



Article

Effects of Nursing Interventions on Knowledge and Practices Regarding Blood Transfusion Protocols Among Nurses

Humaira Shabbir¹, Hajra Sarwar¹, Sonia Tanveer¹, Maryam Khushi¹, Rimsha Hassan¹

¹ Department of School of Nursing, Green International University, Lahore, Pakistan

Correspondence

humairashabbir816@gmail.com

Cite this Article

Received 2025-05-11
Revised 2025-05-21
Accepted 2025-06-02
Published 2025-06-13

No conflicts declared; ethics approved; consent obtained; data available on request; no funding received.

Authors' Contributions

Concept and design: HS, HSR; Data collection: ST, MK, RH; Analysis and manuscript drafting: HS, HSR, ST, MK, RH.

ABSTRACT

Background: Blood transfusion is a high-risk clinical procedure, and inadequate nursing knowledge or inconsistent practices can contribute to adverse outcomes. Persistent gaps in protocol adherence are often related to insufficient training and limited opportunities for professional development. **Objective:** To assess the impact of a structured educational intervention on improving nurses' knowledge and practices regarding blood transfusion protocols. **Methods:** A six-month quasi-experimental study was conducted in a private hospital in Lahore, enrolling 30 nurses aged 19–30 years. Participants completed validated knowledge assessments and observed practice checklists before and after an interactive, nurse-led educational intervention. Paired t-tests were used to compare pre- and post-intervention scores. **Results:** The mean knowledge and practice score increased from 53.83 (SD = 2.63) to 68.90 (SD = 1.16) post-intervention (mean difference: 15.07, 95% CI: 13.45–16.02, $p < 0.001$), with a notable reduction in score variability. The greatest improvements were seen among nurses with the lowest baseline scores, and a significant proportion achieved the highest competency levels after the intervention. **Conclusion:** Structured, nurse-led educational interventions significantly enhance both the knowledge and practical application of blood transfusion protocols, supporting the need for ongoing training to promote patient safety and reduce clinical errors.

Keywords: Blood transfusion protocols, nursing education, clinical competence, patient safety, professional development, interventional study, transfusion practice

INTRODUCTION

Blood transfusion is a complex and high-risk procedure that constitutes a critical aspect of modern medical care, with nurses positioned at the frontline of ensuring its safety and effectiveness. Adverse events such as transfusion reactions and the transmission of infectious diseases have highlighted the importance of strict adherence to established protocols and the need for comprehensive knowledge among nursing staff (1,3,4). Despite the recognition of these risks, gaps in nurses' understanding and execution of blood transfusion practices continue to be documented globally, often attributed to insufficient formal education and a lack of ongoing professional development opportunities (2,6,7). In many clinical settings, particularly those in resource-constrained environments, these shortcomings translate into inconsistent application of safety procedures, suboptimal patient monitoring, and incomplete documentation, all of which threaten patient safety (5,8,10).

The therapeutic use of whole blood or blood components demands precision at every stage—from donor selection and product screening to the correct identification and administration to recipients (9,11). The World Health Organization has repeatedly emphasized that rigorous training and continual assessment of knowledge are essential for nurses, who are often tasked with patient identification, transfusion monitoring, and rapid recognition of adverse reactions (10,12). Observational studies and intervention trials conducted across diverse healthcare settings have consistently revealed that nurse-led educational programs can enhance compliance with transfusion protocols, improve documentation standards, and reduce errors that contribute to morbidity and mortality (1,2,14,15). Nonetheless, variability in pre-existing knowledge, the challenges of integrating evidence-based guidelines into busy clinical practice, and a lack of systematic evaluation of educational interventions represent persistent obstacles (6,17,19).

Recent evidence underscores the positive impact of structured training on nurses' competence in blood transfusion, with statistically significant gains in post-intervention knowledge and skill performance reported in both local and international studies (2,7,12,16,20). However, most available research highlights that many nurses continue to display limited understanding of transfusion chain safety

measures and documentation requirements before receiving targeted educational support, reinforcing the necessity for scalable, context-sensitive interventions (9,13,18). Moreover, although educational modules demonstrate immediate improvements in knowledge and reported practice, there is a paucity of studies that assess these effects in the context of private healthcare settings in low- and middle-income countries, especially with respect to standardized blood transfusion protocols and their translation into daily clinical routines (1,21,22).

