximately 7.6% in high-income countries and 15.5% in low- and middle-income countries (LMICs), and the incidence density in LMIC ICUs is several-fold that of high-income settings.[2] In India, multicentric surveillance from tertiary care hospitals has consistently reported high rates of central line-associated bloodstream infection, ventilator-associated pneumonia (VAP) and catheter-associated urinary tract infection, with substantial resistance to carbapenems among Klebsiella, Escherichia

coli, Acinetobacter and Pseudomonas isolates.[3] The clinical, economic and social costs of these infections — prolonged length of stay, avoidable mortality and out-of-pocket expenditure — fall most heavily on patients cared for at secondary and district hospitals that lack a formal infection-prevention and control (IPC) programme.

The World Health Organization (WHO) has published minimum requirements and core components for IPC at the national and facility level, emphasising a trained IPC team, evidence-based guidelines, education and training, surveillance, monitoring and audit, workload and bed occupancy, and a supportive built environment.[4] Multimodal interventions built on these components — hand hygiene, care bundles, environmental cleaning and antimicrobial stewardship — can reduce device-associated infection rates by 30–70% when consistently implemented.[5] The WHO multimodal hand hygiene improvement strategy in particular remains the single most cost-effective IPC intervention available in resource-limited ICUs.[6] Yet implementation in LMICs is undermined by scarcity of dedicated IPC staff, inconsistent availability and appropriate use of personal protective equipment, over-crowded wards, and gaps in the pre-service preparation of doctors and nurses.[2]

Because bedside nurses deliver the majority of direct patient care in the ICU, their knowledge, attitudes and practice around infection prevention are a proximate determinant of infection rates.[7] Cross-sectional surveys of healthcare workers in the Middle East, South Asia and sub-Saharan Africa have repeatedly demonstrated that only about half to two-thirds of respondents achieve "good" knowledge scores on standard precautions, with training and years of experience being the most consistent positive predictors.[8] Studies focused specifically on nursing students report even wider gaps: many undergraduates begin clinical rotations without a formal course in HAI epidemiology, standard precautions, isolation categories or antimicrobial stewardship, and their scores on validated knowledge instruments are typically well below the level considered adequate for safe ICU practice.[9] Similar deficits in knowledge, practice and hand-hygiene compliance have been documented among Indian nursing students and interns.[10]

A structured teaching programme (STP) is a systematically developed, time-limited instructional package designed to deliver a defined body of content to a specified learner group. In nursing education, brief STPs — usually 30–60 minutes, combining lecture, visual aids and printed material — have been shown to produce clinically meaningful improvements in knowledge across a range of high-priority topics, including HAI prevention.[11] Where such programmes have been evaluated using a pre-experimental one-group pre-test/post-test design, the reported effect sizes have been large, though the absence of a concurrent control and the modest sample sizes limit generalizability.[12] In the local setting of the present study — a college of nursing in Kota, Rajasthan — no formal, standalone module on ICU infection control had previously been evaluated. The investigator therefore designed and delivered a 45-minute STP and assessed its effectiveness against a validated 30-item knowledge questionnaire. The specific objectives were: (i) to assess pre-test knowledge regarding ICU infection control among B.Sc. Nursing Part-II students; (ii) to assess post-test knowledge after the STP; (iii) to determine the effectiveness of the STP in terms of mean gain in knowledge score; and (iv) to identify the association between pre-test knowledge and selected socio-demographic variables.

METHODS

Design and Setting

A quantitative, pre-experimental, one-group pre-test/post-test design was adopted. The study was conducted in a selected College of Nursing in Kota, Rajasthan, India, between the pilot and main data-collection windows of the academic year.

Participants and Sampling

The target population comprised all B.Sc. Nursing Part-II students of the selected college. Seventy students were enrolled through non-probability convenience sampling. Inclusion criteria were current enrolment in the B.Sc. Nursing Part-II programme, availability on the days of pre-test, STP and post-test, and willingness to give written informed consent. Students on approved leave during any of the three sessions were excluded.

