

Bedside Blood Transfusion – What Nurses Know and Perform: A Cross-Sectional Study from A Tertiary-Level Cancer Hospital in Rural Kerala

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ABSTRACT

Objective: Nursing professionals are expected to have updated knowledge of clinical blood transfusion guidelines while catering to cancer patients requiring bedside transfusions.

Methods: A cross-sectional study was conducted to evaluate the knowledge and current practice of nurses at a tertiary-level cancer hospital in rural Kerala using a pretested self-administered structured 20-item questionnaire, and results were analyzed. **Results:** Among 246 nurses who participated, a response rate of 93.08% ($n = 229$) was obtained. Mean scores of 4.64 ± 1.20 out of eight for knowledge-based questions (58.00%) and 6.16 ± 1.49 out of 12 for practical aspects (51.33%) were obtained among respondents. Whereas overall scores were fair (84.28% and 65.94% nurses scoring $\geq 50\%$ in knowledge-based and practice-based questions, respectively), we noticed poor knowledge-level scores for the key aspects such as time taken for cross-matching, cross-match test taking least time, storage temperature, and mandatory transfusion-transmitted infection

tests before initiating transfusion. Poor scores were also noted for key clinical practices relating to warming of blood products, posttransfusion patient monitoring, rate of nonemergency blood transfusions, administration of premedications, and disposal of blood bags among the respondents. Data also revealed that there was a lack of adherence to a uniform cannula size for routine blood transfusion among nurses. Work experience or qualification had no significant relation to the nurses' scores for knowledge or practice-based questions. **Conclusions:** Overall, a fair amount of theoretical and practical knowledge about bedside transfusion practices were observed among nurses with some inconsistencies not related to qualification or work experience. This illuminates inherent lacunae in the existing training system and merits urgent redressal.

Key words: Blood transfusion, knowledge, nurse education, nurses, practices, safe blood

Introduction

In India, about 12 million units of blood are transfused annually, whereas globally, it is around 117.4 million which translates to more than three blood transfusions happening every second.^[1-3] Ensuring patient safety during each blood transfusion depends on bedside nursing quality as much as

with the adequately matched blood product. Nurses assume a central role in the blood transfusion chain from the inception of a transfusion request. Apart from being directly involved with initiation of safe blood transfusion, nurses caring for cancer patients have a greater role in bedside monitoring for reactions

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and toxicities even after the termination of the process.

Human errors largely due to failure to comply with proper guidelines and repeated cross-checks disrupt the execution of safe transfusions.^[4,5] The Serious Hazards of Transfusion survey revealed 87.3% of total serious adverse blood reactions and events in the United Kingdom to be due to human errors like “near miss events” and “right blood right person” issues.^[5] The hemovigilance programme of India, on the other hand, reported that among hemolytic transfusion reactions, 51.2% errors were due to improper handling or bedside storage of blood and that 27.3% of ABO incompatibility hemolytic reactions were due to bedside sampling errors.^[6] The World Health Organization (WHO) recommends training health-care workers as the cornerstone of integrated approach to improve blood safety and quality in the process of blood transfusion.^[2]

Being at the frontline of patient interface during blood transfusion in cancer patients, nurses are expected to have a thorough updated knowledge of bedside transfusion practices. Nurses trained in India, especially from Kerala contribute to a sizeable proportion of those working abroad and contribute to Kerala’s unique position as having high health indices and literacy levels on par with developed countries.^[7,8] In view of a serious lack of researches concerning the bedside knowledge level of blood transfusion among nurses catering to cancer patients from India, this study was conceived at a tertiary-level cancer hospital in rural Kerala.

Methods

Study design and setting

A descriptive, cross-sectional study was undertaken to achieve the purpose of this study. The research was conducted at a philanthropic tertiary-level 1200-bedded cancer center-cum teaching hospital located in a rural area of Thrissur district in Kerala, India, during September 2019. All registered nurses (affiliated to Kerala Nurses and Midwives Council) who were diploma holders (General Nursing and Midwifery), graduates (Bachelor of Sciences), or post-graduates (Master of Sciences) working in the cancer hospital were our study subjects.

Inclusion criteria

Only registered nurses who were regular employees of the hospital marking their daily attendance were listed. Only those nurses involved with direct patient care in any of the wards, intensive care units or other cancer care areas, and consented to participate at the time of the study were included.

Exclusion criteria

Nursing students, interns, observers, contract staff and nurses not involved with bedside patient care, or belonging

to supervisory or administrative cadre were excluded from the study.

