

Effectiveness Of Structured Educational Intervention In Improving ICU Nurses' Attitudes And Clinical Practices For Deep Venous Thrombosis Prevention

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Abstract

Background: Deep venous thrombosis (DVT) is a potentially fatal but largely preventable complication that disproportionately affects intensive care unit (ICU) patients. Although ICU nurses are the primary implementers of DVT prophylaxis, significant deficits in attitudes and clinical practice persist, undermining the safety of patients. Structured educational interventions represent a promising strategy to address these gaps. **Aim:** To evaluate the efficacy of a structured educational program in enhancing ICU nurses' attitudes and clinical practices related to DVT prevention, and to examine the relationship between these domains and nurses' demographic characteristics. **Methods:** A quasi-experimental pre-test/post-test design was employed with 140 ICU nurses equally divided into an intervention group (n = 70) and a control group (n = 70) across three teaching hospitals in Al-Najaf, Iraq. A three-session educational program was delivered to the intervention group. Attitudes and clinical practices were measured using validated instruments, both before and after the intervention. **Results:** The intervention group demonstrated significant improvements in both attitude scores (2.06 ± 0.23 vs. 2.16 ± 0.23 ; $t = 4.304$, $p < 0.001$) and clinical performance (0.79 ± 0.26 vs. 1.46 ± 0.16 ; $t = 54.032$, $p < 0.001$), with 75.71% achieving good performance post-intervention compared to 4.29% at baseline. No meaningful changes were observed in the control group. Post-test Pearson's correlation revealed a weak, non-significant association between attitudes and clinical performance ($r = -0.089$, $p = 0.463$). **Conclusion:** The structured educational program significantly improved ICU nurses' attitudes and clinical performance in DVT prevention. The non-significant attitude–practice correlation likely reflects a ceiling effect and persistent organizational barriers, emphasizing that knowledge and attitude gains alone are insufficient without complementary institutional support and system-level strategies to improve practice.

Keywords: DVT Prevention; ICU Nurses; Educational Intervention; Attitudes; Clinical Practice.

1. Introduction

Deep venous thrombosis (DVT) is a serious thrombotic condition characterized by the formation of blood clots within the deep venous system, most commonly in the lower extremities. It represents a major, yet predominantly preventable, source of morbidity and mortality worldwide, with an estimated annual incidence of 48 per 100,000 people (Alharazi et al., 2024). If left untreated or inadequately managed, DVT can precipitate life-threatening complications, most notably pulmonary embolism (PE) and post-thrombotic syndrome (PTS), which together impose a substantial clinical and economic burden on healthcare systems globally (Lutsey & Zakai, 2023).

Intensive care unit (ICU) patients represent an especially vulnerable population for DVT development. The convergence of multiple risk factors in the ICU setting, including enforced immobilization, prolonged mechanical ventilation, central venous catheterization, systemic infections, renal replacement therapy, respiratory failure, and underlying hypercoagulable states, creates an environment highly conducive to venous stasis and thrombus formation (Vrettou et al., 2024). Critically ill patients who develop pulmonary embolism combined with lower-extremity DVT (PE-LDVT) face a markedly elevated 90-day mortality risk, compared with those without thromboembolic events (Eck et al., 2021). These data underscore the clinical imperative for rigorous and consistent DVT prophylaxis in critical care settings.

ICU nurses play a central and irreplaceable role in the implementation of DVT prevention strategies. As professionals who maintain continuous bedside presence and implement both mechanical and pharmacological prophylactic measures, nurses' knowledge, attitudes, and clinical practices directly determine the effectiveness and consistency of thromboprophylaxis (Li et al., 2025). Deficiencies in nursing competency in this domain have been directly linked to elevated patient risk, as suboptimal implementation of mechanical VTE prevention

measures exposes critically ill patients to unnecessary harm (Xiaoxiao et al., 2023).

