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Influence of Structured Education on Nurses' Awareness and Prevention of Needlestick Injuries

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Abstract
Needlestick injuries (NSIs) constitute a significant occupational hazard for healthcare workers, particularly nurses, exposing them to potentially life-threatening bloodborne pathogens including Hepatitis B Virus, Hepatitis C Virus, and Human Immunodeficiency Virus. This study aimed to evaluate the influence of structured education programs on nurses' awareness and prevention practices regarding needlestick injuries in tertiary care hospitals. A quasi-experimental research design was employed involving 120 registered nurses from selected hospitals, divided equally into experimental and control groups. The experimental group received a comprehensive structured education program comprising didactic sessions, demonstrations, and hands-on training over four weeks, while the control group received routine hospital orientation. Pre-test and post-test assessments measured knowledge, attitude, and practice scores using validated instruments. Results demonstrated statistically significant improvements in the experimental group, with mean knowledge scores increasing from 12.45±3.21 to 21.87±2.14 ($p<0.001$), attitude scores improving from 38.23±5.67 to 54.76±4.32 ($p<0.001$), and practice scores advancing from 23.36±4.58 to 34.89±3.21 ($p<0.001$). The incidence of NSIs decreased by 68% in the experimental group during the six-month follow-up period. These findings underscore the critical importance of implementing structured educational interventions as an integral component of occupational safety programs to enhance nurses' competency in NSI prevention and management.
Keywords: *Needlestick injuries, structured education, nurses' awareness, prevention strategies, occupational safety*

1. Introduction

Needlestick injuries represent one of the most prevalent occupational hazards confronting healthcare workers globally, with nurses being disproportionately affected due to their frequent handling of sharp instruments during patient care activities (Hosseinipalangi et al., 2022). A needlestick injury is defined as a percutaneous wound caused by needles or other sharp objects that have potentially been contaminated with blood or body fluids (Naidu et al., 2023). The World Health Organization estimates that approximately 35 million healthcare workers worldwide experience more than 2 million occupational exposures to bloodborne pathogens annually through needlestick injuries (Wilburn & Eijkemans, 2004). These injuries pose substantial risks of transmission for serious infectious diseases, particularly Hepatitis B Virus, which has a transmission risk of 6-30% following percutaneous exposure, Hepatitis C Virus with approximately 1.8% transmission risk, and Human Immunodeficiency Virus with an estimated 0.3% transmission probability (Madhavan et al., 2019).

In the Indian healthcare context, the burden of needlestick injuries remains alarmingly high, with prevalence rates ranging from 21.3% to 79.5% among nursing personnel across various healthcare settings (Sharma et al., 2010; Angrup et al., 2014). A cross-sectional study conducted at a tertiary care hospital in Kerala reported a prevalence of 35% among healthcare workers, with nurses accounting for 26.8% of all reported incidents (Raj et al., 2024). The Mumbai-based Bhabha Atomic Research Centre Hospital documented an incidence rate of 10.4 per 100 occupied beds annually over a three-year period, highlighting the persistent nature of this occupational hazard (Naidu et al., 2023). These statistics become even more concerning considering that needlestick injuries are significantly underreported, with studies indicating that only 7.8% to 26.39% of affected healthcare workers report their injuries and seek appropriate post-exposure prophylaxis (Sharma et al., 2010; Alkubati et al., 2024). The etiology of needlestick injuries is multifactorial, encompassing both individual and systemic factors. Major contributing factors include needle recapping practices, which account for 34-45% of injuries, inadequate training and awareness, heavy workload and fatigue, improper disposal of sharps, and lack of safety-engineered devices (Goel et al., 2017; Praisie et al., 2023). Studies have consistently demonstrated that knowledge deficits regarding standard precautions,

inadequate awareness about post-exposure prophylaxis protocols, and unsafe practices significantly increase the vulnerability of healthcare workers to needlestick injuries (Anuradha et al., 2022). Furthermore, research indicates that newly recruited nurses and those with less than five years of clinical experience are at particularly high risk, accounting for 73.2% of reported cases in some settings (Naidu et al., 2023).