Study tool

A self-administered structured and pretested paper-based questionnaire comprising of 20 questions was used to collect the data. All questions were multiple choice types with eight questions pertaining to theoretical knowledge and 12 questions related to practical knowledge. The questionnaire was prepared by the investigators and answers marked in accordance with the WHO handbook for the clinical use of blood.^[9] Theoretical knowledge-based questions measured participant knowledge of relevant bedside clinical concepts necessary to ensure safe bedside transfusions like the type of sample tube used to collect blood for cross-matching, time taken for cross-matching blood in the hospital, type of cross-match test that takes least time, universal acceptor blood group in packed red blood cell (PRBC) transfusions, mandatory transfusion-transmitted infection tests before blood transfusions, and storage temperature of whole blood. The investigators also included relevant questions assessing participant awareness about the existence of a written hospital policy for the administration of blood and the location of blood bank in hospital (knowledge of which are quality indicators as per the national accreditation policy of hospitals) which were deemed important knowledge in the local context. Practical aspects such as verification of patient details with blood bag at bedside before transfusion, maximum time within which blood needed to be transfused, maximum time for which blood could be stored at the bedside, size of cannula used for routine transfusions, intravenous fluid compatible with blood, premedications administered prior to transfusion, rate of blood transfusion in nonemergencies, bedside warming of blood products, monitoring of patients following transfusions, return of transfusion reaction forms to blood bank, time within which blood bag had to be returned to blood bank if unused, and appropriateness of waste bins used for disposal of blood bags were all probed. Content validity and internal consistency were ensured by doing a pilot study, and changes were made accordingly to achieve a Cronbach’s alpha of 0.83.

Data measurement and outcome measures

The overall theoretical and practical knowledge of nurses was quantified based on their response to the questionnaire. Correct response to each question was given a score of one and all other responses were given a score of zero. Based on this, a “fair knowledge” or practice was defined as a score $\geq 50\%$ and a “poor knowledge” or practice was defined as a score $< 50\%$ *a priori*.

Sample size

The minimum number of respondents for the study was calculated to be 111 assuming 95% confidence interval and 47% prevalence (based on average knowledge prevalence from previous similar studies.^[10-13]

Ethical approval

Institutional Ethics Committee clearance was obtained before conducting the study. The objectives of the study were explained to all nurses, and a prior written informed consent from each participant was obtained with guaranteed voluntary participation and confidentiality. Participants were free to enroll out of the study anytime.

Data collection

All nurses who were on duty on the day of study were listed after cross-checking with attendance sheets and included to avoid selection bias. The printed questionnaires were distributed among all available nurses across all wards, care areas, and nurses station at the end of their first shifts by the investigators on a single day to avoid bias by means of sharing questions and to improve the response rate. The completed questionnaires were collected after they were given sufficient time to complete it.

Quantitative variables

Data from completed questionnaires were tabulated in Excel spreadsheet (Microsoft Inc., Redmond, Washington, USA). Data from the study sample were divided into two groups of “fair knowledge” and “poor knowledge” based on scores obtained and cross-tabulations performed with basic demographic data.

Statistical analysis

Statistical analysis was carried out after the exclusion of incomplete data. Data were analyzed using the SPSS software version 23.0 (SPSS Inc., Chicago, IL, USA). Pearson’s correlation analysis was used to assess strength and association between quantitative variables, whereas inter-group statistical comparison of continuous variables was done using the analysis of variance (ANOVA), and a $P < 0.05$ was deemed significant *a priori*.

Results

Sample characteristics

Among 835 potentially eligible nurses in hospital, the questionnaires were distributed among the available 296 nurses, out of which 246 nurses participated in the study. Upon further scrutiny, only 229 nurses filled the questionnaires completely (response rate: 93.08%) and hence were included in the final analysis, as summarized

in Figure 1. All nurses had carried out blood transfusion at least once. Females ($n = 227$; 99.13%) were the majority gender. Most of them were of 20–30 years age ($n = 149$, 65.06%) and had a work experience of 1–10 years ($n = 199$, 86.90%), as summarized in Table 1.

Evaluation of theoretical knowledge

A mean score of 4.64 (58.00%) and standard deviation (SD) 1.20 out of eight was observed for theoretical knowledge, as summarized in Figure 2. Majority of nurses (193; 84.28%) had a score of $\geq 50\%$ and 36 (15.72%) had a score of $< 50\%$. Table 2 summarizes the frequencies of responses to individual knowledge-based questions. Knowledge level scores were found to be $< 50\%$ for key aspects such as time