Despite the recognized importance of DVT prevention, substantial gaps in nursing knowledge and practice persist in diverse healthcare settings. In Ethiopian specialized hospitals, nurses demonstrated satisfactory knowledge and practice, respectively (Yohannes et al., 2022). In a tertiary care ICU, nurses exhibited poor knowledge and 46.4% exhibited poor clinical practices regarding DVT prevention (Parveen et al., 2023). Even in more resource-rich environments, as illustrated by a large-scale survey of 568 nurses across Zhejiang Province, China, attained adequate knowledge, expressed positive attitudes, and engaged in proactive prevention practices, significant competency gaps remained across all assessed domains (Hu et al., 2025). These findings collectively highlight that DVT prevention is not merely a matter of the availability of guidelines or technologies but is fundamentally contingent on the preparedness and competence of the nursing workforce.

Structured educational programs have been identified as promising and evidence-based strategies to address persistent knowledge-practice gaps in DVT prevention. A systematic review confirmed that continuing nursing education substantially enhances nurses' knowledge and clinical skills, with technology-enhanced educational modalities further amplifying motivation and engagement (Stavropoulou et al., 2025). Moreover, the implementation of evidence-based standardized nursing protocols has been shown to markedly reduce DVT incidence in conventional care to 2.38% following protocol-based intervention, alongside reductions in complications and improvements in patient quality of life (Chen et al., 2025). Despite this evidence, DVT prevention guidelines remain underutilized in many ICUs, with nurses frequently lacking formal orientation to institutional protocols (Mokadem and El-Sayed, 2019).

The theoretical basis of the present study is grounded in the Knowledge-Attitude-Practice (KAP) model, a widely applied framework in health education and behavioral intervention research. The KAP model proposes that accurate knowledge fosters correct attitudes, which in turn promotes positive behavioral changes, thereby reducing disease incidence and promoting health (Kang et al., 2024). However, the relationship between attitudes and practice is not necessarily linear or automatic; intermediate factors such as organizational context, resource availability, workload, and self-efficacy mediate the translation of knowledge and attitudes into behavior (Ajzen 2020). Understanding this mediation is essential for designing effective educational interventions in high-acuity clinical settings such as the ICU.

Despite the growing body of descriptive evidence, quasi-experimental studies rigorously evaluating the effects of structured educational interventions on both attitudinal and behavioral outcomes among ICU nurses remain scarce. The present study addresses this gap by implementing a three-session educational program and evaluating its effects on ICU nurses' attitudes and clinical practices related to DVT prevention using a pre-test/post-test quasi-experimental design with a control group. The findings are expected to contribute directly to reducing DVT-related complications in ICU patients and inform the development of standardized educational protocols within critical care nursing practice.

2. Materials and Methods

2.1 Research Design

A quasi-experimental pre-test/post-test design with a parallel control group was employed to evaluate the impact of a structured educational program on ICU nurses' attitudes and clinical practices regarding DVT prevention. This design was selected to allow the evaluation of causal effects in a real clinical environment where full randomization was not logistically feasible. This study conforms to the CONSORT reporting guidelines for quasi-experimental research.

2.2 Setting and Participants

The study was conducted in the intensive care units of three major teaching hospitals in Al-Najaf Governorate, Iraq: Al-Najaf Ashraf Teaching Hospital, Al-Furat Al-Awsat Teaching Hospital, and Al-Sadr Medical City. Eligible participants were registered ICU nurses with a minimum of one year of direct patient care experience in a critical care setting. The exclusion criteria were nurses currently in training or orientation, nurses with less than one year of ICU experience, and those unwilling to provide informed consent. Hospital-based allocation was used to assign facilities to the intervention and control conditions, thereby minimizing the risk of contamination between groups.

2.3 Sample Size and Sampling

The sample size was determined using the standard formula for two independent proportions: $n = [2 \times (Z_{1-\alpha/2} + Z_{1-\beta})^2] / d^2$, with $Z_{1-\alpha/2} = 1.96$ ($\alpha = 0.05$, two-tailed), $Z_{1-\beta} = 0.84$ (power = 80%), and an effect size (d) of 0.5. This calculation yielded a minimum of 64 participants per group (total = 128 subjects). Anticipating an attrition rate of approximately 10%, the target sample was increased to 70 participants per group, for a total of 140 participants. Non-probability purposive sampling was initially used to identify eligible nurses, followed by the allocation of participants to intervention and control groups based on hospital assignment.