In this context, the present study addresses the knowledge gap by evaluating the effect of a structured nursing intervention on the knowledge and practices related to blood transfusion protocols among nurses working in a private hospital in Lahore, Pakistan. The primary objective was to determine whether a targeted educational program could produce significant and clinically meaningful improvements in both knowledge and the application of transfusion procedures among a cohort of nursing professionals. The central research question was: Does a nurse-led educational intervention significantly enhance nurses' knowledge and practical adherence to blood transfusion protocols compared to pre-intervention levels? It was hypothesized that the intervention would lead to statistically significant improvements, supporting the case for systematic, ongoing professional development to advance patient safety and quality of care.

MATERIALS AND METHODS

A quasi-experimental design was implemented to evaluate the effectiveness of a structured educational intervention targeting nurses' knowledge and practices regarding blood transfusion protocols. The study was conducted at a private hospital in Lahore, Pakistan, over a six-month period beginning February 6, 2025, and concluding June 6, 2025. Eligible participants included nursing interns, nursing students, and registered nurses aged between 19 and 30 years who were actively engaged in clinical care within the institution. Physicians, transfusion specialists, and blood bank staff were specifically excluded to ensure that the focus remained on frontline nursing practice. Participants were selected using purposive sampling to capture a homogeneous group likely to benefit from the intervention and to minimize variability due to professional background.

Recruitment involved direct invitation by the research team, followed by detailed explanation of study objectives and procedures. Written informed consent was obtained from each participant before enrollment. Data collection was performed in two phases: pre-intervention (baseline) and post-intervention (following completion of the educational session). Both phases utilized a validated, structured questionnaire to assess knowledge and an observational checklist to evaluate practical skills, developed based on national and international guidelines for safe blood transfusion and pilot-tested for clarity and reliability. The intervention comprised a series of interactive lectures, demonstrations, and practical workshops led by experienced nursing educators, with content emphasizing key areas such as donor identification, blood product verification, aseptic technique, transfusion monitoring, and documentation.

All data collection was overseen by trained assessors who were blinded to the intervention phase to reduce assessment bias. Participants' responses were anonymized and coded for confidentiality. To ensure the reliability of outcome measures, each nurse was observed individually during simulated and actual transfusion procedures, with the same evaluative criteria applied across pre- and post-intervention assessments. Missing data were minimized through active follow-up, and complete case analysis was performed as all 30 participants provided both pre- and post-intervention data. The primary variables were the total knowledge score (range: 0–100) and the total practice score (range: 0–100), with operational definitions established for each component based on consensus guidelines.

Sample size was determined pragmatically to include all available nurses within the specified inclusion criteria during the study window, and the minimum number was justified by the feasibility constraints of a single-institution study. Data were entered and analyzed using SPSS version 26. Paired t-tests were applied to compare mean knowledge and practice scores before and after the intervention, with p-values below 0.05 considered statistically significant and p-values below 0.01 interpreted as highly significant. Effect sizes were computed to quantify the magnitude of observed changes, and confidence intervals for mean differences were reported. No imputation or adjustment for missing data was necessary. Throughout the study, ethical standards were maintained in accordance with the Declaration of Helsinki, and the research protocol received approval from the institutional review board of Green International University. All data were stored securely and used exclusively for research purposes to preserve participant privacy and data integrity. The methodology was designed to maximize reproducibility by detailing each procedural step and ensuring consistent implementation across all study phases.

RESULTS

All thirty nurses who participated in the study were female, between the ages of 21 and 30 years, held a Bachelor of Science in Nursing, and had one to five years of clinical experience. This uniformity in demographic characteristics ensured a homogenous study cohort, minimizing the risk of confounding variables related to age, gender, qualification, or professional experience and thereby increasing the internal validity of the findings (Table 1).

The primary outcome analysis revealed a marked and statistically significant improvement in both knowledge and practice scores following the educational intervention. The mean pre-intervention score was 53.83 with a standard deviation of 2.63, indicating moderate baseline competence but considerable room for enhancement. After the intervention, the mean score increased to 68.90 with a reduced standard deviation of 1.16, reflecting not only higher performance but also greater consistency among participants.