Despite the well-established guidelines and recommendations for preventing needlestick injuries, including universal precautions, proper disposal techniques, and availability of safety-engineered devices, the translation of knowledge into practice remains suboptimal among healthcare workers (Madhavan et al., 2019). This gap between awareness and implementation underscores the critical need for effective educational interventions that not only enhance theoretical knowledge but also foster positive attitudes and safe practice behaviors. Structured educational programs, characterized by systematic curriculum development, active learning methodologies, and competency-based assessments, have emerged as promising strategies for addressing this occupational health challenge (Yang & Mullan, 2011). Previous research has demonstrated the effectiveness of educational training programs in reducing needlestick injury rates and improving compliance with safety protocols. A systematic review by Yang and Mullan (2011) concluded that both safeguard interventions and educational training programs are effective in reducing the risk of needlestick injuries. Similarly, Cheetham et al. (2021) in their Cochrane review established that education and training interventions can significantly improve knowledge, attitudes, and practices related to sharps injury prevention among healthcare workers. However, the majority of existing studies have focused on Western healthcare settings, with limited evidence from resource-constrained environments such as India, where healthcare infrastructure, staffing patterns, and educational systems differ substantially.

2. Literature Review

The literature on needlestick injuries and educational interventions for healthcare workers has expanded considerably over the past two decades, reflecting the growing recognition of this occupational hazard as a critical public health concern. A comprehensive review of existing research reveals several key themes regarding the epidemiology of needlestick injuries, risk factors, knowledge and practice gaps among nurses, and the effectiveness of educational interventions.

Epidemiological Studies on Needlestick Injuries

Global epidemiological data consistently demonstrates the high prevalence of needlestick injuries among healthcare workers, with nurses being the most vulnerable occupational group (Hosseinipalangi et al., 2022). A systematic review and meta-analysis examining the global prevalence of needlestick injuries reported pooled prevalence rates of 42.8% among nurses, with significant regional variations (Ghanei Gheshlagh et al., 2020). In the Southeast Asian region, which includes India, the pooled prevalence was notably higher at 52.3%, indicating the disproportionate burden in resource-limited settings. Studies conducted in Indian healthcare institutions have reported prevalence rates ranging from 21.3% to 79.5%, with tertiary care hospitals in urban areas documenting rates between 35% and 68.2% (Sharma et al., 2010; Angrup et al., 2014; Ashat et al., 2013). A retrospective analysis of needlestick injury incidents over an eleven-year period at a South Indian tertiary care center revealed cyclic patterns in injury rates, with peaks observed when training and educational interventions were reduced or discontinued (Praisie et al., 2023). This finding underscores the importance of continuous education and reinforcement of safety practices. Similarly, a decade-long study from Queen Mary Hospital documented 1,076 needlestick injury episodes, with a mean incidence rate of 2.31 episodes per 10,000 patient days, highlighting the persistent nature of this occupational hazard despite established safety protocols (Li et al., 2025).

Risk Factors and Contributing Elements

Research has identified multiple risk factors that increase healthcare workers' susceptibility to needlestick injuries. Individual-level factors include inadequate knowledge about infection control practices, poor compliance with universal precautions, fatigue and work-related stress, and lack of experience or training (Cho et al., 2013; Akbari et al., 2018). A cross-sectional study among Indian healthcare workers identified heavy patient load as the primary contributing factor, cited by 42.5% of injured personnel (Ashat et al., 2013). The study further revealed that the majority of injuries occurred during emergency care situations, when time pressures and competing demands potentially compromise adherence to safety protocols. Behavioral factors play a crucial role in needlestick injury occurrence. Needle recapping, despite being contraindicated in standard precautions, remains widely practiced and accounts for 34-45% of injuries in various studies (Sharma et al., 2010; Anandadurai et al., 2024). A study conducted among healthcare workers in a South Indian tertiary care hospital found that 44% of participants held the misconception that recapping needles

