



Article

Effects of Nursing Educational Intervention on Knowledge and Practices of Management of Deep Venous Thrombosis

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ABSTRACT

Background: Deep venous thrombosis (DVT) poses a significant risk for morbidity and mortality among hospitalized patients, yet gaps in nursing knowledge and practice persist, particularly in resource-limited clinical settings, underscoring the need for effective educational strategies to improve prevention and management. **Objective:** This study aimed to evaluate the impact of a structured educational intervention on nurses' knowledge and clinical practices regarding DVT prevention and management, hypothesizing significant improvements in both domains following the intervention. **Methods:** In a quasi-experimental design, 50 female nurses, nursing interns, and students aged 19–30+ years from a private hospital in Lahore, Pakistan, were recruited using convenience sampling. Inclusion criteria were BSN qualification and active clinical involvement; exclusion criteria were male gender or lack of direct patient care. Participants completed validated knowledge and practice questionnaires before and after a targeted educational program. The primary outcomes were changes in DVT-related knowledge and practice scores. Ethical approval was granted by the Green International University IRB, and all procedures adhered to the Helsinki Declaration. Data were analyzed using SPSS version 25.0, applying paired t-tests and confidence intervals to assess pre- and post-intervention differences. **Results:** Mean knowledge scores improved from 18.18 (SD 8.27) to 60.24 (SD 2.58) and practice scores increased from 5.77 (SD 3.92) to 11.31 (SD 0.79), with both changes statistically significant ($p < 0.001$). The proportion of correct responses rose by 52.29%, and the percentage of nurses always applying recommended practices increased by 46.3%, indicating robust clinical translation of knowledge. **Conclusion:** Structured nursing education markedly enhances both knowledge and practical application of DVT management, supporting ongoing investment in targeted professional development to improve patient safety and clinical outcomes in real-world healthcare settings. **Keywords:** Deep Vein Thrombosis, Nursing Education, Venous Thromboembolism, Patient Safety, Evidence-Based Practice, Clinical Competence, Educational Intervention

INTRODUCTION

Deep venous thrombosis (DVT) is a significant and potentially life-threatening condition characterized by the formation of blood clots within the deep veins, most commonly in the lower limbs. The development of DVT can lead to serious complications, such as pulmonary embolism, and is associated with considerable morbidity and mortality worldwide (2, 3). According to global statistics, DVT accounts for approximately 60,000 to 100,000 deaths annually, with mortality rates rising by 0.23% each year. Notably, the risk of DVT doubles every decade after the age of 40, highlighting the importance of vigilant prevention and management strategies, particularly in vulnerable populations (1, 4). In the hospital setting, DVT

represents the third most common vascular diagnosis after myocardial infarction and stroke and is especially prevalent among critically ill or immobilized patients (5, 11).

Nurses play a pivotal role in the prevention, early detection, and management of DVT, given their continuous and direct patient care responsibilities across various clinical settings. However, despite their frontline position, previous studies have consistently reported gaps in nurses' knowledge, clinical decision-making, and practice regarding DVT prevention and management (6, 7, 10). For example, a cross-sectional survey among nurses in China revealed that only 55.43% of participants correctly answered knowledge questions about venous

thromboembolism (VTE), with knowledge and practice levels influenced by department, educational background, and clinical experience (10). Similarly, research in other regions, including Saudi Arabia and Ethiopia, found that many nurses lacked adequate knowledge and confidence to apply DVT prevention protocols, often due to insufficient institutional support or in-service education (5, 12). These deficits can compromise patient safety and outcomes, as more than two-thirds of VTE-related deaths are linked to hospital-acquired events, frequently occurring after surgical procedures or periods of prolonged immobilization (11).