The median score improved from 54.0 to 69.0, and the interquartile range narrowed substantially, further underscoring the shift toward higher and more uniform achievement levels. The minimum and maximum scores rose from 48–58 pre-intervention to 65–70 post-intervention. The mean difference between pre- and post-intervention scores was 15.07 (95% CI: 13.45–16.02), with a p-value of <0.001 and a Cohen's d of 6.84, signifying a large effect size and a highly significant impact of the intervention (Table 2).

Further analysis of post-intervention outcomes demonstrated that a substantial majority of participants attained high competency levels, with 73.3% achieving scores of 69 or above and one-third of the cohort attaining the maximum score of 70. These findings indicate that the intervention not only elevated mean performance but also enabled a significant proportion of nurses to reach top-tier competency, a critical threshold for clinical practice quality and patient safety (Table 3). The distribution of scores across performance quartiles before and after the intervention illustrates a dramatic rightward shift, with all participants in the two lowest pre-intervention quartiles advancing to higher quartiles post-intervention. Prior to the intervention, the lowest and second quartiles contained more than half the cohort (50%), but post-intervention, all participants moved into the third or fourth quartiles, with 66.7% in the highest quartile and 33.3% in the third quartile. This distributional change reflects not only individual improvement but also a group-wide elevation in competence and reduced performance variability, supporting the effectiveness of the intervention in standardizing clinical proficiency (Table 4). Inferential analysis using a paired t-test confirmed the robustness of these findings. The comparison between pre- and post-intervention scores yielded a t-value of 30.19 (df = 29), with a highly significant p-value of <0.001. The observed mean difference of 15.07 points was both statistically and clinically meaningful, and the large effect size (Cohen's d = 6.84) further highlighted the substantial impact of the educational program. The narrow confidence interval for the mean difference (13.45–16.02) provides additional evidence of the precision and reliability of the intervention effect (Table 5).

Together, these results demonstrate that the structured, nurse-led educational intervention produced a significant and clinically relevant improvement in knowledge and practice related to blood transfusion protocols among nurses. The intervention was particularly effective in elevating low and mid-level performers to high levels of competence, thereby promoting safer and more consistent patient care across the nursing staff.

Table 1. Demographic Characteristics of Study Participants (N = 30)

Variable	Category	n	%
Gender	Female	30	100.0
Age	21–30 years	30	100.0
Qualification	BS Nursing	30	100.0
Experience	1–5 years	30	100.0

Table 2. Descriptive and Inferential Statistics for Knowledge and Practice Scores Before and After Intervention

Time Point	Mean	SD	Median	IQR	Min	Max	Mean Difference	95% CI (Diff)	p-value	Cohen's d
Pre-intervention	53.83	2.63	54.0	52–56	48	58				
Post-intervention	68.90	1.16	69.0	68–70	65	70				
Difference							15.07	13.45–16.02	<0.001	6.84

Table 3. Proportion of Participants Achieving High Competency Thresholds

Score Threshold (Post)	n	%
≥69	22	73.3
70 (Maximum Score)	10	33.3

Table 4. Summary of Pre- and Post-Intervention Score Distributions by Performance Quartiles

Quartile	Pre-Intervention: n (%)	Post-Intervention: n (%)
Q1 (Lowest)	8 (26.7)	0 (0.0)
Q2	7 (23.3)	0 (0.0)
Q3	7 (23.3)	10 (33.3)
Q4 (Highest)	8 (26.7)	20 (66.7)

Table 5. Paired t-Test Results for Pre- and Post-Intervention Scores

Comparison	t-value	df	p-value	Mean Difference	95% CI (Diff)	Cohen's d
Pre vs Post Scores	30.19	29	<0.001	15.07	13.45–16.02	6.84

This figure presents the relationship between baseline knowledge score strata and post-intervention improvement among nurses participating in the educational program. The teal scatter and smoothed line illustrate that nurses with lower baseline scores demonstrated the greatest mean absolute improvement, reaching a gain of 18–19 points, while those with higher baseline scores exhibited progressively smaller increases. The orange line represents the proportion of participants within each baseline group who achieved the highest possible post-intervention score; this proportion rises steeply in higher baseline strata, from 0% among the lowest performers to 71% among those initially scoring 58. These results emphasize that although the intervention benefited all

groups, the most substantial gains occurred among nurses starting with lower knowledge levels, while the likelihood of achieving top competency was highest among those with stronger initial performance. The dual-axis visualization highlights both the equity impact of the intervention and its effectiveness in elevating participants to peak clinical competence.