2.4 Educational Intervention

The educational program was specifically designed to enhance ICU nurses' knowledge, attitudes, and clinical practices regarding DVT prevention. The program comprised three structured sessions, each lasting 90 min, and delivered on consecutive weekly days to the intervention group. Session 1 provided an orientation to the program, administered the pre-test assessment, and introduced the pathophysiology and epidemiology of DVT in critically ill patients. Session 2 focused on DVT risk stratification, clinical risk assessment tools, and evidence-based pharmacological prophylaxis, incorporating case-based vignettes from the ICU context. Session 3 was dedicated to mechanical and non-pharmacological preventive strategies, including compression devices, early mobilization, hydration, and patient and family education, with hands-on demonstrations and skills practice. The teaching methods included interactive lectures, group discussions, case-based learning scenarios, and simulation exercises. Educational materials, including a self-learning illustrated booklet and a clinical reference card, were developed and distributed to the participants. The control group received no educational intervention during the study period and continued with routine care as usual.

2.5 Data Collection Instruments

Nurses' Attitudes Toward DVT Prevention Scale: Attitudes were assessed using a 10-item scale adapted from Lv et al. (2025), with minor ICU-specific wording modifications to enhance contextual relevance of the items. Each item was rated on a three-point Likert scale (2 = agree, 1 = Somewhat Agree, 0 = disagree). Scores ranged from 0 to 2, with a mean > 1.5 classified as positive. The instrument demonstrated excellent content validity (I-CVI = 1.00 for all items; S-CVI/Ave = 1.00) and high internal consistency (Cronbach's $\alpha = 0.97$).

Clinical Practice Performance Checklist: Clinical practices were evaluated using a 13-item observational checklist adapted from Alharazi et al. (2024). Each item was rated on a three-point scale (2 = always, 1 = sometimes, 0 = never). Scores were classified as poor (mean score ≤ 0.66), moderate (mean score 0.67–1.33), or good (mean score ≥ 1.34). The checklist demonstrated excellent content validity (I-CVI = 1.00; S-CVI/Ave = 1.00) and satisfactory reliability (Cronbach's $\alpha = 0.88$). Both instruments were reviewed and validated by a panel of 13 critical care nursing experts, each with a minimum of seven years of ICU experience.

2.6 Statistical Analysis

All data were entered and analyzed using IBM SPSS Statistics, Version 26. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were computed for all variables. Chi-square tests were used to assess baseline comparability of demographic characteristics between groups. Within-group pre- and post-test comparisons were performed using paired-samples t-tests, and between-group comparisons were conducted using independent-samples t-tests. Pearson's r was computed to examine the post-test correlation between attitude and clinical practice scores. Statistical significance was set at $P \leq 0.05$.

2.7 Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of the Faculty of Nursing, University of Kufa, supplemented by official permission from the Al-Najaf Health Directorate and the Nursing Management of each participating hospital. Participation was entirely voluntary. Written informed consent was obtained from all participants following a thorough explanation of the study objectives, procedures, anticipated risks, and their unconditional right to withdraw at any time without penalty. Confidentiality and anonymity were strictly maintained throughout the study. No personal identifiers were collected, all data were stored securely, and access was restricted to the research team members. This study was conducted in accordance with the Declaration of Helsinki.

3. Results

3.1 Demographic and Baseline Characteristics

A total of 140 ICU nurses completed the study, with 70 allocated to the intervention group and 70 to the control group. As presented in Table 1, no statistically significant differences were observed between the two groups across any demographic variable (all $p > 0.05$), confirming baseline equivalence. The mean ages were 26.9 ± 3.2 years and 26.6 ± 3.0 years for the intervention and control groups, respectively, with the majority of participants aged 26–30 years in both the groups. Females constituted the majority in both groups (58.57% vs. 54.29%, respectively). The educational backgrounds were similar, with nursing diploma holders predominating (60.00% vs. 55.71%), followed by bachelor's degree holders (37.14% vs. 38.57%). Most nurses had five or fewer years of general nursing experience (72.86% in both groups), with comparable mean unit-level experience (3.2 ± 2.2 vs. 2.5 ± 1.5 years, respectively). Work shifts were relatively balanced; morning shifts accounted for 51.43% and 42.86%, and night shifts comprised 48.57% and 57.14% in the intervention and control groups, respectively. The majority of nurses were responsible for two patients per shift (61.43% vs. 57.14%).