Instrument

A self-administered structured knowledge questionnaire was developed in English based on standard IPC texts and existing knowledge tools. Section A recorded seven socio-demographic variables (age, gender, religion, area of residence, previous knowledge about infection control, source of information and prior clinical exposure to ICU). Section B contained 30 multiple-choice items distributed across three content areas — general information regarding infection control (6 items), standard precautions for infection control in the ICU (7 items) and prevention and management of ICU infections (17 items). Each correct response scored one point (maximum 30). Scores were interpreted as inadequate (1–15), moderately adequate (16–23) or adequate (24–30). Content validity was established by five subject experts and reliability was assessed by the split-half method ($r = 0.86$).

Intervention

The STP was a 45-minute investigator-led session covering the definition and epidemiology of ICU infection, common ICU-acquired infections (VAP, CLABSI, CAUTI, surgical-site infection), standard and transmission-based precautions, WHO "5 Moments" of hand hygiene, personal protective equipment, environmental cleaning and disinfection, and principles

of antimicrobial stewardship. Lecture-discussion was supported by slides, posters and a handout.

Procedure

After institutional permission and written informed consent, the pre-test questionnaire was administered under examination conditions. The STP was then delivered to the same students. Seven days after the intervention, the identical questionnaire was administered as the post-test. Anonymity was preserved through unique study codes.

Data Analysis

Data were entered in Microsoft Excel and analysed using descriptive statistics (frequency, percentage, mean, median and standard deviation) and inferential statistics. The effectiveness of the STP was tested by comparing paired pre- and post-test scores; the association between pre-test scores (dichotomised at the sample mean of 14.78) and socio-demographic variables was tested with Pearson's chi-square. A two-sided p-value < 0.05 was considered statistically significant.

Ethical Considerations

Administrative permission was obtained from the head of the institution, and each participant gave written informed consent after being informed of the voluntary nature of the study, the right to withdraw, and the confidentiality of individual responses.

RESULTS

All 70 enrolled students completed both the pre-test and the post-test (100% retention). Forty per cent were aged 20–21 years and 35.71% were aged 22–23 years; the sample was evenly split by gender (50% male, 50% female); the majority were Hindu (75.71%) and lived in urban areas (64.28%). Eighty-seven per cent had no previous formal exposure to infection-control teaching, and 60% had not yet undertaken an ICU clinical posting. Among students who reported prior exposure, articles (47.14%) and mass media (32.85%) were the most common information sources, while only 12.85% cited academic education. The full demographic profile is presented in Table 1.

Table 1: Socio-demographic profile of participants (N = 70).

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–19	2	2.87
	20–21	28	40.00
	22–23	25	35.71
	≥ 24	15	21.42
Gender	Male	35	50.00
	Female	35	50.00
Religion	Hindu	53	75.71
	Muslim	15	21.42
	Christian	2	2.85
Area of residence	Rural	25	35.71
	Urban	45	64.28
Previous knowledge of IPC in ICU	Yes	9	12.85
	No	61	87.14
Source of information	Academic education	9	12.85
	Experience	5	7.14
	Mass media	23	32.85
	Articles	33	47.14
Clinical exposure to ICU	Yes	28	40.00
	No	42	60.00

Note. IPC = infection-prevention and control; ICU = intensive care unit. Percentages may not sum to 100 due to rounding.

Mean pre-test knowledge score was 12.76 (SD 1.59; range 0–21), with 68.57% of students scoring in the inadequate band and none reaching the adequate threshold. Following the 45-minute STP, mean post-test score rose to 24.91 (SD 1.12; range 19–30), and 92.85% of participants scored in the adequate band; no student remained in the inadequate band (Figure 1). The mean gain of 12.15 points on a 30-point instrument represents an approximately 40-percentage-point absolute increase in knowledge and was consistent across the sample, as reflected by the reduced dispersion of scores after the intervention (SD 1.59 → 1.12).