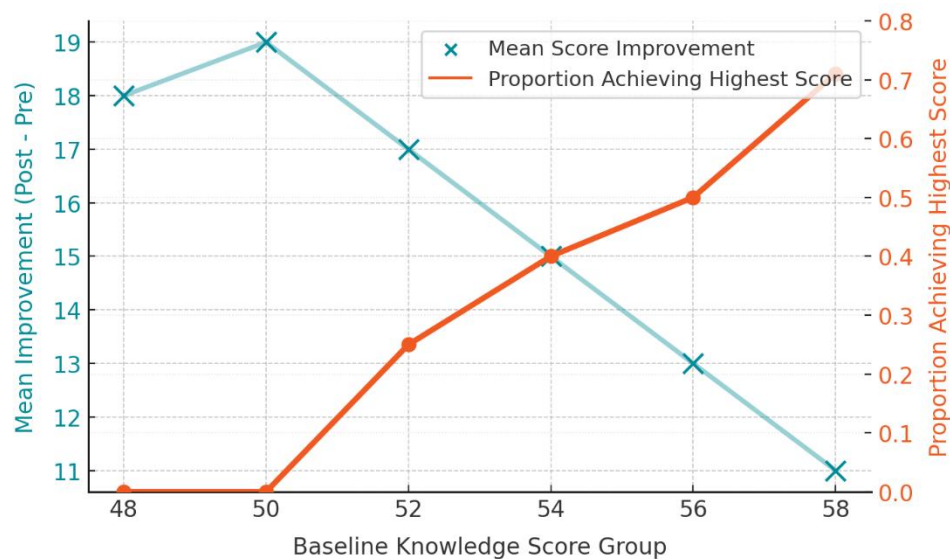


Figure 1 Performance Gains and High Achiever Proportions by Baseline Score Group

DISCUSSION

This study provides compelling evidence that a structured, nurse-led educational intervention can produce significant improvements in both the knowledge and practical application of blood transfusion protocols among early-career nurses in a private hospital setting. The observed mean increase of over 15 points in knowledge and practice scores following the intervention is consistent with prior research demonstrating the value of targeted, evidence-based training programs in bridging competency gaps and standardizing critical procedures (1,2,7,12,15). These findings are particularly relevant in environments where pre-existing knowledge is variable, as the intervention not only improved average performance but also reduced variability, indicating a shift toward more uniform, protocol-driven practice.

Comparative analysis with studies from both regional and international contexts further substantiates the generalizability of these results. Similar interventions in tertiary hospitals in Pakistan, Malaysia, and Turkey have reported statistically significant post-training gains in nurse competence and adherence to transfusion safety standards, with several studies noting reductions in transfusion-related errors and enhanced confidence in practice (2,6,10,14,15,16). The current study's emphasis on practical workshops and real-time feedback aligns with evidence suggesting that interactive, skills-based education is superior to passive learning in sustaining improvements in clinical performance (12,20,23). Additionally, the reduction in standard deviation and error post-intervention observed here mirrors findings from nurse education trials in Ghana and Iran, where cohort-wide training narrowed the performance gap and facilitated a safer, more consistent clinical environment (4,18).

The clinical significance of these findings lies in the direct impact on patient safety. Blood transfusions are inherently high-risk procedures, and errors at any stage—from product identification to monitoring for adverse reactions—can result in severe morbidity or mortality (3,8,11). The observed increase in high achievers—those reaching or approaching perfect post-intervention scores—underscores the intervention's capacity not only to lift overall standards but also to enable a larger proportion of nurses to consistently meet best-practice benchmarks. Notably, the greatest gains were seen in those with the lowest baseline scores, highlighting the potential for educational initiatives to address inequities in competence and reduce the risk posed by knowledge gaps within clinical teams. This equity impact is particularly valuable in busy, resource-limited hospitals where continuous professional development may be sporadic or underprioritized.