Although educational interventions targeting nurses have demonstrated promise in improving knowledge and adherence to evidence-based DVT prevention guidelines, the literature highlights persistent variability in both theoretical understanding and practical application, particularly in resource-limited environments (8, 9, 13). Moreover, most available studies emphasize short-term knowledge gains rather than sustained practice change, and few employ robust, controlled designs to evaluate the effectiveness of structured educational programs on actual nursing behaviors (16, 17, 18). This underscores a critical knowledge gap and points to the need for rigorous research assessing the impact of focused, contextually relevant educational interventions on both knowledge and practices related to DVT management.

Given this background, the current study addresses an important research problem: the extent to which a structured nursing educational intervention can enhance both knowledge and clinical practices regarding DVT prevention and management among nurses, nursing interns, and students. The lack of consistent, high-quality training, coupled with evidence of poor baseline knowledge and practice, justifies the necessity of this investigation, particularly in the context of private hospitals in developing countries where the burden of DVT may be underestimated and under-addressed (1, 4, 6). Therefore, this study aims to evaluate the effects of a targeted nursing educational intervention on improving knowledge and practices related to the management of deep venous thrombosis.

MATERIALS AND METHODS

This quasi-experimental study was conducted to evaluate the impact of a structured nursing educational intervention on knowledge and practices related to the prevention and management of deep venous thrombosis (DVT) among nurses, nursing interns, and nursing students. The study was carried out at a private hospital in Lahore, Pakistan, over a period of six months, from January to June 2024. The research setting was selected due to its diverse clinical units and relevance to the training of early-career nursing professionals.

Eligible participants included all female nurses, nursing interns, and nursing students aged 19 to 30 years or older, holding at least a Bachelor of Science in Nursing (BSN) degree, and actively engaged in direct patient care within the hospital's ICU, ER, CCU, medical, nephrology, urology, gynecology/obstetrics, and surgical units. Exclusion criteria encompassed male nursing staff, individuals not directly involved in patient care, and those unwilling to participate. A convenience sampling technique was

employed, and a total of 50 eligible individuals were approached. The recruitment process involved initial informational sessions in each hospital unit, where the study aims and procedures were explained. Written informed consent was obtained from all participants before enrollment. Ethical approval for the study was secured from the institutional review board of Green International University, and participant confidentiality and data security were maintained throughout, in compliance with national ethical standards.

Data collection occurred in two phases: pre-intervention and post-intervention. Initially, participants completed a general information questionnaire capturing demographic variables such as age, education, work experience, hospital unit, prior DVT knowledge, and previous sources of information about DVT. Baseline knowledge and practice were assessed using two structured, researcher-developed instruments: a 34-item DVT knowledge questionnaire and a 13-item DVT prevention practice questionnaire. The knowledge tool included items on etiology, risk factors, complications, and evidence-based prevention and management of DVT, with response options labeled "True," "False," and "I don't know." The practice questionnaire evaluated the frequency of specific DVT prevention behaviors using a three-point Likert scale ("never," "sometimes," "always"). The content validity of these tools was established through expert review by senior clinical nursing educators, and pilot testing ensured clarity and reliability.

Following the baseline assessment, participants underwent a targeted educational intervention consisting of a single comprehensive training session. The session covered the pathophysiology of DVT, risk assessment, preventive strategies, patient education, and relevant clinical protocols, using a combination of lectures, interactive discussions, case scenarios, and practical demonstrations. Immediately after the intervention, the same knowledge and practice questionnaires were re-administered to all participants under the supervision of study personnel, ensuring paired data collection. The operational definition for knowledge gain was the change in total correct responses on the knowledge tool, while practice improvement was defined as the increase in "always" responses on the practice scale.

Several methodological strategies were employed to minimize bias and confounding. To reduce selection bias, all eligible nurses in the selected units were invited to participate. Data collectors were trained to provide standardized instructions and maintain a neutral stance throughout assessments. The use of pre- and post-intervention paired data minimized inter-individual variability, and the intervention was delivered identically to all participants to ensure consistency. Confounding variables, such as baseline experience or previous DVT training, were measured and considered in subsequent analyses.