Regarding prior DVT education, 67.14% of the intervention group and 58.57% of the control group reported previous exposure, primarily through formal academic study and in-service training. Despite this, the majority of nurses rated their preparation for clinical application as only partially adequate (68.57% vs. 80.00%), and an overwhelming proportion expressed a strong desire for further education (92.86% vs. 95.71% of the respondents). Notably, only a minority of nurses reported the existence of a DVT prevention protocol in their respective hospitals (11.43% vs. 15.71%), while a substantial proportion were unaware of any such protocols (58.57% vs. 54.29%), reflecting a critical institutional gap in DVT prevention infrastructure.

Table 1. Socio-Demographic Characteristics of the Intervention (n = 70) and Control (n = 70) Groups.

Characteristic	Category	Study Group		Control Group		χ² (df)	p-value
		F.	%	F.	%		
Age (Years)	≤ 25	26	37.14	27	38.57	0.283 (2)	0.868 NS
	26–30	35	50.00	36	51.43		
	≥ 31	9	12.86	7	10.00		
Mean ± SD	26.9 ± 3.2			26.6 ± 3.0			
Gender	Male	29	41.43	32	45.71	0.261 (1)	0.609 NS
	Female	41	58.57	38	54.29		
Education	Diploma	42	60.00	39	55.71	1.924 (2)	0.382 NS
	Bachelor	26	37.14	27	38.57		
	Master/PhD	2	2.86	4	5.71		
Experience (Years)	≤ 5	51	72.86	51	72.86	0.451 (2)	0.798 NS
	> 5	19	27.14	19	27.14		
Prior DVT Education	Yes	47	67.14	41	58.57	1.065 (1)	0.302 NS
	No	23	32.86	29	41.43		
DVT Protocol Available	Yes	8	11.43	11	15.71	3.112 (2)	0.211 NS
	No	21	30.00	21	30.00		
	Unknown	41	58.57	38	54.29		

F. = Frequency; Int. = Intervention group; Con. = Control group; χ^2 = Chi-square statistic; df = degrees of freedom; NS = Not Significant ($p > 0.05$).

Table 2. Paired t-test results for attitude scores in pre- and post-tests.

Outcome	Group	Period	M	SD	t	p-value
Attitudes Toward DVT Prevention	Intervention	Pre-test	2.06	0.23	4.304	< 0.001 **
		Post-test	2.16	0.23		
	Control	Pre-test	2.08	0.15	0.283	0.778 NS
		Post-test	2.08	0.20		

*M = Mean; SD = Standard deviation; ** $p < 0.01$; NS = Not Significant ($p > 0.05$); $df = 69$ for all comparisons.*

3.2 Nurses' Clinical Practice Regarding DVT Prevention

At baseline, both groups demonstrated suboptimal levels of DVT prevention practice. Deficiencies were particularly evident in patient and family education, DVT risk assessment, anticoagulant monitoring, and the promotion of early ambulation—all areas of critical importance in ICU care. Table 4 summarizes the overall distribution of clinical practice performance levels in the pre- and post-tests for both groups.

Following the intervention, the intervention group achieved marked improvements across all practice domains. The proportion of nurses classified as having good performance rose dramatically from 4.29% to 75.71%, whereas the proportion with poor performance decreased from 35.71% to 0%. The overall mean performance score improved significantly from 0.79 ± 0.26 (moderate level) to 1.46 ± 0.16 (good level). In contrast, the control group showed no meaningful improvement; the proportion of participants with poor performance actually increased slightly from 20.00% to 31.43%, good performance decreased from 2.86% to 1.43%, and the mean score showed a marginal decline from 0.81 ± 0.22 to 0.75 ± 0.22 , remaining in the moderate range throughout.

Table 3. Clinical Practice Scores Between Groups in Pre-test and Post-test.

