

Nurses' Knowledge, Attitude, and Practice in Peripherally Inserted Central Catheter-related Thrombosis Prophylactic Practices.Muhammad Shaban¹, Kousar Perveen², Sajida Batool³¹ BSN, Superior University, College of Nursing, Lahore. Email: shabanidrees72@gmail.com² Associate Professor Superior University College of Nursing, Lahore. Email: kous84@gmail.com³ Assistant Professor Superior University College of Nursing, Lahore. Email: sajidabatool0@gmail.com

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Abstract**Background:** Peripherally inserted central catheter (PICC)-related thrombosis is an important complication that can compromise patient safety and interrupt essential intravenous therapy. Nurses play a central role in identifying risk factors, providing preventive care, recognizing early signs, and educating patients. Evidence indicates that gaps remain in nurses' PICC-related thrombosis knowledge and clinical practices, highlighting the need for competency-based training and standardized preventive approaches.**Objective:** To assess nurses' knowledge, attitude, and practice regarding PICC-related thrombosis prophylactic practices at Jinnah Hospital, Lahore.**Methods:** A descriptive cross-sectional study was conducted among 218 registered nurses at Jinnah Hospital, Lahore. Participants were selected through simple random sampling. Data were collected using a structured self-administered questionnaire assessing demographic characteristics, knowledge, attitude, and practice regarding PICC-related thrombosis prevention. Data were analyzed using SPSS version 27. Descriptive statistics, chi-square tests, and Pearson correlation were applied. Statistical significance was set at $p < 0.05$.**Results:** Of 218 nurses, 48.2% demonstrated moderate knowledge, 55.5% had a favorable attitude, and 46.8% demonstrated moderate preventive practices. Knowledge, attitude, and practice were significantly correlated. Education, clinical experience, previous PICC training, and PICC-care experience were significantly associated with KAP outcomes ($p < 0.05$).**Conclusion:** Nurses demonstrated moderate knowledge and practice with generally favorable attitudes toward PICC-related thrombosis prevention. Regular PICC-focused training, competency assessment, standardized protocols, and clinical audits are recommended.**Keywords:** PICC; thrombosis; nurses; knowledge; attitude; practice; thrombosis prophylaxis; nursing care.**Introduction**

Peripherally inserted central catheters (PICCs) have become an important component of contemporary vascular access because they provide reliable central venous access for patients requiring prolonged intravenous therapy, chemotherapy, parenteral nutrition, antimicrobial treatment, blood products, and other complex therapies. Their comparatively less invasive insertion route, ability to remain in situ for extended periods, and potential to reduce repeated peripheral venipuncture have contributed to their widespread use across acute, critical, oncology, and long-term care settings. However, the clinical advantages of PICCs coexist with

important mechanical, infectious, and thrombotic complications. Among these, PICC-related thrombosis (PICC-RT) is particularly important because it may compromise the affected limb, interrupt essential treatment, increase healthcare utilization, and, in severe cases, progress to pulmonary embolism. Thus, PICC safety should not be conceptualized merely as successful insertion and infection prevention; prevention of catheter-associated thrombosis represents an equally important dimension of high-quality vascular-access nursing care (Puri et al., 2022; World Health Organization [WHO], 2024).

The clinical burden of thrombosis associated with PICC is not representative of the real burden. In a systematic review and meta-analysis that included 10 studies and 1,591 adult participants, the pooled incidence of asymptomatic PICC-related thrombosis was 22%, most of which were found within 3-12 days following insertion (Chen et al., 2021). A more extensive systematic review of 75 studies and over 109,000 patients, in contrast, estimated the pooled incidence rate for symptomatic venous thromboembolism associated with PICCs to be 3.7% (95% CI: 3.1–4.4%), of which about 3.9% were deep-vein thrombosis. Clinically important is the difference between estimates derived from asymptomatic and symptomatic patients since, in the absence of systematic surveillance, thrombosis can remain undetected, leading to significant underestimation of the problem. This variation also highlights that prevalence estimates are dependent upon diagnostic methods rather than being a single uniform epidemiological phenomenon, as driven by patient characteristics, clinical setting, and definitions of thrombosis (Chen et al., 2021; Puri et al., 2022).

The clinical impact of PAT increases in susceptible patient groups. In their meta-analysis, Puri et al (2022) showed that the overall incidence of VTE in critically ill patients was 10.6%, while in non-critical-care patients it was 3.3%, suggesting a significant difference in thrombotic risk with patient acuity. In the same way, oncology patients continue to be a significant group as malignancy, chemotherapy, immobility and inflammation all may combine to enhance the thrombogenic potential. Importantly, pooled comparative analyses, but not the subgroup findings from randomized trials, suggested an association between PICC use and increased odds of VTE compared with conventional central venous catheters (CVCs) (OR = 2.48, 95% CI: 1.83–3.37). This heterogeneity is a significant hurdle for a simplistic view of PICCs being safer than other central venous devices and drives the need for a personalized assessment of patient, catheter, and procedural risks (Puri et al., 2022).

The pathophysiology of PICC related thrombosis can be explained via Virchow's triad: venous stasis, endothelial or vessel wall injury and hypercoagulability. The insertion of PICCs can cause endothelial trauma and the mechanical effect of the catheter within the vein can create less space for blood to flow through the vein and thus cause some stasis. There is increased risk if there are patient-related factors including malignancy, previous thrombosis, infection, immobility, dehydration, critical illness and hypercoagulable states. Catheter-related factors are size, multiple lumens, catheter to vein ratio, insertion site, catheter tip placement and length of time the catheter is in place. This means that preventing thrombosis is not a one-off procedure – rather a multi-faceted process that begins with patient selection and assessment of the vessel, continues through insertion, maintenance, monitoring, patient education and the prompt removal of unnecessary devices (Puri et al, 2022; Schiffer et al, 2013).