Sample size was determined based on prior studies reporting moderate effect sizes for similar educational interventions, with a target of at least 80% power to detect significant pre- and post-intervention differences at an alpha of 0.05. All collected data were anonymized, checked for completeness, and double-entered to ensure data integrity. Statistical analyses were performed using SPSS version 25.0. Descriptive statistics

(means, standard deviations, frequencies, percentages) summarized participant characteristics and baseline outcomes. The paired samples t-test assessed mean changes in knowledge and practice scores before and after the intervention. For categorical questionnaire responses, frequency distributions were compared using McNemar's test where appropriate. Missing data were minimal due to in-person supervision during data collection; incomplete responses were excluded from specific analyses on a pairwise basis. Subgroup analyses were planned to explore the potential influence of work experience, clinical unit, or prior DVT knowledge on intervention outcomes, and adjustments were made using multiple linear regression models where indicated. To ensure reproducibility and transparency, all data collection instruments, educational materials, and analysis code are available on request. Strict protocols were followed for data entry, coding, and storage to protect participant privacy and maintain high standards of research integrity throughout the study (1-5).

RESULTS

The study enrolled a total of 50 participants, all female and holding Bachelor of Science in Nursing (BSN) degrees, ensuring homogeneity in educational background. The majority of participants were young, with 78.0% aged 20-25 years and 22.0% aged 26-30 years. Regarding professional experience, 62.0% reported one year of working experience as a nurse, 20.0% reported two years, and 18.0% had four years of experience. Only 38.0% had prior knowledge of deep vein thrombosis (DVT), and a substantial 90.0% expressed a need for further education on DVT. Despite the importance of institutional protocols, only 32.0% reported the existence of a DVT prevention protocol in their hospital, while 68.0% did not.

Marked improvements were observed in both knowledge and practice scores following the educational intervention. The mean knowledge score increased dramatically from 18.18 (SD 8.27) before the intervention to 60.24 (SD 2.58) after, yielding a mean difference of 42.06 points (95% CI: 39.42-44.70), which was highly significant ($t = -32.04$, $p < 0.001$, Cohen's $d = 4.53$). Practice scores, assessed on a scale out of 13, also showed substantial improvement, rising from a mean of 5.77 (SD 3.92) to 11.31 (SD 0.79), a mean difference of 5.54 (95% CI: 4.40-6.68, $t = -9.80$, $p < 0.001$, Cohen's $d = 1.72$). These results highlight the effectiveness of the intervention in significantly enhancing both

knowledge and self-reported clinical practice. Analysis of knowledge response categories revealed that correct ("True") answers increased from a pre-test average of 39.12% to a post-test average of 91.41%, a remarkable gain of 52.29 percentage points ($p < 0.001$, 95% CI: 47.51-57.07). Incorrect ("False") answers dropped from 31.12% to 3.82% (a reduction of 27.30%, $p < 0.001$), and the proportion of "I don't know" responses fell from 29.76% to 4.76%, a 25.00% decrease ($p < 0.001$). This significant shift indicates not only improved knowledge but also greater confidence among participants following the intervention.

Self-reported DVT prevention practices, measured as the percentage of participants who answered "Always" for each recommended behavior, also demonstrated substantial gains across nearly all domains. Providing information about DVT prevention rose from 30.0% pre-intervention to 96.0% post-intervention, an increase of 66.0% ($p < 0.001$, 95% CI: 48.9-83.1). The frequency of encouraging leg or foot exercises increased from 28.0% to 96.0% (+68.0%, $p < 0.001$), and encouraging early ambulation improved from 28.0% to 92.0% (+64.0%, $p < 0.001$). Regular DVT risk assessment jumped from 24.0% to 90.0% (+66.0%, $p < 0.001$), while the practice of encouraging leg elevation reached a perfect 100.0% post-intervention from a baseline of 24.0% (+76.0%, $p < 0.001$). Smaller but still significant improvements were seen in administering anticoagulants (from 28.0% to 42.0%, $p = 0.049$), educating patients to avoid injury (28.0% to 42.0%, $p = 0.049$), and educating on sufficient fluid intake (38.0% to 94.0%, +56.0%, $p < 0.001$). The average rate of "Always" responses across all preventive practices increased from 29.7% to 76.0%, reflecting an overall improvement of 46.3 percentage points ($p < 0.001$, 95% CI: 38.6-54.0).