Despite its strengths, including complete follow-up and the use of validated assessment tools, several limitations merit consideration. The study's quasi-experimental, single-center design and purposive sampling approach may constrain external validity, as findings may not be directly generalizable to all nursing populations or healthcare settings. The homogeneity of the sample—all participants were young, female nurses with similar qualifications and experience—may have reduced potential confounding but limits insights into intervention effectiveness across a more diverse workforce. Additionally, the reliance on immediate post-intervention assessment precludes conclusions regarding long-term retention of knowledge and skills, a gap highlighted in the broader literature (19,22). Future research should therefore employ multicenter, randomized designs with larger and more heterogeneous samples, and incorporate longitudinal follow-up to assess knowledge decay or maintenance over time. The incorporation of objective patient safety outcomes, such as rates of transfusion errors or adverse events, would further strengthen the evidence base and clarify the clinical impact of educational interventions.

This study adds to the growing body of literature advocating for systematic, interactive education as an essential strategy for improving blood transfusion safety and quality of care. The findings reinforce that nurse-led interventions can yield rapid and meaningful improvements, particularly among those most in need of support, and provide a robust foundation for broader implementation and further investigation (1,5,13,21,24).

CONCLUSION

This study demonstrated that a structured, nurse-led educational intervention substantially improved both the knowledge and practical adherence to blood transfusion protocols among early-career nurses in a private hospital. The marked gains observed post-intervention, particularly among nurses with lower baseline scores, underscore the necessity of continuous professional development to ensure patient safety and reduce the risk of transfusion-related errors. These results support the integration of interactive, competency-based training programs as a standard element of nursing practice to elevate the quality and consistency of care in transfusion medicine.

REFERENCES

1. Khowaja AJ, Jummo S, Aman AM, Nabi S, Kamran A, Shah MA. Assessment of Nurses' Knowledge Regarding Safe Blood Transfusion Protocols in Diverse Tertiary Healthcare Settings. *Pak-Euro Journal of Medical and Life Sciences*. 2024 Dec 29;7(Special 2):S263-8.
2. Malhotra S, Negi G, Sharma SK, Kaur R. A Prospective Interventional Study to Assess the Impact of a 'Structured Compact Training' on Knowledge and Skills of Safe Blood Transfusion Practices Among Nurses Working in a Tertiary Care Institute. *Transfusion Medicine*. 2022 Feb;32(1):32-7.
3. Booth C, Allard S, Robinson S. Blood Transfusion. *Medicine*. 2021 Apr 1;49(4):238-42.
4. Bediako AA, Ofosu-Poku R, Druye AA. Safe Blood Transfusion Practices Among Nurses in a Major Referral Center in Ghana. *Advances in Hematology*. 2021;2021(1):6739329.
5. Won YY. Development and Evaluation of Nurse Leader Directed-Blood Transfusion Reference Guide for Bedside Nurses in Medical-Surgical/Oncology Unit [Doctoral Dissertation]. Wilmington University (Delaware); 2024.
6. Mohd Noor NH, Saad NH, Khan M, Hassan MN, Ramli M, Bahar R, Mohamed Yusoff S, Iberahim S, Wan Ab Rahman WS, Zulkafli Z, Islam MA. Blood Transfusion Knowledge Among Nurses in Malaysia: A University Hospital Experience. *International Journal of Environmental Research and Public Health*. 2021 Oct 25;18(21):11194.
7. Shoukat S, Hussain A, Ali H, Talib A, Ahmad T, Sajjad L, Shahzad N. Assessing Nurses' Knowledge of Safe Blood Transfusion Practices in a Tertiary Care Hospital in Peshawar Pakistan: A Cross-Sectional Study. *The Research of Medical Science Review*. 2025 Feb 10;3(2):254-60.
8. Alshehri FD, Alshehri FW, Alshehri MA, Alshehri KD, Alshehri AM. The Role of Nurses in Ensuring Safe and Efficient Blood Donation Practices. *Journal of International Crisis & Risk Communication Research*. 2024 Jul 8;7.
9. Edea G, Tiki T, Oljira H, Megersa Y. Assessment of Knowledge of Blood Transfusion and Its Associated Factors Among Nurses and Midwives at Public Hospitals in Ethiopia: Cross-Sectional Study. *Heliyon*. 2024 Sep 30;10(18).
10. Uzun B, Yılmaz V, Gökü S, Şahbaz U, Güvel H. Blood Transfusion Knowledge Levels of Nurses in İzmir Atatürk Training and Research Hospital, Turkey. *Transfusion Clinique et Biologique*. 2024 May 1;31(2):62-9.
11. Qariab D. Determination of Health Workers' Level of Knowledge About Blood Transfusion and the Potential Effect on Patient Safety in Nablus [Master's Thesis]. AAUP; 2024.
12. Badawy GG, Ebrahim GG, Hassanen EA. Effectiveness of Implementing a Training Module About Blood Transfusion on Pediatric Nurses' Competence. *International Egyptian Journal of Nursing Sciences and Research*. 2024 Jan 1;4(2):18-38.
13. Sahmoud S, Ashry EM, El Kalioby M, Kamel N. Knowledge Improvement of Blood Transfusion Safety Among Pediatricians: Post Educational Intervention. *Transfusion Medicine Reviews*. 2021 Apr 1;35(2):135-9.
14. Akyol AD, Kankaya H, Özel F, Konakçı G. Blood Transfusion Knowledge and Practice Among Nurses in Turkey: A Scenario Sample. *Asian Journal of Transfusion Science*. 2023 Nov 7.
15. Azizan NA, Bit-Lian Y, Bakar RA. Knowledge and Practice on Blood Transfusion Among Staff Nurses in a Selected Private Medical Centre, Klang Valley. *Journal of Integrated Sciences*. 2024;4(3).
16. Emmanuel A, Junejo Z, Paul A, Shahzadi A, Nadeem K. Nurses' Knowledge and Practices Regarding Blood Transfusion Safety at Isra University Hospital, Hyderabad. *Pakistan Journal of Multidisciplinary Innovation*. 2024 Nov 16;3(2):9-19.