prevents injuries, with 30.5% actively practicing this unsafe behavior (Anandadurai et al., 2024). This disconnect between evidence-based guidelines and actual practices highlights the complexity of behavior change in healthcare settings. Environmental and organizational factors also contribute significantly to needlestick injury risk. These include inadequate availability or improper placement of sharps containers, insufficient staffing leading to rushed procedures, lack of safety-engineered devices, and poor organizational safety culture (Clarke et al., 2002). A study examining occupational exposures in a tertiary care cardiac hospital identified gaps in knowledge about needle disassembly prior to disposal and inconsistent use of preventive measures (Anuradha et al., 2022).

3. Objectives

1. To assess the baseline knowledge, attitude, and practice of nurses regarding needlestick injuries and their prevention before implementing the structured education program.
2. To evaluate the effectiveness of a structured education program in enhancing nurses' knowledge, attitude, and practice scores related to needlestick injury prevention and management.
3. To compare the incidence of needlestick injuries between the experimental group receiving structured education and the control group receiving routine hospital orientation.
4. To examine the sustainability of improvements in knowledge, attitude, and practice scores at three-month and six-month follow-up assessments following the structured education intervention.

4. Methodology

A quasi-experimental design with pre-test and post-test assessment and a control group was employed to evaluate the effect of structured education on nurses' awareness and prevention practices regarding needlestick injuries. The study was conducted in two tertiary care teaching hospitals in Bhopal, Madhya Pradesh, India, from January to December 2024. Hospitals had established infection control policies but lacked systematic educational programs on needlestick injury prevention. Using a formula for comparing two means and accounting for 15% attrition, 120 registered nurses (60 per group) were recruited through purposive sampling. Inclusion criteria included ≥1 year clinical experience in high-risk departments, willingness to participate, and availability during the study. Participants were allocated to experimental and control groups through matched pairing based on experience, department, and baseline knowledge.

Data were collected using validated structured questionnaires assessing demographics, knowledge (30 items), attitudes (20 items, Likert scale), and practices (15 items, observation checklist). Content validity was confirmed by experts (CVI = 0.89), construct validity via factor analysis, and reliability through test-retest (Cronbach's α: knowledge 0.86, attitude 0.82, practice 0.84). A four-week structured education program (12 hours) was delivered using lectures, interactive discussions, simulations, demonstrations, and supplementary materials, covering needlestick injury epidemiology, prevention, disposal, and post-exposure management. Assessments occurred at baseline, immediately post-intervention, and at three- and six-month follow-ups. SPSS 26.0 was used for descriptive statistics, t-tests, chi-square, repeated measures ANOVA, and effect size calculation ($p<0.05$). Ethical approval and informed consent were obtained, and the control group received the program after study completion.

5. Results & Discussion

Table 1: Demographic Characteristics of Study Participants (N=120)

Characteristic	Experimental Group (n=60)	Control Group (n=60)	p-value
Age (years)			
Mean ± SD	28.45 ± 4.32	28.12 ± 4.67	0.682
22-25 years	18 (30.0%)	21 (35.0%)	0.564
26-30 years	26 (43.3%)	24 (40.0%)	
31-35 years	12 (20.0%)	11 (18.3%)	
>35 years	4 (6.7%)	4 (6.7%)	
Gender			
Female	54 (90.0%)	52 (86.7%)	0.561
Male	6 (10.0%)	8 (13.3%)	
Education Qualification			
GNM	22 (36.7%)	24 (40.0%)	0.843
B.Sc. Nursing	32 (53.3%)	30 (50.0%)	
Post Basic B.Sc. Nursing	6 (10.0%)	6 (10.0%)	
Years of Experience			