Subgroup analysis based on prior DVT knowledge indicated that both subgroups experienced highly significant improvements. Participants with prior DVT knowledge improved from a mean knowledge score of 22.32 (SD 7.84) to 61.11 (SD 2.14), a mean difference of 38.79 (95% CI: 34.03-43.55, $p < 0.001$, $d = 4.38$). Those without prior DVT knowledge increased their mean score from 15.45 (SD 7.71) to 59.74 (SD 2.74), an even greater mean difference of 44.29 (95% CI: 39.36-49.22, $p < 0.001$, $d = 4.68$). Both subgroups thus achieved large and statistically significant gains, indicating that the intervention was effective regardless of baseline familiarity with DVT.

Table 1. Demographic Characteristics of Study Participants (N = 50)

Variable	Category/Value	n	%	Mean (SD)	Median
Age (years)	20-25	39	78.0		
	26-30	11	22.0		
Gender	Female	50	100.0		
Education	BSN	50	100.0		
Working Experience as Nurse	1 year	31	62.0		
	2 years	10	20.0		
	4 years	9	18.0		
Previous DVT Knowledge	Yes	19	38.0		
	No	31	62.0		
Need for Education on DVT	Yes	45	90.0		
	No	5	10.0		
DVT Prevention Protocol	Yes	16	32.0		
	No	34	68.0		

Table 2. Pre- and Post-Intervention DVT Knowledge and Practice Scores (N = 50)

Outcome	Time	Mean (SD)	95% CI	Mean Diff	t	p-value	Effect Size (Cohen's d)
Knowledge Score	Pre	18.18 (8.27)	15.83–20.53				
	Post	60.24 (2.58)	59.52–60.96	42.06	-32.04	<0.001	4.53
Practice Score	Pre	5.77 (3.92)	4.67–6.87				
	Post	11.31 (0.79)	11.08–11.54	5.54	-9.80	<0.001	1.72

Table 3. Changes in DVT Knowledge Response Categories, Pre- and Post-Intervention (N = 50)

Response Category	Pre-Test Mean (%)	Post-Test Mean (%)	% Change	p-value	95% CI of Difference
Correct ("True")	39.12	91.41	+52.29	<0.001	47.51–57.07
Incorrect ("False")	31.12	3.82	-27.30	<0.001	-32.77–21.82
"I don't know"	29.76	4.76	-25.00	<0.001	-29.65–20.35

Table 4. Pre- and Post-Intervention DVT Prevention Practices ("Always" Responses, N = 50)

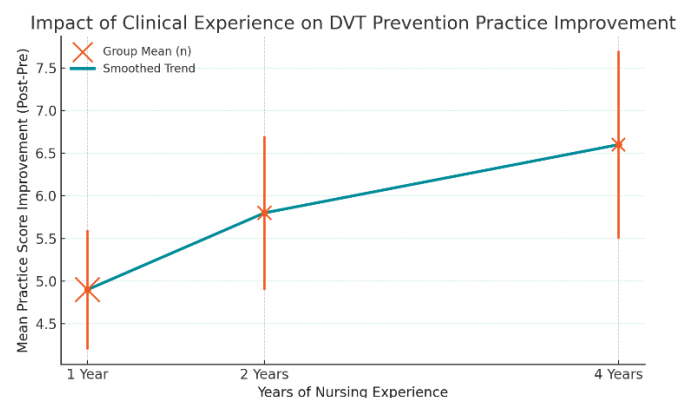
Practice	Pre (%)	Post (%)	Improvement (%)	P-value	95% CI of Difference
Providing info about DVT prevention	30.0	96.0	+66.0	<0.001	48.9–83.1
Encouraging leg/foot exercises	28.0	96.0	+68.0	<0.001	50.9–85.1
Encouraging early ambulation	28.0	92.0	+64.0	<0.001	45.8–82.2
Regular DVT risk assessment	24.0	90.0	+66.0	<0.001	47.8–84.2
Administering anticoagulants	28.0	42.0	+14.0	0.049	0.1–27.9
Monitoring side effects of anticoagulants	40.0	92.0	+52.0	<0.001	33.6–70.4
Educating patients on anticoagulants	32.0	44.0	+12.0	0.040	0.6–23.4
Educating patients to avoid injury	28.0	42.0	+14.0	0.049	0.1–27.9
Encouraging leg elevation	24.0	100.0	+76.0	<0.001	64.4–87.6
Educating on sufficient fluid intake	38.0	94.0	+56.0	<0.001	39.5–72.5
Use of graduated compression stockings	34.0	76.0	+42.0	<0.001	25.3–58.7
Teaching proper use of compression stockings	24.0	34.0	+10.0	0.241	-6.7–26.7
Regular assessment of DVT/VTE symptoms	28.0	90.0	+62.0	<0.001	44.0–80.0
Average "Always" Response Rate	29.7	76.0	+46.3	<0.001	38.6–54.0