The contemporary concept of particular importance is the catheter-to-vein ratio (CVR). The use of a catheter with too large a proportion of the venous lumen, it appears, may impair venous flow and increase the risk of thrombosis. The use of the smallest catheter and least number of lumens feasible for a specific treatment and keeping a CVR of about 45% or less are now among the recommended vascular access options. Sharp et al., 2021 found that patients with a CVR of more than 45% were more than twice as likely to develop thrombosis compared to patients with a CVR equal to or less than 45% (RR = 2.30, 95% CI: 1.20–4.38). Modern guidelines thus focus on preinsertion ultrasound evaluation of caliber and patency of vessels rather than on

anatomical landmarks and operator preference. These changes have moved the direction of care for thrombosis prevention beyond the "reactive" approach to the "vessel preservation and risk reduction" approach and nurses play an important role in making sure that the evidence-based insertion and maintenance practices are in fact implemented (Infusion Nurses Society [INS], 2024; Sharp et al., 2021).

An additional important factor that influences the risk of thrombosis is the position of the catheter. The usual site for the PICC is the lower third of the superior vena cava or cavoatrial junction because good blood flow is achieved and mechanical complications are minimized. Likewise, ultrasound vascular evaluation will help in identifying the appropriate vessels for catheterization, vessel diameter, vessel patency, and any possible vascular abnormalities prior to catheterization. In keeping with the trend of evidence-informed vascular-access practice (WHO, 2024), ultrasound-guided assistance is endorsed as a suitable method for insertion of PICCs in appropriate patient populations. But the presence of guidelines does not necessarily mean that they are followed at the level of the care given at the bedside. The importance of these recommendations will rely on the knowledge the nurses have in identifying suitable vessel and catheter features, the attitude that they have to prioritize thrombosis prevention, and the practical skills that they have in incorporating the principles into the routine management skills. A crucial discussion on pharmacologic versus non-pharmacologic prophylaxis is also necessary in the prevention of PICC related thrombosis. Routine use of anticoagulants for the prevention of catheter-related thrombosis is not universally recommended as the potential for bleeding risks may outweigh the uncertain benefits in certain populations compared with the standard hospital-wide VTE prevention program. Recent evidence and guidelines support individualized risk assessment instead of blanket pharmacologic prophylaxis. Therefore, appropriate management of the catheter, insertion guided by ultrasonography, reduction of the catheter size and number of lumens, optimal positioning of the catheter, maintenance of patency, patient education and removal of non-necessary PICC, are extra significant features of nursing-led prevention. Nurses' role in managing a patient's anticoagulation therapy becomes even more pertinent in the absence of consensus on prophylactic anticoagulation (Gao et al., 2024; Farge et al., 2022).

Another difficulty is that thrombosis associated with PICC can be asymptomatic. The literature suggests that many catheter-related thrombotic events are not associated with symptoms of pain, swelling, erythema, or venous distention. Given the high rates of asymptomatic thrombosis reported in systematic evidence, symptom triggered assessment should not be used as a sole method of assessing thrombosis (Chen et al., 2021). This has direct relevance to nursing practice due to the frequent need for repeated bedside assessment and the possibility for nurses to be the first professionals to recognize subtle changes in the catheterized limb, catheter function, patient mobility or systemic condition. Thus, good nursing practice should not only involve identifying actual thrombosis but also identifying and intervening on modifiable risk factors and early signs of thrombosis. The difference between what it means to prevent thrombosis and to observe for thrombosis is therefore relevant: Prevention starts before the symptoms occur, not after the thrombosis has manifested itself clinically.

In this context, knowledge, attitude and practice of nurses are interrelated but they are conceptually different. Knowledge is defined as nurses' understanding of the risk factors, mechanism, manifestation, assessment, prevention, and response to PICC-related thrombosis. Attitude involves the opinions on the significance of thrombosis prevention, perceived professional responsibility, willingness to follow evidence-based standards and preparation to engage in preventive interventions. Practice is the actions that are seen or reported in the implementation of recommended activities such as risk assessment, patient education, catheter surveillance, preventative measures and timely escalation of suspected complications. The constructs should not be seen as interchangeable, as there is a difference between having high

knowledge and having appropriate clinical practice. There is a possibility that organizational resources, workload, staffing, protocols, availability of training, professional autonomy, and institutional culture affect the relationship between knowledge and action of nurses.

The relation can be well understood by the help of a theoretical approach known as Knowledge–Attitude–Practice (KAP) model. It is hypothesized that the model will facilitate the change of knowledge to attitude and that this change of attitude and acquired knowledge will lead to a change in health related practices. But a key understanding of the KAP model is that behaviour is not solely influenced by knowledge. The transfer of knowledge to action can be promoted or hindered by structural and organizational conditions in complex clinical environments. This is especially pertinent to PICC related thrombosis, as the nurse might be aware of the importance of preventing thrombosis, but not have access to ultrasound, may not have a consistent institutional policy, lack staffing, not be able to do the continuing education, or not know who is responsible for the risk assessment. Empirical support for this conceptualization comes from a recent multicenter survey of 5,544 registered nurses in China, in which KAP scores were all significantly positively correlated, though there were significant problems with risk assessment even in the face of overwhelmingly positive attitudes (Zhang et al., 2025).

An important international indicator of the nursing practice gap has been provided within recent evidence. In a study conducted in five regions of China, researchers Zhang et al. (2025) found that all the nurses participating had a knowledge score of at least 80% correct, in only 40.38% of cases. Over 97% had a positive attitude towards prevention, but over 58% did not always or frequently discuss the risk factors of thrombosis or screen for PICC-related thrombosis, and 43.25% did not always or frequently utilize a risk-assessment tool. The results are significant as they illustrate a gap between knowledge and action, with nurses having a strong preference for the importance of thrombosis prevention but inconsistent risk assessment practice. This indicates that educational interventions need to not only be focused on fact-enrichment but also be related to clinical decision making, standardised assessment procedures, competency development, audit and feedback, and organisational support (Zhang et al., 2025).