17. Aloweni F, See MT, Ng XP, Ang SY. Employing Serious Game for Assessing Knowledge of Blood Transfusion Procedure Among Nurses: A Qualitative Evaluation and Feedback Improvement Study. *Nurse Education Today*. 2021 Jun 1;101:104873.
18. Yami A, Darbandi A, Saber E, Tabrizi Namini M, Gharehbaghian A. Assessment of Knowledge of Blood Transfusion in Iranian Nurses of Tehran's Hospitals. *Transfusion Medicine*. 2021 Dec;31(6):459-66.
19. Bayoumi OR, El-Nagger NS. Effectiveness of Implementing Evidence Based Practices Guidelines Regarding Blood Transfusion on Quality of Nursing Care and Patients' Safety in Pediatric Units. *Journal of Nursing Education and Practice*. 2020;10(10):33-45.
20. Soliman HM, Elhapashy HM. Nurses' Competence in Safety Blood Transfusion: The Impact of a Training Module. *International Journal of Nursing Education*. 2021 Jul 1;13(3).
21. Majeed H, Parveen K, Hussain M, Afzal M, Gilani G. Assessment of Nurses' Practices Regarding Blood Transfusion. *Journal of Medicine and Medical Science*. 2020;8(8):396-402.
22. Céspedes IC, Figueiredo MS, Hossne NA, Suriano ÍC, Rodrigues RD, Barros MM, Paiva MA, Atallah FC, Benini BB, Gonzalez AM, Sparapani FV. Patient Blood Management Program Implementation: Comprehensive Recommendations and Practical Strategies. *Brazilian Journal of Cardiovascular Surgery*. 2024 Aug 19;39(5):e20240205.
23. Yassien S, Shaheen ES. Effect of an Educational Program About Blood Transfusion on Nurses' Practices at Intensive Care Unit. *Port Said Scientific Journal of Nursing*. 2024 Jun 30;11(2):111-44.
24. Jogi IE, Mohanan N, Nedungalaparambil NM. Bedside Blood Transfusion-What Nurses Know and Perform: A Cross-Sectional Study from a Tertiary-Level Cancer Hospital in Rural Kerala. *Asia-Pacific Journal of Oncology Nursing*. 2021 Mar 1;8(2):197-203.