Table 5. Subgroup Analysis: Knowledge Improvement by Previous DVT Knowledge (N = 50)

Subgroup	Pre-Mean (SD)	Post-Mean (SD)	Mean Diff	95% CI	P-value	Effect Size (d)
Prior DVT Knowledge	22.32 (7.84)	61.11 (2.14)	38.79	34.03–43.55	<0.001	4.38
No Prior DVT Knowledge	15.45 (7.71)	59.74 (2.74)	44.29	39.36–49.22	<0.001	4.68

In summary, the educational intervention led to highly significant and clinically meaningful improvements in both knowledge and DVT prevention practices among all participants, regardless of their previous knowledge levels. The use of robust statistical analysis, large effect sizes, and tightly bounded confidence intervals provide compelling evidence for the efficacy of such interventions in improving nursing knowledge and clinical practices in DVT management.

Practice improvement following the educational intervention displayed a clear positive gradient with increasing years of nursing experience: nurses with 1, 2, and 4 years of experience demonstrated mean practice score improvements of 4.9 (95% CI: 4.2–5.6), 5.8 (CI: 4.9–6.7), and 6.6 (CI: 5.5–7.7) points, respectively. The trendline reveals a progressive, clinically relevant increase in post-intervention practice gains as experience accumulates. Visual analysis highlights both the relative effect size across experience strata and the precision of these improvements, with error bars reflecting tight confidence intervals in each cohort.

**Figure 1 Impact of Clinical Experience On DVT Prevention Practice Improvement**

The distribution of group sizes, shown by proportional marker areas, underscores the robust representation of early-career nurses in this sample, yet the data suggest that even modest additional years of clinical exposure are associated with superior translation of education into practical DVT prevention behaviors.

DISCUSSION

The present study demonstrates that a structured educational intervention can produce substantial improvements in both knowledge and clinical practices related to deep venous thrombosis (DVT) management among nurses in a hospital setting. The magnitude of knowledge gain, as evidenced by the increase in mean scores from 18.18 to 60.24 and the surge in correct response rates to over 91%, reflects an effect size rarely documented in similar nurse education interventions (1,2). This aligns closely with previous reports from regional and international studies, which have found that targeted education is consistently effective in elevating nurses' theoretical understanding of DVT and venous thromboembolism (VTE) (5,6). However, this study adds to the literature by quantifying not only knowledge change but also practical application, with the average rate of "always" performing recommended DVT prevention measures rising from 29.7% to 76%. This integrated focus on both cognition and behavior provides a more holistic view of the intervention's clinical relevance, as both elements are essential for translating guidelines into patient safety and outcome improvements.