South Asian evidence base is not as robust as from East Asian, European and North American contexts. In general literature available from the South Asian region, the focus has been more on providing VTE prophylaxis than on preventing thrombosis in PICCs. This is relevant because generic VTE prevention does not account for catheter-specific determinants like CVR, insertion-site selection, catheter characteristics, tip position, necessity of catheterization and PICC-specific surveillance. There was significant inter-institutional variation in the clinical practice guidelines available regarding prevention of PICC-related thrombosis, as well as recommendations for risk assessment, risk-scoring systems, pharmacological prevention, non-pharmacological prevention, and catheter removal. The variation indicates that there are still many unanswered questions regarding the translation of international evidence into context-specific nursing protocols, especially in health systems with less specialized vascular-access teams and not fully standardized PICC programs (Gao et al., 2024).

This research problem is of special interest in the context of Pakistan. There are significant challenges in the implementation of VTE prophylaxis in a standard hospital setting in Pakistan, while existing studies have identified the disconnect between the clinicians' awareness of thrombosis as a clinical problem and practice of VTE prophylaxis. In the teaching hospitals of Rawalpindi, 98.8% of the surveyed healthcare providers felt that DVT prophylaxis was clinically important, but only 39.4% were prescribing it and only 10.3% were doing it routinely, so the authors felt that there was a need for institutional guidelines for the routine use of DVT prophylaxis (Alam et al., 2014). Similar quality improvement evidence was found in a tertiary care hospital in Karachi, which showed that structured educational sessions will enhance the practices and knowledge of the healthcare professionals related to DVT prophylaxis (Khan et al., 2025). Though these studies did not in particular focus on nurses who develop PICC related

thrombosis, the evidence was valuable contextual information that knowledge and practice of thromboprophylaxis is still susceptible to educational and system-level deficiencies in Pakistan. The problem is worthy of investigation at a local level depending on the complexity of the hospital care and the resulting dependency from durable vascular access, as well as the constraints faced by nursing care in the provision of resources, staffing, training and protocols, especially in tertiary hospitals of Khyber Pakhtunkhwa. But published evidence that is focused on assessment of the knowledge, attitudes and practices of nurses about PICC thrombosis prophylaxis in settings similar to Khyber Pakhtunkhwa in Pakistan is scarce. It is important to note that the lack of good local data does not mean the problem does not exist, it might just mean that it is not being recognised, diagnosed, monitored or studied. Local assessment is therefore essential as evidence from abroad cannot be translated into Pakistani hospitals where there can be significant differences in evidence bases such as: the types of catheters used, nurse training, vascular access provision, diagnostic facilities, clinical protocols and patient groups. For international recommendations to be translated into bedside nursing practice, evidence can be generated and presented in a way that is relevant to that specific context, and can help identify locally appropriate quality-improvement strategies.

The central research question is not just whether there is a prevalence of PICC-related thrombosis but whether there is a discrepancy between what is recommended and what nurses do in their role to prevent PICC-related thrombosis. The literature has demonstrated the clinical significance of PICC-related thrombosis, an effect of patient and catheter characteristics, and important role of nursing care in preventing it. However, there is a skewed distribution of evidence in a limited number of countries and specific groups, and there is little Pakistan specific evidence. In addition, the recent Chinese KAP study shows that having a positive attitude is not sufficient to ensure a full risk analysis and regular preventive practice even in a relatively developed PICC-care environment (Zhang et al., 2025). The multiple knowledge gap is thus identified – lack of knowledge regarding what Pakistani nurses know, Pakistani nurses' awareness of the importance of PICC thrombosis prevention, their adherence to recommended practices for PICC thrombosis prevention, and professional or contextual factors that relate to these four areas.

The background in this case warranted a clinical and academic study of the knowledge, attitude, and practice of nurses in the practice of thrombosis prophylaxis in PICC. The study could set a standard for nursing competence, highlight gaps in knowledge, clarify if positive attitudes are associated with positive preventive actions, and uncover areas that need to be reinforced through institutional policies, continuing professional education, standardised assessment tools and vascular-access protocols. Most importantly, the study can advance the transition from a reactive approach to dealing with complications of catheters to a proactive approach of risk assessment and evidence-based nursing practice. The results may also give a base to design contextually appropriate educational programs and quality improvement interventions in Pakistan hospitals. In summary, increased capacity of nurses to prevent thrombosis at the PICC insertion site could lead to enhanced patient safety, maintain vascular access, reduce unnecessary complications and decrease the strain on the system of providing prolonged intravenous treatments.

Methods

Study Design and Setting

A descriptive cross-sectional research design was used to assess nurses' knowledge, attitude, and practice regarding peripherally inserted central catheter (PICC)-related thrombosis prophylactic practices. The study was conducted at Jinnah Hospital, Lahore, Punjab, Pakistan, a tertiary-care teaching hospital providing services through medical, surgical, oncology, critical-care, emergency, and other specialized units. The setting was selected because nurses

in these departments were involved in the care, monitoring, maintenance, and assessment of patients with PICCs.

Population and Sampling

The study population consisted of registered nurses working at Jinnah Hospital who were involved in direct patient care and had experience caring for patients with or at risk of requiring PICC therapy. A sample of **218 nurses** was selected from an accessible population of approximately 500 nurses. The sample size was calculated using the Raosoft sample size calculator with a 95% confidence level, 5% margin of error, and 50% response distribution. Simple random sampling was used to select eligible participants. Nurses who met the inclusion criteria and provided written informed consent were included.

Data Collection Procedure

Data were collected using a structured self-administered questionnaire consisting of demographic and professional characteristics and sections assessing knowledge, attitude, and practice regarding PICC-related thrombosis prophylaxis. Ethical approval and administrative permission were obtained before data collection. Selected nurses were approached at suitable times without disrupting patient care. The purpose and procedures of the study were explained, and written informed consent was obtained. Participants completed the questionnaire independently. Completed questionnaires were checked for completeness, coded using unique identification numbers, and securely stored.