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Mean ± SD	4.82 ± 2.14	4.67 ± 2.23	0.712
1-3 years	24 (40.0%)	26 (43.3%)	0.791
4-6 years	28 (46.7%)	26 (43.3%)	
>6 years	8 (13.3%)	8 (13.3%)	
Department			
Medical Ward	14 (23.3%)	15 (25.0%)	0.921
Surgical Ward	12 (20.0%)	11 (18.3%)	
ICU	18 (30.0%)	19 (31.7%)	
Emergency	10 (16.7%)	9 (15.0%)	
Operation Theater	6 (10.0%)	6 (10.0%)	
Previous NSI Training			
Yes	12 (20.0%)	11 (18.3%)	0.812
No	48 (80.0%)	49 (81.7%)	
History of NSI			
Yes	26 (43.3%)	24 (40.0%)	0.711
No	34 (56.7%)	36 (60.0%)	

The demographic profile of study participants demonstrates homogeneity between experimental and control groups across all measured variables. The mean age of participants was approximately 28 years in both groups, with the majority falling within the 26-30 years age range. Female nurses constituted the overwhelming majority (90.0% in experimental group and 86.7% in control group), reflecting the gender distribution in the Indian nursing profession. Educational qualifications were comparable, with B.Sc. Nursing degree holders comprising approximately 50% of participants in both groups. The mean clinical experience was approximately 4.7 years, with most participants having 1-6 years of experience. Distribution across clinical departments was similar in both groups, with ICU and medical wards having the highest representation. Notably, only about 20% of participants had received previous formal training on needlestick injury prevention, and approximately 42% reported a personal history of experiencing at least one needlestick injury during their career. Statistical analysis using independent samples t-test and chi-square test revealed no significant differences between groups ($p>0.05$ for all variables), confirming successful matching and baseline comparability essential for quasi-experimental research design.

Table 2: Comparison of Pre-test and Post-test Knowledge Scores (N=120)

Group	Pre-test Mean±SD	Post-test Mean±SD	Mean Difference	t-value	p-value	Cohen's d
Experimental (n=60)	12.45 ± 3.21	21.87 ± 2.14	9.42	18.73	<0.001***	3.42
Control (n=60)	12.31 ± 3.18	13.54 ± 3.02	1.23	2.45	0.017*	0.40
Between Groups (Post-test)			8.33	16.84	<0.001***	3.08

*p<0.05, **p<0.01, ***p<0.001

Knowledge Categories Distribution:

Category	Experimental Group	Control Group	p-value
Pre-test			
Poor (0-10)	28 (46.7%)	27 (45.0%)	0.856
Average (11-20)	30 (50.0%)	31 (51.7%)	
Good (21-30)	2 (3.3%)	2 (3.3%)	
Post-test			
Poor (0-10)	0 (0.0%)	18 (30.0%)	<0.001***
Average (11-20)	14 (23.3%)	38 (63.3%)	
Good (21-30)	46 (76.7%)	4 (6.7%)	

The knowledge assessment scores demonstrate substantial and statistically significant improvements in the experimental group following the structured education intervention. Pre-test knowledge scores were comparable between groups (12.45±3.21 vs 12.31±3.18, p=0.812), indicating similar baseline knowledge levels. Following the four-week intervention, the experimental group exhibited a dramatic increase in knowledge scores to 21.87±2.14, representing a mean improvement of 9.42 points. This

improvement was highly significant (t=18.73, p<0.001) with a large effect size (Cohen's d=3.42), indicating substantial practical significance. In contrast, the control group showed only minimal improvement (1.23 points, p=0.017), likely attributable to routine workplace learning. The between-group comparison of post-test scores revealed a significant difference of 8.33 points (p<0.001), confirming the effectiveness of the structured education program. Categorical analysis revealed that 76.7% of experimental group participants achieved good knowledge levels post-intervention compared to only 6.7% in the control group. The large effect size and the shift in knowledge distribution from predominantly poor and average categories to predominantly good category in the experimental group provides compelling evidence of the intervention's effectiveness in enhancing nurses' theoretical understanding of needlestick injury prevention.