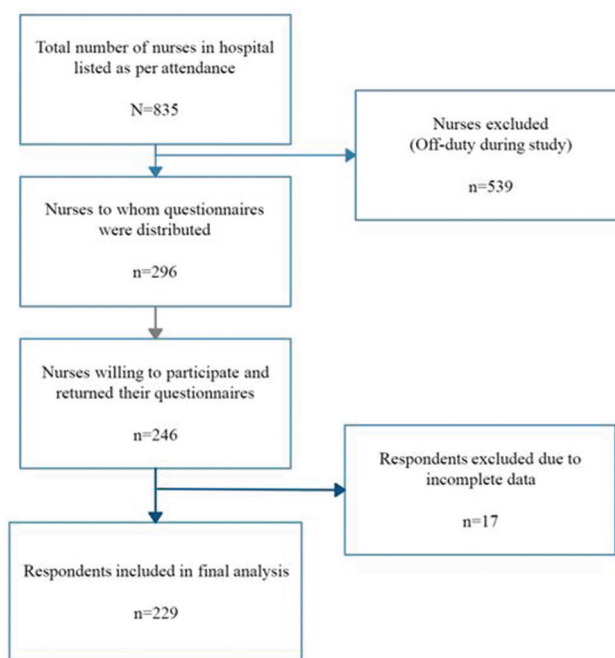


Figure 1: Flow chart depicting summary of data collection from the study participants

Table 1: Demographic characteristics of study participants (n = 229)

Variables	Categories	Frequencies, n (%)
Gender	Male	2 (0.87)
	Female	227 (99.13)
Age (years)	20-30	149 (65.06)
	31-40	66 (28.82)
	> 40	14 (6.12)
Qualification	GNM	118 (51.52)
	B.Sc.	106 (46.28)
	M.Sc.	5 (2.20)
Work experience (years)	< 1	8 (3.49)
	1-10	199 (86.90)
	> 10	22 (9.61)

GNM: General Nursing and Midwifery (diploma course); B.Sc.: Bachelor of Sciences in Nursing (graduate degree); M.Sc.: Master of Sciences in Nursing (postgraduate degree)

for cross-matching, cross-match test taking least time, storage temperature, and mandatory tests before initiating transfusion.

Evaluation of practice-based questions

A mean score of 6.16 (51.33%) and SD of 1.49 was observed out of 12 for practical knowledge and is summarized in Figure 3. A majority of nurses (151, 65.94%) had a score of $\geq 50\%$ while 78 (34.06%) had a score $< 50\%$. Table 3 summarizes the frequencies of nurses' responses to individual practice-based questions.

We noticed low scores in key practical aspects of bedside blood transfusion such as warming of blood products, monitoring of patient following transfusion, rate of nonemergency PRBC transfusion, and administration of premedications among the respondents. Data also revealed that there was no uniform practice with regard to the use of a standard cannula size for blood transfusion among nurses [summarized in Figure 4]. Only 35 (15.28%) nurses reported about cannulating as per the sizes prescribed by the WHO guidelines. A disparity was also noted regarding the proper disposal of blood bag after transfusion [as plotted in Figure 5] where 106 (46.28%) nurses reported disposing blood bags correctly into yellow color-coded biohazard bins (meant for disposing blood products in India).

Comparison across groups

The present study revealed no statistically significant

association between qualification of nurses and their knowledge ($P = 0.147$) or practice ($P = 0.069$) regarding blood transfusion, as summarized in Table 4. No statistically significant association between work experience of nurses and knowledge or practice (both $P = 0.969$) regarding blood transfusion was also noted [summarized in Table 5].

Discussion

Indian studies have assessed blood transfusion knowledge among doctors, nurses, and other staff in general except a few which exclusively examined nurses' knowledge in the clinical setting.^[11-13] Although the most comparable Indian study to ours' was Panchawagh *et al.*^[11] that assessed both theoretical and practical knowledge about bedside blood transfusion among nurses including hemato-oncology nurses among their study population, ours' is the first Indian study done exclusively among nurses caring for cancer patients.

A very high response rate was received for our survey probably due to proper percolation of information among nurses regarding the study, approaching them at a relaxed time after duty shifts and co-operation from supervisory staff. Our study reported fair theoretical and practical knowledge in the domain as reflected by their scores. Our study reported higher theoretical knowledge (84.28% vs. 54.0%) and

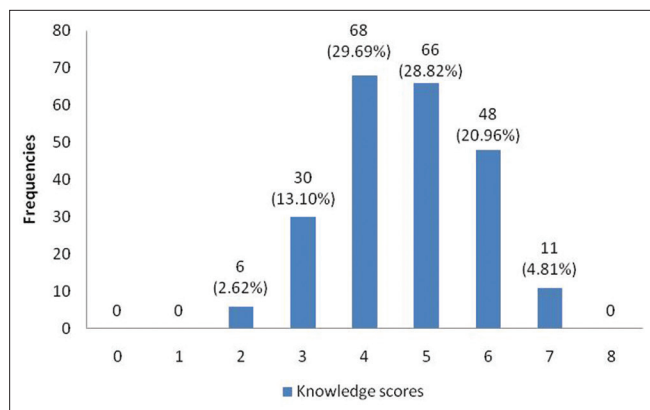


Figure 2: Distribution of respondent scores to practice-based questions (n = 229)