Data Analysis Procedure

Data were entered, coded, cleaned, and analyzed using **SPSS version 27**. Frequencies and percentages were calculated for categorical variables, while means and standard deviations were used for continuous scores. Chi-square tests were used to determine associations between categorical demographic/professional variables and categorized knowledge, attitude, and practice levels. Pearson or Spearman correlation was used to assess relationships among knowledge, attitude, and practice scores, according to data distribution. Statistical significance was considered at $p < 0.05$ with a 95% confidence level.

Results

Demographic Analysis

Table 4.1 presents the demographic and professional characteristics of the 218 participating nurses. The largest proportion of nurses (42.2%) was aged 30–39 years, followed by 32.1% aged 20–29 years, while only 7.3% were aged 50 years or above. Females constituted the majority of participants (61.5%), compared with 38.5% males. Regarding educational qualification, almost half of the participants (49.5%) had a BSN degree, 39.4% had a nursing diploma, and 11.0% had an MSN or higher qualification. In terms of professional experience, 36.7% had 5–10 years of nursing experience, while 17.0% had more than 15 years of experience. Only 40.8% of nurses reported having received previous PICC-related training, whereas 59.2% had not received such training. Although 71.6% had experience caring for patients with PICCs, 28.4% reported no such experience. These findings indicated that most participants had clinical exposure to PICC care, but a considerable proportion had not received formal PICC-related training.

Table 4.1

Demographic and Professional Characteristics of Nurses (n = 218)

Variable	Category	f	%
Age	20–29 years	70	32.1
	30–39 years	92	42.2
	40–49 years	40	18.3
	≥50 years	16	7.3
Gender	Male	84	38.5

	Female	134	61.5
Education	Nursing Diploma	86	39.4
	BSN	108	49.5
	MSN or above	24	11.0
Nursing experience	<5 years	48	22.0
	5–10 years	80	36.7
	11–15 years	53	24.3
	>15 years	37	17.0
Previous PICC-related training	Yes	89	40.8
	No	129	59.2
Experience caring for patients with PICCs	Yes	156	71.6
	No	62	28.4

Figure 1 shows the nurses' level of knowledge regarding PICC-related thrombosis prophylaxis. The findings demonstrated that 48.2% of nurses had a moderate level of knowledge, 29.8% had good knowledge, and 22.0% had poor knowledge. Thus, almost half of the participants demonstrated moderate knowledge, while less than one-third achieved the good-knowledge category. The mean knowledge score was 16.84 ± 3.72 out of a possible 25 points, indicating an overall moderate level of knowledge among participants. The findings suggested that although nurses possessed a reasonable understanding of PICC-related thrombosis prophylaxis, substantial knowledge gaps remained, particularly among those who demonstrated poor knowledge. These gaps may affect nurses' ability to recognize risk factors, identify early signs and symptoms, and consistently implement appropriate preventive measures.

Figure 1
Level of Knowledge Regarding PICC-Related Thrombosis Prophylaxis (n = 218)

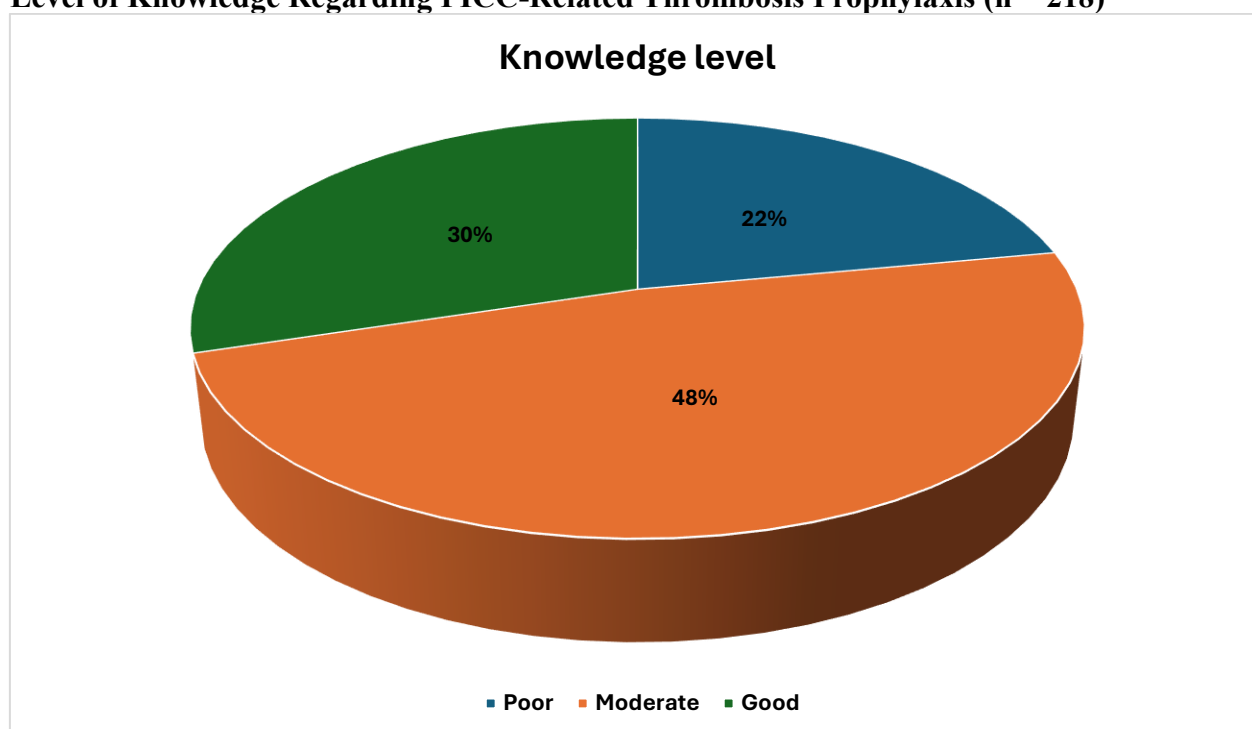


Figure 2 presents the nurses' attitudes toward PICC-related thrombosis prophylaxis. More than half of the participants (55.5%) demonstrated a favorable attitude, while 29.4% demonstrated a moderately favorable attitude and 15.1% demonstrated a less favorable attitude. The mean attitude score was 41.62 ± 6.18 , indicating that the overall attitude toward PICC-related

thrombosis prevention was comparatively favorable. The findings suggested that most nurses recognized the importance of preventing PICC-related thrombosis and appeared willing to undertake appropriate preventive measures. However, the presence of less favorable attitudes among 15.1% of participants indicated that some nurses may require additional professional education, awareness, and reinforcement regarding their responsibility in preventing PICC-related complications.