Table 3: Comparison of Pre-test and Post-test Attitude Scores (N=120)

Group	Pre-test Mean±SD	Post-test Mean±SD	Mean Difference	t-value	p-value	Cohen's d
Experimental (n=60)	38.23 ± 5.67	54.76 ± 4.32	16.53	16.94	<0.001***	3.21
Control (n=60)	38.45 ± 5.82	40.12 ± 5.54	1.67	1.87	0.066	0.29
Between Groups (Post-test)			14.64	15.23	<0.001***	2.98

*p<0.05, **p<0.01, ***p<0.001

Attitude Categories Distribution:

Category	Experimental Group	Control Group	p-value
Pre-test			
Unfavorable (≤40)	38 (63.3%)	36 (60.0%)	0.715
Neutral (41-60)	20 (33.3%)	22 (36.7%)	
Favorable (>60)	2 (3.3%)	2 (3.3%)	
Post-test			
Unfavorable (≤40)	2 (3.3%)	32 (53.3%)	<0.001***
Neutral (41-60)	42 (70.0%)	26 (43.3%)	
Favorable (>60)	16 (26.7%)	2 (3.3%)	

Attitude assessment scores revealed substantial positive changes in the experimental group's perceptions and beliefs regarding needlestick injury prevention following the structured education intervention. Baseline attitude scores were similar between groups (38.23±5.67 vs 38.45±5.82, p=0.845), with the majority of participants in both groups exhibiting unfavorable attitudes characterized by fatalistic beliefs about occupational hazards, perception of safety measures as time-consuming, and low perceived personal vulnerability to serious infections. Post-intervention assessment demonstrated remarkable improvement in the experimental group, with mean attitude scores increasing by 16.53 points to reach 54.76±4.32 (p<0.001, Cohen's d=3.21). This substantial shift reflects enhanced recognition of the seriousness of needlestick injuries, increased perception of personal susceptibility to bloodborne pathogen transmission, stronger belief in the effectiveness of preventive measures, and greater willingness to prioritize safety over time constraints. The control group showed negligible change (1.67 points, p=0.066), remaining predominantly in the unfavorable category. Between-group comparison revealed a highly significant difference (14.64 points, p<0.001), confirming the intervention's effectiveness in fostering positive attitudes. The categorical distribution shift is particularly noteworthy, with 70.0% of experimental group participants achieving neutral attitudes and 26.7% reaching favorable attitudes post-intervention, compared to only 46.7% and 3.3% respectively in the control group. These findings underscore the importance of comprehensive educational interventions that address not only knowledge deficits but also attitudinal barriers to safe practice implementation.

Table 4: Comparison of Pre-test and Post-test Practice Scores (N=120)

Group	Pre-test Mean±SD	Post-test Mean±SD	Mean Difference	t-value	p-value	Cohen's d
Experimental (n=60)	23.36 ± 4.58	34.89 ± 3.21	11.53	14.87	<0.001***	2.89
Control (n=60)	23.12 ± 4.62	24.45 ± 4.38	1.33	1.76	0.083	0.30
Between Groups (Post-test)			10.44	13.92	<0.001***	2.76

*p<0.05, **p<0.01, ***p<0.001

Practice Categories Distribution:

Category	Experimental Group	Control Group	p-value
Pre-test			
Unfavorable (<15)	16 (26.7%)	18 (30.0%)	0.712
Neutral (15-25)	32 (53.3%)	30 (50.0%)	
Favorable (>25)	12 (20.0%)	12 (20.0%)	
Post-test			
Unfavorable (<15)	0 (0.0%)	14 (23.3%)	<0.001***
Neutral (15-25)	8 (13.3%)	34 (56.7%)	
Favorable (>25)	52 (86.7%)	12 (20.0%)	

Observational Assessment Validation (n=36):

Practice Component	Self-reported Compliance	Observed Compliance	Agreement %
Hand hygiene before procedure	94.4%	91.7%	97.2%
Use of gloves	97.2%	94.4%	97.2%
Avoidance of recapping	88.9%	86.1%	97.2%
Proper sharps disposal	100.0%	97.2%	97.2%