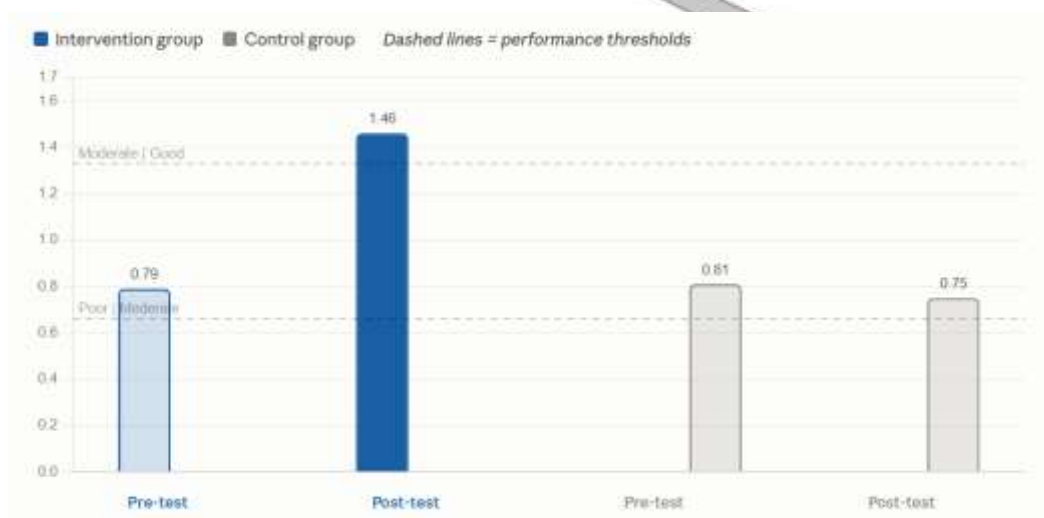
Outcome	Group	Period	M	SD	t	p-value
Clinical Practice – DVT Prevention	Intervention	Pre-test	0.79	0.26	54.032	< 0.001 **
		Post-test	1.46	0.16		
	Control	Pre-test	0.81	0.22	0.866	0.557 NS
		Post-test	0.75	0.22		
	Pre-test	Intervention	0.79	0.26	0.622	0.535 NS
		Control	0.81	0.22		
	Post-test	Intervention	1.46	0.16	21.381	< 0.001 **
		Control	0.75	0.22		

*M = Mean; SD = Standard deviation; ** $p < 0.01$; NS = Not Significant ($p > 0.05$);*

3.3 Relationship Between Attitudes and Clinical Practice

Post-test Pearson's correlation analysis revealed a weak, negative, and statistically non-significant association between nurses' attitude scores and clinical practice performance in the intervention group ($r = -0.089$, $p = 0.463$, $n = 70$). This finding indicates that, despite significant improvements in both domains following the educational program, post-test attitude scores did not correlate significantly with clinical practice performance. The implications of this finding are discussed in detail in Section 4.

Figure1. Overall Pre-test and Post-test Assessment of Clinical Practice Regarding DVT Prevention.



Poor = mean score 0.00–0.66; Moderate = 0.67–1.33; Good = ≥ 1.34 . F. = Frequency; M = Mean; SD = Standard deviation.

4. Discussion

The present study demonstrated a clinically meaningful and statistically significant improvement in ICU nurses' DVT prevention practices following the structured educational intervention. The proportion of nurses achieving good clinical performance rose from 4.29% at baseline to 75.71% post-intervention, representing an 18-fold increase, while poor performance was completely eliminated. Gains were observed across a broad range of practice domains, with particularly notable improvements in patient and family education and encouragement of leg exercises and early ambulation. Guidance on adequate fluid intake also improved substantially. These findings are consistent with those reported by Huang et al. (2025), who documented a reduction in DVT incidence from 26.70% with conventional care to 8.90% following predictive nursing interventions ($p < 0.05$). Similarly, Zhang et al. (2024) observed significant improvements in nurses' knowledge and practice compliance following educational interventions, with composite scores. These convergent findings reinforce the view that targeted, structured education is highly effective in translating theoretical knowledge into clinical behavioral changes.

Despite the overall positive trajectory, progress in complex clinical practice domains remains incomplete. DVT risk assessment improved of nurses performing it consistently, and anticoagulant monitoring, indicating that these advanced judgment-intensive practices are less responsive to short-term educational programs than simpler procedural behaviors. This pattern is consistent with the findings of Al-Mugheed and Bayraktar (2023), who identified persisting implementation gaps despite improved awareness, and with those of Almarshad et al. (2024), who emphasized that effective VTE prevention requires not only adequate knowledge and favorable attitudes but also active engagement in systematic risk stratification, consistent protocol application, and integration of evidence-based guidelines into daily clinical workflows. Complex clinical practices are mediated by systemic factors, including staffing ratios, multidisciplinary coordination, availability of assessment tools, and institutional culture, which a three-session educational program cannot adequately address in isolation. This underscores the necessity of complementary organizational and structural interventions.