Figure 2

Level of Attitude Toward PICC-Related Thrombosis Prophylaxis (n = 218)

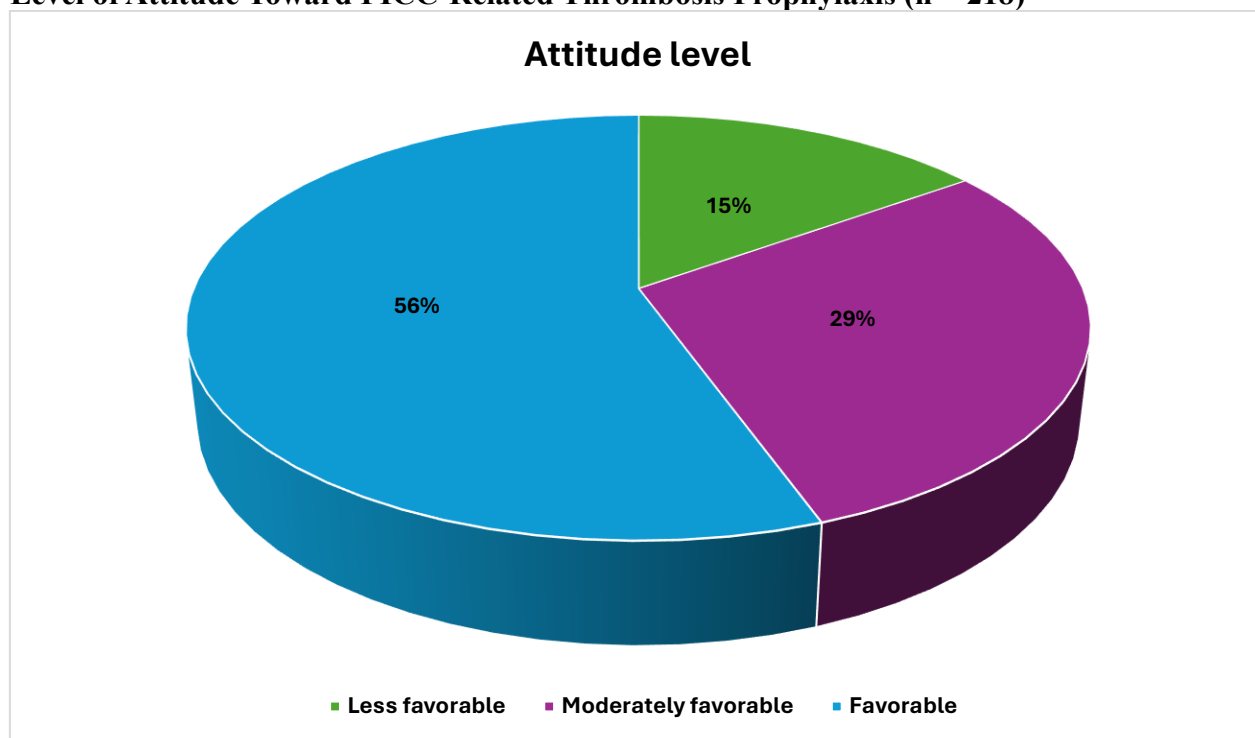


Figure 3 describes the nurses' level of practice regarding PICC-related thrombosis prophylaxis. The results showed that 46.8% of nurses demonstrated moderate practice, 31.2% demonstrated good practice, and 22.0% demonstrated poor practice. The mean practice score was 38.47 ± 7.24 , suggesting an overall moderate level of reported PICC-related thrombosis prophylactic practice. Although approximately one-third of nurses demonstrated good practice, nearly one-quarter reported poor practice, indicating important deficiencies in the consistent implementation of preventive measures. These findings suggested that favorable attitudes alone may not always translate into optimal clinical practice and highlighted the importance of regular competency-based training, standardized PICC-care protocols, clinical supervision, and reinforcement of evidence-based thrombosis-prevention practices.

Figure 3
Level of Practice Regarding PICC-Related Thrombosis Prophylaxis (n = 218)