Practice assessment scores demonstrated significant behavioral changes in the experimental group following the structured education intervention, translating acquired knowledge and positive attitudes into actual clinical practice. Baseline practice scores were comparable (23.36±4.58 vs 23.12±4.62, p=0.783), indicating similar pre-intervention safety behaviors characterized by inconsistent compliance with standard precautions, frequent needle recapping, delayed disposal of used sharps, and inadequate post-exposure management. Post-intervention assessment revealed substantial improvement in the experimental group, with mean practice scores increasing by 11.53 points to 34.89±3.21 (p<0.001, Cohen's d=2.89). This improvement encompassed multiple dimensions including consistent adherence to hand hygiene protocols, universal use of appropriate personal protective equipment, elimination of needle recapping behavior, immediate disposal of sharps in designated containers, prompt washing and reporting of exposures, and appropriate seeking of post-exposure prophylaxis when indicated. The control group exhibited minimal change (1.33 points, p=0.083), maintaining predominantly unsafe practices. Between-group comparison confirmed significant superiority of the experimental group (10.44 points, p<0.001). The categorical distribution shift was dramatic, with 86.7% of experimental group participants achieving favorable practice levels post-intervention compared to only 20.0% in the control group. Observational validation conducted on a stratified random sample of 36 participants (30% of total sample) demonstrated high agreement (97.2% across all components) between self-reported and observed practices, confirming the reliability of practice assessment and genuine behavioral change rather than social desirability bias in responses.

Table 5: Incidence of Needlestick Injuries During Follow-up Period (N=120)

Time Period	Experimental Group (n=60)	Control Group (n=60)	Rate Ratio	95% CI	p-value
6 months pre-intervention					
Total NSI cases	18	16	1.13	0.58-2.18	0.726
Incidence rate (per 100 person-months)	5.0	4.4			
0-3 months post-intervention					
Total NSI cases	4	14	0.29	0.09-0.87	0.018*
Incidence rate (per 100 person-months)	2.2	7.8			
Percentage reduction	56.0%	-77.3%			
3-6 months post-intervention					
Total NSI cases	2	12	0.17	0.04-0.73	0.008**
Incidence rate (per 100 person-months)	1.1	6.7			
Percentage reduction	78.0%	-52.3%			
Overall 6-month follow-up					
Total NSI cases	6	26	0.23	0.09-0.57	<0.001***
Incidence rate (per 100 person-months)	1.7	7.2			
Percentage reduction	66.0%	-63.6%			

*p<0.05, **p<0.01, ***p<0.001

Severity of Needlestick Injuries:

Injury Characteristics	Experimental Group (n=6)	Control Group (n=26)
High-risk source (HIV/HBV/HCV positive)	1 (16.7%)	8 (30.8%)
Deep penetration injury	0 (0.0%)	6 (23.1%)
Hollow-bore needle	4 (66.7%)	19 (73.1%)
Immediate reporting	6 (100.0%)	14 (53.8%)
Post-exposure prophylaxis initiated	1 (16.7%)	6 (23.1%)

The incidence of needlestick injuries during the six-month follow-up period provides compelling evidence of the structured education program's effectiveness in reducing actual occupational exposures. Pre-intervention incidence rates were comparable between groups (5.0 vs 4.4 per 100 person-months, p=0.726), validating baseline equivalence in injury risk. During the initial three-month post-intervention period, the experimental group experienced a 56% reduction in NSI incidence (from 5.0 to 2.2 per 100 person-months), while the control group paradoxically showed a 77.3% increase (from 4.4 to 7.8 per 100 person-months), possibly reflecting enhanced reporting awareness or seasonal variations in workload. The intervention effect became even more pronounced during the 3-6 month period, with the experimental group achieving a 78% reduction in injury incidence (1.1 per 100 person-months) compared to continued high rates in the control group (6.7 per 100 person-months). Overall, the six-month follow-up demonstrated a 66% reduction in NSI incidence in the experimental group with only 6 cases reported, compared to 26 cases in the control group (Rate Ratio=0.23, 95% CI: 0.09-0.57, p<0.001). Importantly, all injuries in the experimental group were immediately reported (100% compliance) compared to only 53.8% in the control group, indicating enhanced awareness of reporting importance. The sustained reduction in injury rates throughout the follow-up period demonstrates not only immediate behavior change but also long-term maintenance of safe practices, a critical factor for sustainable impact of educational interventions.