The absence of meaningful change in the control group—with clinical practice remaining predominantly at the moderate level and poor performance slightly increasing—provides strong evidence that clinical experience alone, in the absence of structured educational input, is insufficient to generate or sustain improvements in DVT prevention practices. This finding aligns with Ahmed et al. (2020), who documented consistently unsatisfactory DVT prevention practices in settings that lacked organized training programs. The contrast between the marked gains in the intervention group and the stagnation in the control group reinforces the necessity of proactive, theory-grounded educational strategies as components of institutional DVT prevention programs. Furthermore, Al-Mugheed and Bayraktar (2018) observed that even nurses with established DVT knowledge may not translate that knowledge into consistent practice, suggesting that periodic reinforcement and structured skills training are essential for sustaining behavioral gains.

Nurses in both groups exhibited predominantly positive baseline attitudes toward DVT prevention (98.57% and 100% positive, respectively), consistent with Hu et al. 's (2025) report from a large-scale survey of 568 nurses in Zhejiang Province, where 82.5% expressed positive DVT management attitudes. The high baseline positivity likely partly reflects prior DVT education reported by the majority of participants, even if this had not consistently translated into optimal practice. Following the intervention, attitude scores in the intervention group improved significantly, with the between-group post-test difference confirming the specificity of this effect. These findings align with Mokadem and El-Sayed (2019), who reported significant attitude improvements among critical care nurses following structured educational intervention.

However, item-level analysis revealed persistent negative attitudes regarding organizational support and interdepartmental coordination, resource availability, and the absence of clear institutional DVT protocols. These findings resonate with evidence from a multicenter study of 575 ICU nurses across 16 tertiary hospitals, in which perceived behavioral control—defined as nurses' confidence in their capacity to implement preventive measures—ranked lowest among all behavioral intention dimensions, indicating that favorable professional attitudes can coexist with significant environmental and organizational constraints (Nie & Jiang, 2025). These structural barriers are particularly salient in ICU settings, where high clinical acuity, substantial workload, and staffing pressures systematically limit nurses' capacity to translate positive professional beliefs into consistent daily action.

The post-test Pearson's correlation between attitude and clinical practice scores was weak, negative, and non-significant, a finding that may initially appear paradoxical, given the significant improvements observed in both domains. However, this result is well documented in the DVT and VTE nursing literature and warrants careful theoretical interpretation. Yan et al. (2021) reported that despite nurses displaying positive attitudes toward VTE prevention, actual practice levels remained significantly lower, attributing this disparity to heavy workload, financial disincentives, extended hospital stays, and organizational inefficiency. In a multicenter study, positive attitude response rate was accompanied by only 56.19% correct practice, illustrating a systematic attitude–behavior gap.

This discrepancy is theoretically explained by Ajzen's Theory of Planned Behavior (2020), which posits those behavioral intentions and therefore actions—are not exclusively determined by attitudes. Rather, behavior is jointly governed by attitudes, subjective norms, and perceived behavioral control. In clinical environments, perceived behavioral control is frequently compromised by structural factors—limited equipment, inadequate staffing, and insufficient protocols—that obstruct the enactment of positively held professional values. In a realist review of e-learning interventions for VTE prevention, Dyke et al. (2023) similarly concluded that educational programs frequently fail to influence practice when contextual obstacles such as limited managerial support, time constraints, and resource deficiencies are not concurrently addressed.

A purely statistical explanation also merits consideration: the ceiling effect observed in post-test attitude scores, where 100% of intervention group nurses were classified as positive and reduced variance, would substantially attenuate Pearson's r , as the correlation coefficient requires variability in both variables to detect linear associations. This limitation is well recognized in quasi-experimental educational research and does not indicate a true absence of a relationship. Clinically, the concurrent substantial improvement in practice scores alongside highly favorable attitudes reflected overall program efficacy, even in the absence of a statistically significant attitude–practice correlation. Silva et al. (2020) reported analogous findings—a mismatch between nurses' positive self-assessed VTE knowledge, self-efficacy, and actual preventive performance—further supporting the proposition that attitudinal enhancement and behavioral change operate as partially independent educational outcomes.