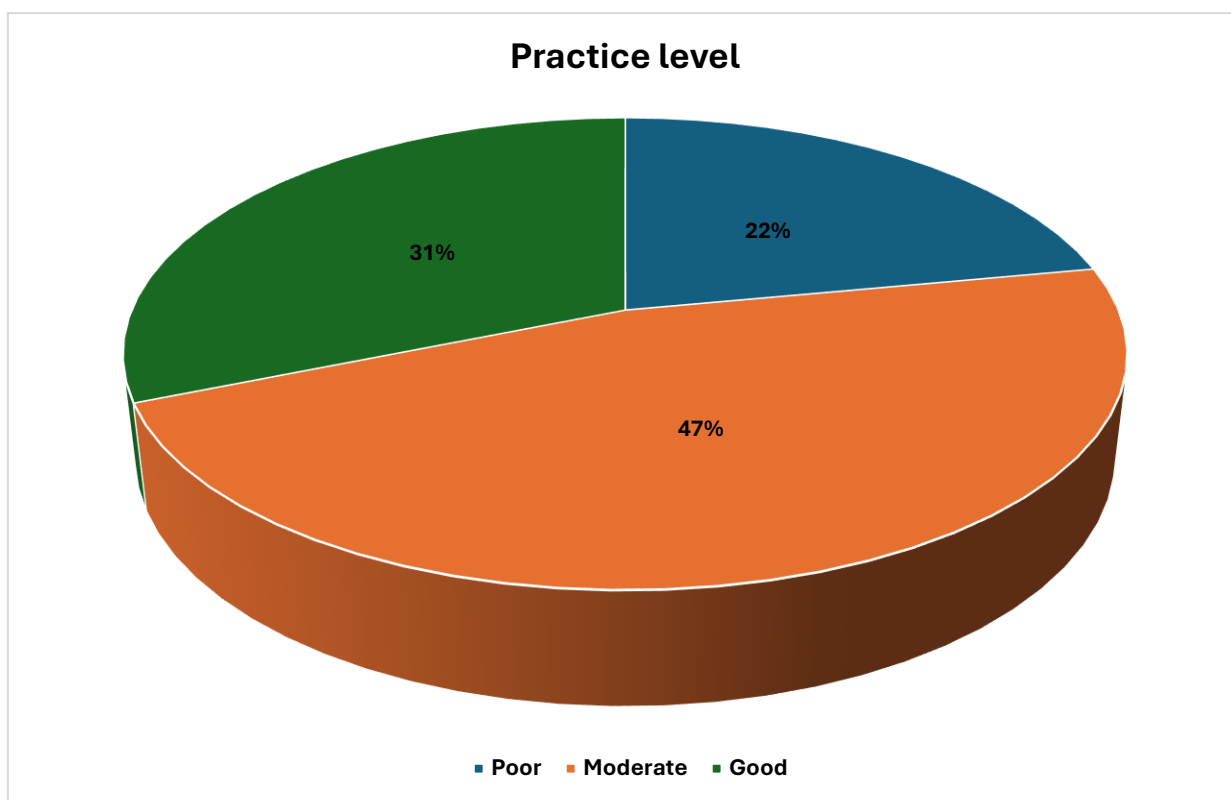


Table 2 presents the descriptive statistics for the nurses' knowledge, attitude, and practice scores. The mean knowledge score was 16.84 ± 3.72 , the mean attitude score was 41.62 ± 6.18 , and the mean practice score was 38.47 ± 7.24 . The findings demonstrated that participants had a comparatively favorable attitude toward PICC-related thrombosis prophylaxis, whereas their knowledge and practice levels were more moderate. The variation in standard deviation values indicated differences among nurses in their levels of knowledge, attitudes, and reported practices. Overall, the findings suggested that nurses generally recognized the importance of PICC-related thrombosis prevention but that improvements in knowledge and translation of knowledge into consistent clinical practice were still needed.

Table 2

Mean Scores of Knowledges, Attitude, and Practice (n = 218)

Variable	Minimum	Maximum	Mean	SD
Knowledge	7	24	16.84	3.72
Attitude	25	50	41.62	6.18
Practice	19	55	38.47	7.24

Table 3 presents the associations between selected demographic and professional characteristics and nurses' knowledge regarding PICC-related thrombosis prophylaxis. The findings showed statistically significant associations between educational qualification ($\chi^2 = 8.74$, $p = 0.013$), nursing experience ($\chi^2 = 9.87$, $p = 0.020$), previous PICC-related training ($\chi^2 = 12.64$, $p = 0.002$), and PICC-care experience ($\chi^2 = 7.91$, $p = 0.019$) and knowledge level. In contrast, age ($p = 0.078$) and gender ($p = 0.384$) were not significantly associated with knowledge. The strongest observed association was between previous PICC-related training and knowledge, suggesting that formal training may contribute substantially to nurses' understanding of PICC-related

thrombosis prevention. These findings emphasized the potential value of structured education and continuing professional development in improving nurses' knowledge.

Table 3

Association Between Selected Characteristics and Knowledge Level

Variable	χ^2	p-value	Decision
Age	6.82	0.078	Not significant
Gender	1.91	0.384	Not significant
Educational qualification	8.74	0.013	Significant
Nursing experience	9.87	0.020	Significant
Previous PICC training	12.64	0.002	Significant
PICC-care experience	7.91	0.019	Significant

Table 4 presents the association between selected demographic and professional characteristics and nurses' attitudes toward PICC-related thrombosis prophylaxis. Significant associations were observed between educational qualification ($\chi^2 = 7.83$, $p = 0.020$), nursing experience ($\chi^2 = 6.94$, $p = 0.031$), previous PICC-related training ($\chi^2 = 8.92$, $p = 0.012$), and PICC-care experience ($\chi^2 = 7.16$, $p = 0.028$) and attitude level. However, age ($p = 0.155$) and gender ($p = 0.517$) were not significantly associated with attitude. These findings suggested that professional preparation and clinical exposure may influence nurses' perceptions and attitudes toward PICC-related thrombosis prevention. In particular, previous PICC-related training appeared to be an important factor associated with a more favorable attitude toward thrombosis prophylactic practices.

Table 4

Association Between Selected Characteristics and Attitude Level

Variable	χ^2	p-value	Decision
Age	5.24	0.155	Not significant
Gender	1.32	0.517	Not significant
Educational qualification	7.83	0.020	Significant
Nursing experience	6.94	0.031	Significant
Previous PICC training	8.92	0.012	Significant
PICC-care experience	7.16	0.028	Significant

Table 5 demonstrates the associations between selected demographic and professional characteristics and nurses' practice regarding PICC-related thrombosis prophylaxis. Statistically significant associations were identified for educational qualification ($\chi^2 = 7.64$, $p = 0.022$), nursing experience ($\chi^2 = 10.12$, $p = 0.018$), previous PICC-related training ($\chi^2 = 15.27$, $p < 0.001$), and PICC-care experience ($\chi^2 = 11.48$, $p = 0.003$). In contrast, age ($p = 0.065$) and gender ($p = 0.336$) were not significantly associated with practice. The strongest association was observed between previous PICC-related training and practice, indicating that nurses who had received relevant training were more likely to demonstrate better PICC-related thrombosis prophylactic practices. The findings highlighted the importance of continuous professional education and practical competency development in improving nurses' clinical performance.