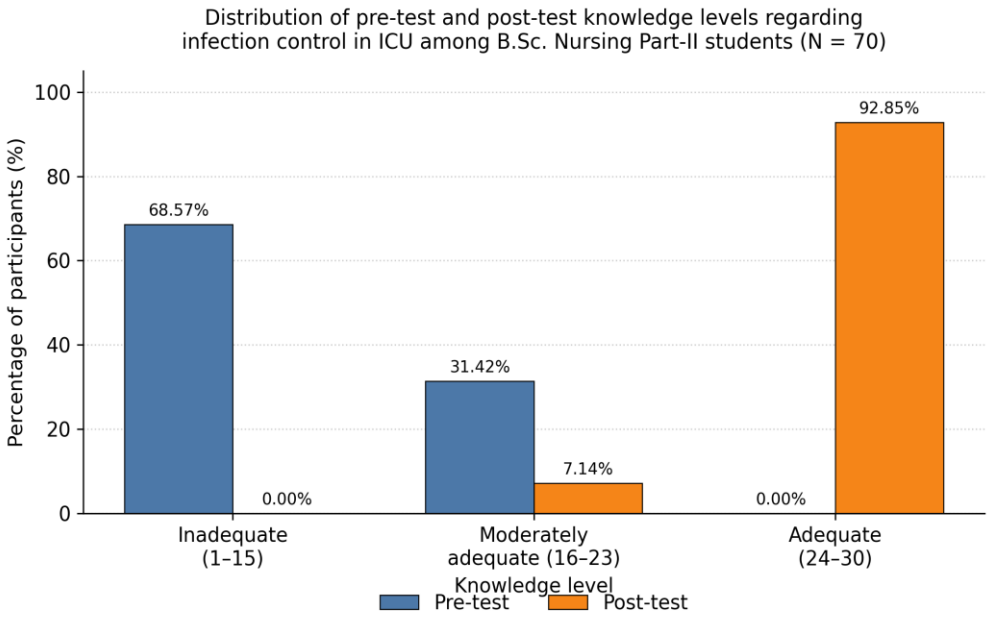

Figure 1: Distribution of pre-test and post-test knowledge levels regarding infection control in the ICU among B.Sc. Nursing Part-II students (N = 70).

The improvement was seen in every content area of the questionnaire. Area-wise mean percentage scores rose from 24.28% to 90.71% (gain 66.43%) for general information regarding infection control, from 52.44% to 98.97% (gain 46.53%) for standard precautions, and from 56.80% to 84.62% (gain 27.82%) for prevention and management of ICU infection. Pre-test knowledge was significantly associated with several socio-demographic variables (Table 2): older age, urban residence, prior exposure to infection-control information, its source, and previous clinical exposure to the ICU were all associated with higher pre-test scores (all $p < 0.05$). Gender and religion were not associated with pre-test knowledge.

Table 2: Association between pre-test knowledge scores and selected socio-demographic variables (N = 70).

Variable	χ^2	df	p < 0.05	Inference
Age (years)	18.07	3	Yes	Significant
Gender	0.09	1	No	Not significant
Religion	5.89	2	No	Not significant
Area of residence	13.58	1	Yes	Significant
Previous knowledge of IPC in ICU	15.82	1	Yes	Significant
Source of information	42.33	3	Yes	Significant
Clinical exposure to ICU	6.36	1	Yes	Significant

Note. Pearson chi-square test with pre-test knowledge dichotomised at the sample mean (14.78). IPC = infection-prevention and control; ICU = intensive care unit.

DISCUSSION

The present study provides a clear demonstration that a brief, well-designed structured teaching programme is capable of producing a large and clinically meaningful improvement in ICU infection-control knowledge among undergraduate nursing students. Baseline scores were low: 68.57% of participants scored in the inadequate band on a standard 30-item instrument, and none reached the adequate threshold. This is consistent with cross-sectional surveys among nursing students in South Asia and the Middle East, which repeatedly document baseline knowledge on standard precautions and hand hygiene well below the ≥ 80% correct-response threshold usually taken as "good".[13] A recent systematic review of IPC knowledge among healthcare workers similarly found that fewer than half of undergraduates and junior staff achieve adequate scores before targeted training.[14]