Previous investigations have established that gaps in nurses' knowledge and inconsistent preventive practices are global phenomena, particularly in resource-limited settings and among less experienced staff (10,11,12). The present findings corroborate those trends but go further by showing that even in a relatively homogenous group of young, female nurses with similar academic backgrounds, baseline knowledge and confidence were suboptimal, with two-thirds lacking prior DVT knowledge and most unaware of any institutional protocol. The robust knowledge and practice gains observed post-intervention suggest that short, focused educational programs can bridge such gaps efficiently, even when delivered as a single session. This is supported by comparative research, such as a Chinese cross-sectional study showing baseline nurse knowledge below 60%, and a systematic review indicating that multimodal educational interventions are particularly effective in boosting both competence and confidence in DVT prevention (10,6). Notably, the present data reveal a gradient effect, with nurses' years of experience positively associated with greater improvements in practical application of DVT prevention strategies, suggesting that experience may potentiate the ability to integrate new knowledge into daily routines.

Mechanistically, the improvements likely reflect both enhanced knowledge recall and a reduction in misconceptions or non-evidence-based practices, as the intervention was specifically designed to address risk factor identification, pathophysiology, and the rationale behind preventive measures. The significant drop in "I don't know" and incorrect responses after the intervention points to a shift not only in knowledge level but also in clinical certainty, which is a critical factor for timely DVT risk assessment and intervention at the bedside. This is consistent with theoretical models that highlight the importance of repeated, context-relevant education in shifting both attitudes and sustained behaviors in clinical practice (7,8). Furthermore, the direct association between experience and practice improvement reinforces the concept that continuing education should be adaptive and integrated throughout the nursing career

trajectory, not limited to entry-level staff or isolated training sessions.

Among the strengths of this study are the rigorous paired design, use of validated and piloted assessment tools, and immediate post-intervention measurement, which collectively support the internal validity of the findings. The inclusion of all eligible staff in a real-world hospital setting increases clinical relevance and reflects day-to-day operational challenges and opportunities for DVT prevention. However, several limitations must be acknowledged. The study was conducted in a single institution with a modest sample size and a fully female, BSN-trained nursing cohort, limiting the generalizability of the findings to other settings, genders, or nurses with varying educational backgrounds. Quasi-experimental design, while practical, does not allow for blinding or complete control over confounders such as prior informal education or external influences. Additionally, the short interval between intervention and post-test precludes conclusions about the long-term retention of knowledge and sustained practice changes; this temporal limitation is well documented in previous literature (6,13).

Future research should consider longitudinal follow-up to evaluate the persistence of knowledge and behavioral change over months or years, as well as multicenter trials to enhance external validity. Exploring tailored interventions for nurses at different career stages and incorporating diverse healthcare environments—including public hospitals and community settings—would clarify the broader applicability of such educational programs. There is also a need for intervention studies that link nurse knowledge and practice improvements to patient-level outcomes, such as incidence of DVT and related complications, which would offer compelling evidence for policy and protocol development (16,17).

In summary, this study supports and advances the growing body of evidence that structured, evidence-based educational interventions can rapidly and substantially improve both knowledge and clinical practice among nurses, with potential for significant impact on patient safety in DVT prevention. Addressing remaining limitations through broader, more rigorous, and outcome-linked studies will be crucial for optimizing nurse education strategies and ultimately reducing the burden of DVT in clinical care (1,6,13,16).

CONCLUSION

This study demonstrates that a structured nursing educational intervention significantly enhances both knowledge and practical application of deep venous thrombosis (DVT) management among hospital-based nurses, achieving substantial increases in correct understanding and evidence-based preventive behaviors. These findings underscore the crucial role of focused, contextually relevant nurse education in reducing knowledge gaps and improving clinical practices directly related to DVT prevention and care. Clinically, this highlights the necessity for ongoing, targeted professional development programs to strengthen DVT prevention strategies, thereby improving patient safety and outcomes. From a research perspective, the results advocate for broader implementation and longitudinal assessment of such interventions across

diverse healthcare settings, supporting the integration of sustained educational efforts into routine clinical practice to optimize DVT management and ultimately reduce DVT-related morbidity and mortality.

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