Table 5

Association Between Selected Characteristics and Practice Level

Variable	χ^2	p-value	Decision
Age	7.21	0.065	Not significant
Gender	2.18	0.336	Not significant

Educational qualification	7.64	0.022	Significant
Nursing experience	10.12	0.018	Significant
Previous PICC training	15.27	<0.001	Significant
PICC-care experience	11.48	0.003	Significant

Significance level: $p < 0.05$.

Discussion

This study aimed to evaluate the knowledge, attitude and practices of nurse with regard to peripherally inserted central catheter (PICC) related thrombosis prophylaxis practices in Jinnah hospital Lahore. The results revealed that 48.2% of the nurses had moderate level of knowledge, 29.8% had good knowledge and 22.0% had poor knowledge, and the mean knowledge was 16.84 ± 3.72 . The results are aligned with Peng et al. (2022) who found that 55.0% of clinical nurses were not knowledgeable about CRT. The results of this study suggest that there is no automatic assumption that good theoretical knowledge of thrombosis prevention is achieved on exposure to patients with PICCs. In a large multicentric study of 5,544 clinical nurses, Zhang et al (2025) identified that about 55% attained or surpassed the median knowledge score, although there were gaps in the knowledge of risk-factors, signs and symptoms, and treatment for thrombosis. The high degree of similarity of these findings indicates that there is still a lack of knowledge about catheter-related thrombosis prevention even in environments where PICC usage has been established.

This finding of moderate knowledge by the nurses in the current study can be explained in the context of PICC thrombosis prevention being a multifactorial process. Patient-specific risk factors, catheter characteristics, venous anatomy, early clinical manifestations and preventive interventions are all important to know, as well as understanding how to maintain a catheter. Puri et al. (2022) found that VTE was a clinically significant problem, with a pooled incidence of symptomatic VTE of 3.7% in 75 studies with 109,292 patients. It was found to be significantly higher in critical-care populations. Similarly, Sharpe et al. (2021) showed that the catheter to vein ratio is important in thrombosis risk and that the selection of catheter and vein dimensions are relevant factors in prevention. The moderate knowledge observed in the current study may be due to the limited exposure to these technical aspects of PICC management and not to a lack of general knowledge of catheter care.

Compared to previous studies, the present study showed a relatively good attitude towards thrombosis prophylaxis related to PICC placement with a score of 41.62 ± 6.18 and 55.5% of nurses having a favorable attitude. This result is consistent with Peng et al. (2022), who found 88.49% of clinical nurses had a positive attitude towards prevention of catheter-related thrombosis. However, even a stronger attitudinal pattern was found by Zhang et al., (2025) with over 97% of the nurses having a positive attitude towards thrombosis prevention of PICC while only 76.79% had a strongly positive attitude. This difference in the proportion of favorable attitudes may be attributed to the various educational experiences, institutional procedures, professional experiences, workload, and availability of specialized vascular-access training. The results highlight that although nurses' knowledge and practice with regards to thrombosis prevention may be incomplete, they may be aware of its significance.

The practice findings revealed that 46.8% of the nurses had moderate practice, 31.2% had good practice and 22.0% had poor practice with mean practice score of 38.47 ± 7.24 . The outcome is similar to that of Peng et al. (2022) where they reported the inadequate practices of catheter-related thrombosis among 68.62% of nurses. While this study found positive attitudes among participating nurses, Zhang et al. (2025) also noted critical defects in practice, such as the failure to assess routine risk-factors. A positive attitude towards practice, combined with a moderate

level of practice in this study, reinforces the notion that positive professional perceptions do not equate to consistent evidence-based clinical practice. PICC thrombosis prevention is dependent on patient competence and clinical environment as it involves repeated assessment, accurate documentation, patient education, catheter management, early warning signs and timely clinical response.

The present study showed that significant association between the previous training in PICC and the level of knowledge ($\chi^2 = 12.64$, $p = 0.002$) further supports the need for ongoing professional education. Those nurses who had gotten training for PICC were more inclined to demonstrate better knowledge. Catheter-related thrombosis training frequency was also a crucial positive factor in Peng et al. (2022) study of nurses' knowledge and practice related to catheter-related thrombosis. In their study, training frequency was also correlated with attitude. According to Zhang et al. (2025), 61.99% of nurses had completed continuing education about PICC care, but there were still gaps in knowledge regarding thrombosis prevention. The results suggest that participation in training is not enough, the content, frequency of the training sessions, clinical relevance and competency assessment aspects can be the determinants of the effectiveness of the training. Frequent evidence-based risk assessment, early detection and practical prevention education might be more beneficial than general catheter-care education.

In the current study, there were significant associations between the three in the areas of educational qualification and nursing experience. More highly educated nurses and those with more years of experience may have more exposure to clinical decision making, evidence-based guidelines and managing complex patients with vascular access. Peng et al. (2022) reported that educational level and job title were significantly related with the knowledge of catheter-related thrombosis. A cross-sectional study of 1046 Master of Nursing Specialist students conducted in 2024 also showed measurable relationships between knowledge, attitudes and practices pertaining to catheter-related thrombosis and found that knowledge and attitudes had a positive correlation with each other and with practice. The current results extend this evidence to practicing hospital nurses, and suggest that professional development could be a factor that supports the enhancement of the competencies related to thrombosis prevention associated with PICC.

A major positive correlation between knowledge and practice in the current study ($r = 0.51$, $p < 0.001$) is clinically significant. The more knowledgeable nurses were more likely to report good practices for thrombosis prevention. There were significant positive correlations between knowledge, attitude and practice regarding thrombosis prevention in PICCs (Zhang et al., 2025). Training was the only factor that was significantly associated with practice in Peng et al. (2022) multivariable analysis, further highlighting the importance of knowledge acquisition and competency building. Another study conducted in 2025 on the knowledge, attitudes, and practices of nurses in relation to DVT nursing management found that both knowledge and attitude were factors that were independently related to proactive practice. The results suggest that this may help to enhance preventive intervention implementation when knowledge is accompanied by suitable clinical systems and practice opportunities, and to strengthen nurses' theory knowledge.