Collectively, these findings emphasize that competency-based nursing curricula must address attitude and clinical practice as distinct, albeit interrelated, domains, rather than treating attitude improvement as an automatic precursor to behavioral change. Institutional support mechanisms, including standardized DVT protocols, interdisciplinary coordination, adequate nurse-to-patient ratios, and ongoing clinical supervision, are indispensable complements to educational interventions for achieving sustained improvements in DVT prevention practices.

Limitations

Several limitations should be acknowledged when interpreting the findings of this study. First, the quasi-

experimental design, while appropriate for the clinical context, precludes full randomization at the individual level, introducing potential selection bias, despite confirmed baseline equivalence between groups. Second, the study was conducted exclusively in three teaching hospitals within a single Iraqi governorate, limiting the generalizability of the findings to ICU nurses in other regional, cultural, or resource contexts. Third, clinical practice was assessed using an observational checklist developed by the research team. Although standardized and validated, performance may have been influenced by the Hawthorne effect, whereby nurses alter their behavior when they are aware of being observed. Fourth, follow-up assessment was conducted only one-month post-intervention; the durability of the observed improvements in attitudes and practice beyond this period remains unknown. Fifth, the attitude scale demonstrated a ceiling effect in the post-test assessment, which may have attenuated the correlation between attitudes and clinical performance. Finally, potentially important mediating variables, including self-efficacy, peer support, workload, and managerial engagement, were not formally measured and may account for some of the unexplained variance in practice outcomes.

Future Scope

Based on the findings of the current study, several directions for future research are recommended. Longitudinal quasi-experimental or randomized controlled trials with follow-up assessments at three, six-, and twelve-months post-intervention are needed to evaluate the durability of the educational programme's effects on DVT prevention attitudes and practice. Future studies should incorporate mediation analyses to elucidate the roles of self-efficacy, organizational support, perceived behavioral control, and workload in the attitude–practice relationship. Multi-institutional, multi-governorate studies with diverse ICU populations would substantially enhance the generalizability of the findings. The development and validation of standardized, evidence-based DVT prevention competency frameworks for ICU nurses, integrated into both undergraduate nursing curricula and continuing professional development programs, represents a critical priority. Future interventions should incorporate blended learning formats, simulation-based training, and case-based digital modules to enhance engagement, knowledge retention, and skill transfer. Evaluating the impact of concurrent organizational interventions, such as protocol implementation, staffing improvements, and multidisciplinary DVT prevention committees, alongside educational programs, would provide valuable evidence for system-level DVT prevention strategies.

5. Conclusion

This quasi-experimental study provides compelling evidence that a structured three-session educational program significantly improved ICU nurses' attitudes toward and clinical practices for DVT prevention. The intervention group demonstrated a marked increase in good clinical performance and significant improvement in attitude scores, whereas the control group exhibited no meaningful change. These findings underscore the critical importance of targeted, evidence-based educational interventions in equipping ICU nurses with the knowledge and behavioral skills necessary to prevent one of the most serious and preventable complications in critical care.

Nevertheless, the non-significant post-test correlation between attitudes and clinical practice highlights that favorable attitude, while necessary, are insufficient to guarantee optimal practice in the absence of supportive organizational conditions. Persistent deficits in complex practice domains, such as DVT risk assessment and anticoagulant monitoring, further affirm that educational programs must be complemented by institutional reforms, including the enforcement of evidence-based DVT protocols, adequate staffing, interdisciplinary coordination, and structured clinical supervision. Healthcare leaders and nursing educators must recognize that sustainable improvements in DVT prevention practices require a dual commitment to professional education and organizational enablement.

AI Assistance Declaration

The authors utilized AI-assisted writing tools for language enhancement, grammar correction, and structural refinement during manuscript preparation. All AI-generated suggestions were critically reviewed, revised, and verified by the authors, who retained full responsibility for the scientific accuracy, integrity, and content of the final manuscript.

Conflict of Interest

The authors declare no actual or potential conflicts of interest, financial or otherwise, related to this article.

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