The magnitude of the post-intervention gain in the present sample — from 12.76 to 24.91 on a 30-point scale — is comparable to that reported by other pre-experimental Indian nursing studies that have evaluated STPs on infection control or ventilator-associated pneumonia among undergraduate students and staff nurses, in which mean gains of 8–14 points on similar instruments are typical.[15] Sharma and colleagues, evaluating an STP on standard precautions among nursing students, reported that the percentage of participants achieving adequate scores rose from under 10% at baseline to more than 90% after a 45- to 60-minute session, closely mirroring the shift from 0% to

92.85% observed here.[16] A recent randomised evaluation of a simulation-augmented IPC module among nursing interns also showed a large short-term improvement in knowledge scores, suggesting that the format (didactic versus simulated) matters less than the presence of a structured, focused curriculum.[17]

The area-wise pattern of gain is instructive. The largest absolute improvement was in general information regarding infection control (66.43%), where baseline scores were lowest, followed by standard precautions (46.53%) and prevention and management of ICU infection (27.82%). The narrower gain in the most complex content area — bundle-based prevention of VAP, CLABSI and CAUTI — is consistent with observations that operational, protocol-based IPC content requires reinforcement through repeated exposure and bedside practice, not a single teaching session.[18] Multimodal WHO-endorsed strategies that combine didactic teaching with reminders, audit and feedback, and administrative support have been shown to produce more durable improvements in practice than teaching alone.[19] VAP care bundles and CLABSI bundles, when implemented with staff education, have reduced device-associated infection rates by 30–70% in adult and paediatric ICUs across LMIC settings.[20][21]

Among socio-demographic variables, age, area of residence, previous exposure to infection-control information, its source and prior ICU clinical posting were all significantly associated with pre-test knowledge. The direction of these associations mirrors that reported by Abalkhail et al. and by other KAP surveys, where age, years of exposure and prior training consistently emerge as the strongest predictors of good IPC knowledge, whereas gender and religion do not.[22] The fact that only 12.85% of the present cohort cited academic education as their source of information — with articles and mass media accounting for the remainder — points to a gap in the pre-service curriculum that a brief STP appears well-suited to fill. Given that Indian nursing schools produce a large share of the future ICU workforce, embedding a compulsory, examinable IPC module of this length within B.Sc. curricula would be an inexpensive and scalable step towards strengthening the country's response to HAIs and antimicrobial resistance.[23][24]

Limitations

This study has several limitations. First, the pre-experimental one-group pre-test/post-test design has no concurrent control, so history, maturation and testing effects cannot be ruled out. Second, the short one-week interval between the STP and post-test measures short-term recall rather than durable knowledge retention or bedside behaviour change. Third, convenience sampling from a single college of nursing in Kota limits generalisability. Fourth, the outcome was self-reported knowledge on a written questionnaire; actual adherence to hand hygiene, personal protective equipment and care-bundle protocols was not observed. Future work should use a randomised or quasi-experimental design with a comparison group, longer follow-up, direct observation of clinical practice and, where feasible, linkage to unit-level HAI surveillance data.

CONCLUSION

A 45-minute structured teaching programme substantially and consistently improved knowledge regarding infection control in the ICU among B.Sc. Nursing Part-II students, moving the majority of participants from the inadequate to the adequate band on a validated 30-item instrument. Baseline knowledge was strongly related to prior exposure, source of information and clinical experience, underlining that the observed deficit is largely a curricular one and is therefore correctable. Formal, examinable IPC teaching should be integrated into the standard B.Sc. Nursing programme, and its effect on downstream clinical practice and HAI rates should be evaluated prospectively.

DECLARATIONS

Ethical approval and consent

Institutional administrative permission was obtained. All participants provided written informed consent after being informed of the voluntary nature of the study, the confidentiality of responses and the right to withdraw at any time.

Conflicts of interest

The author declares no conflicts of interest.

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Data availability

De-identified data are available from the corresponding author on reasonable request.

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