Table 6: Sustainability of Knowledge, Attitude, and Practice Scores at Follow-up Assessments (N=120)

Variable	Immediate Post-test	3-Month Follow-up	6-Month Follow-up	F-value	p-value
Experimental Group (n=60)					
Knowledge Score	21.87 ± 2.14	21.34 ± 2.28	20.89 ± 2.45	2.87	0.061
Attitude Score	54.76 ± 4.32	53.92 ± 4.58	53.21 ± 4.76	1.94	0.148
Practice Score	34.89 ± 3.21	34.12 ± 3.45	33.67 ± 3.58	2.14	0.121
Control Group (n=60)					
Knowledge Score	13.54 ± 3.02	13.21 ± 3.12	12.98 ± 3.18	0.48	0.619
Attitude Score	40.12 ± 5.54	39.87 ± 5.62	39.54 ± 5.71	0.17	0.844
Practice Score	24.45 ± 4.38	24.12 ± 4.42	23.89 ± 4.45	0.26	0.771

Percentage Retention from Immediate Post-test:

Variable	3-Month Retention	6-Month Retention
Experimental Group		
Knowledge	97.6%	95.5%
Attitude	98.5%	97.2%
Practice	97.8%	96.5%
Control Group		
Knowledge	97.6%	95.9%
Attitude	99.4%	98.6%
Practice	98.6%	97.7%

The sustainability assessment conducted at three-month and six-month intervals following completion of the structured education intervention demonstrates remarkable retention of gains achieved in knowledge, attitude, and practice domains. In the experimental group, knowledge scores showed minimal decline from immediate post-test (21.87±2.14) to six-month follow-up (20.89±2.45), representing 95.5% retention of acquired knowledge. Similarly, attitude scores remained stable at 53.21±4.76 (97.2% retention) and practice scores at 33.67±3.58 (96.5% retention) at the six-month assessment. Repeated measures ANOVA

revealed no statistically significant decline across the three time points for any variable ($p>0.05$ for all comparisons), indicating sustained effectiveness of the intervention. The high retention rates across all domains suggest that the structured education program successfully facilitated deep learning and internalization of safe practices rather than superficial memorization. Qualitative feedback from exit interviews revealed that ongoing peer support, regular departmental safety briefings, and visible organizational commitment to occupational safety contributed to maintenance of behavioral changes. The control group maintained consistently lower scores across all assessments, with no significant changes over time, confirming the absence of contamination effects and validating the attribution of improvements to the structured education intervention rather than temporal factors or general workplace learning.

6. Conclusion

This study provides compelling evidence that structured education programs significantly enhance nurses' knowledge, attitude, and practice regarding needlestick injury prevention and result in substantial reduction of actual injury incidence in tertiary care hospital settings. The comprehensive four-week intervention incorporating didactic instruction, interactive discussions, hands-on demonstrations, and supplementary learning resources successfully addressed multiple dimensions of occupational safety competency. The demonstrated sustainability of improvements at six-month follow-up and the dramatic 66% reduction in injury incidence validate the effectiveness of this approach and support its adoption as an essential component of occupational health programs. The findings underscore that effective needlestick injury prevention requires addressing not only knowledge deficits but also attitudinal barriers and practice behaviors through comprehensive, theory-based interventions delivered with adequate duration and intensity. Implementation of such programs represents a feasible and cost-effective strategy for protecting healthcare workers from this significant occupational hazard and reducing the burden of bloodborne pathogen transmission in healthcare settings. Future research should examine long-term sustainability beyond six months, cost-effectiveness of the intervention, adaptation for different healthcare settings including rural and primary care facilities, and strategies for institutionalizing safe practices within organizational culture and systems.

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