The present study found a positive correlation between attitude and practice ($r = 0.47$; $p < 0.001$); those with more positive attitudes towards the prevention of PICC-related thrombosis tended to express more positive clinical practices. The findings are consistent with the findings of the Master of Nursing Specialist students where positive relationships were found between attitudes and practice in relation to catheter-related thrombosis. Similarly, Zhang et al. (2025) found strong positive relations between the three domains of knowledge, attitude and practice. Attitude can affect willingness to repeat the risk assessment, adhere to catheter care, patient education and reporting of early changes in the clinical picture. However, a positive attitude alone will not ensure good practice as other factors such as organizational arrangements,

staffing, workload, equipment, clinical supervision and standardisation of procedures can impact on the implementation of professional intentions.

Recent intervention evidence supports the clinical importance of improving the practice of nurses in regard to PICC-related thrombosis. Sun et al. (2025) found that the incidence of PICC-related thrombosis decreased from 29.91% to 4.20% ($p < 0.001$) in the intervention group compared to the routine care group. They included individual risk assessment and nursing plans that were tailored to the patient, and several risk factors were found to be of significance, including advanced tumor stage, previous thrombosis, diabetes, catheter tip malposition, and an elevation of D-dimer. There is also empirical evidence supporting the practice of preventive measures that involve exercise. Liu et al. (2023) identified the effect of exercise therapy on the incidence of VTE in PICC using a meta-analysis of 11 randomized controlled trials (RCTs) involving 1,919 patients; and handgrip exercise quantified in another meta-analysis was associated with a lower thrombosis rate than voluntary exercise. The results highlight the importance of having practical knowledge of patient-specific assessment of risk for thrombosis and preventive measures.

The overall findings of the present study revealed moderate knowledge, positive attitude and moderate practice with regards to thrombosis prophylaxis of PICC related thrombosis among the nurses of Jinnah Hospital Lahore. Results suggest that nurses generally have good attitudes towards thrombosis prevention but lack knowledge in particular areas and they lack confidence in how they implement their knowledge in clinical practice, which is similar to the international evidence. The significant relationships between knowledge, attitude and practice indicate that it is important to tackle them in a combined manner and not by individual educational interventions. A competency-based education program, periodic evaluation of nurse skills, standardized protocols, individualized assessment of patient risk, screening for signs and symptoms of thrombosis, proper catheter utilization, patient education, and ongoing quality improvement are all needed for the prevention of PICC-related thrombosis. The results offer a foundation for improving the institutional PICC-care programmes at Jinnah Hospital Lahore and assist in creating structured continuing professional development programmes, specifically on thrombosis prophylaxis.

Conclusion:

The study concluded that nurses at Jinnah Hospital, Lahore demonstrated a moderate level of knowledge and practice and a generally favorable attitude regarding PICC-related thrombosis prophylactic practices. The findings indicated that 48.2% of nurses had moderate knowledge, 55.5% demonstrated a favorable attitude, and 46.8% reported moderate preventive practices. Significant associations were identified between knowledge, attitude, and practice and selected professional characteristics, particularly educational level, years of clinical experience, previous PICC-related training, and experience in caring for patients with PICCs. Knowledge, attitude, and practice also demonstrated significant positive correlations, indicating that improvement in one domain may contribute to improvement in the others. The findings highlight that favorable attitudes alone may not be sufficient to ensure consistent evidence-based practice. Regular competency-based education, clinical supervision, standardized PICC protocols, risk assessment, early recognition of thrombosis-related signs and symptoms, and continuous monitoring are required to strengthen nurses' preventive practices. Recent multicenter evidence similarly identified gaps in risk-factor assessment and preventive practice despite generally positive attitudes among nurses.

Recommendations

1. **Regular PICC-related thrombosis training:** Jinnah Hospital should conduct regular continuing professional development sessions covering PICC insertion, catheter

- selection, catheter-to-vein considerations, maintenance, thrombosis risk factors, early signs and symptoms, prevention, and appropriate referral.
2. **Competency-based assessment:** Nursing managers should introduce periodic theoretical and practical competency assessments to ensure that nurses can correctly perform PICC-related thrombosis preventive practices.
 3. **Standardized clinical protocols:** Evidence-based PICC thrombosis prevention protocols and checklists should be developed and implemented across relevant departments to standardize nursing practice.
 4. **Risk assessment:** Nurses should routinely assess patients for PICC-related thrombosis risk factors and document risk assessment findings before and throughout PICC use.
 5. **Early recognition and reporting:** Nurses should receive focused training on early recognition of swelling, pain, redness, changes in limb circumference, catheter dysfunction, and other possible indicators of thrombosis, with clear procedures for escalation and referral.
 6. **Patient education:** Nurses should provide structured education to patients and families regarding limb movement, appropriate activity, PICC-site observation, warning signs, and the importance of immediately reporting new symptoms.
 7. **Targeted training for less-experienced nurses:** Nurses with limited PICC experience should receive orientation and supervised clinical training before independently managing patients with PICCs.
 8. **Audit and feedback:** Nursing administrators should conduct periodic clinical audits of PICC care and provide individualized feedback to nurses to identify and correct gaps in practice.
 9. **Interdisciplinary collaboration:** Nurses, physicians, vascular-access specialists, pharmacists, and infection-control personnel should collaborate to strengthen PICC safety and thrombosis prevention.
 10. **Future research:** Similar studies should be conducted in other tertiary hospitals in Punjab and other regions of Pakistan using larger samples and multicenter designs. Intervention studies should evaluate whether structured educational programs and risk-stratified PICC-care protocols improve nurses' competency and reduce PICC-related thrombosis.

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