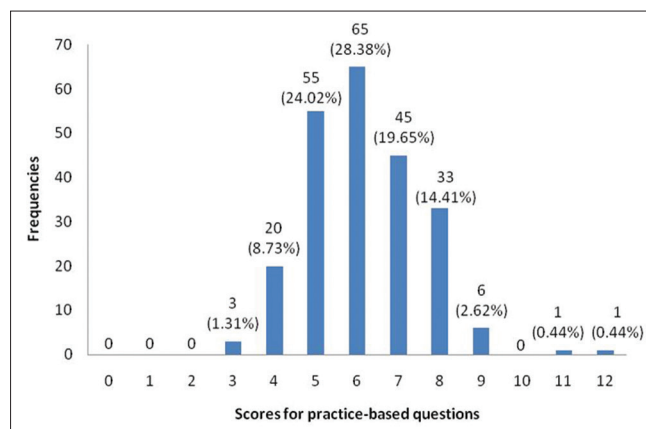


Figure 3: Practice among nurses regarding the disposal of blood bag into color-coded waste bins (n = 229)

Table 2: Summary of theoretical knowledge of respondents (n = 229)

Knowledge-based questions	Correct responses, n (%)	Incorrect responses, n (%)
Written policy for the administration of blood	223 (97.38)	6 (2.62)
Location of blood bank in hospital	217 (94.76)	12 (5.24)
Type of sample tube used to collect blood for cross-matching	215 (93.89)	14 (6.11)
Universal acceptor blood group in PRBC transfusion	142 (62.01)	87 (37.99)
Type of cross-match test which takes the least time	103 (44.98)	126 (55.02)
Storage temperature of whole blood	72 (31.44)	157 (68.56)
Time taken for routine cross-match in the hospital	57 (24.89)	172 (75.11)
Mandatory transfusion-transmitted infection tests prior to transfusion	44 (19.21)	185 (80.79)

n: Number of respondents; PRBC: Packed red blood cells

Table 3: Summary of practical knowledge of respondents

Practice based questions	Correct responses, n (%)	Incorrect responses, n (%)
Verification of patient details with the blood bag at bedside	228 (99.56)	1 (0.44)
Intravenous fluid compatible with blood	190 (82.97)	39 (17.03)
Maximum time within which PRBC transfusion must be completed	173 (75.55)	56 (24.45)
Return of the transfusion reaction form to blood bank	160 (69.87)	69 (30.13)
Time within which blood must be returned to blood bank if unused	139 (60.70)	90 (39.30)
Maximum time for which blood can be kept at room temperature before transfusion	132 (57.64)	97 (42.36)
Blood bag and blood products disposal bin	106 (46.29)	123 (53.71)
Warming of PRBC before transfusion	90 (39.30)	139 (60.70)
Monitoring of patient following a transfusion	43 (18.78)	186 (81.22)
Size of the cannula used for routine transfusion	35 (15.28)	194 (84.72)
Rate of PRBC transfusion in nonemergency	25 (10.92)	204 (89.08)
Premedications prior to transfusion	10 (4.37)	219 (95.63)

n: Number of respondents; PRBC: Packed red blood cells

Table 4: Comparison of knowledge levels and practice of blood transfusion across educational qualification of nurses

Educational qualification	n	Practices (score out of 12), mean±SD	P	Knowledge (score out of 8), mean±SD	P
GNM	118	6.36±1.43	0.069	4.55±1.11	0.147
B.Sc.	106	5.93±1.35		4.82±1.21	
M.Sc.	5	6.00±1.23		4.20±1.10	
Total	229	6.16±1.40		4.67±1.16	

n: Number of respondents; SD: Standard deviation; GNM: General Nursing and Midwifery (diploma course); B.Sc.: Bachelor of Sciences in Nursing (graduate degree); M.Sc.: Master of Sciences in Nursing (postgraduate degree)

Table 5: Comparison of knowledge levels and practice of blood transfusion across the experience of nurses

Experience (in years)	n	Practices (score out of 12), mean±SD	P	Knowledge (score out of 8), mean±SD	P
<1	8	6.13±1.89	0.969	4.13±1.25	0.969
1-10	199	6.15±1.40		4.72±1.16	
>10	22	6.23±1.31		4.36±1.09	
Total	229	6.16±1.40		4.67±1.16	

SD: Standard deviation

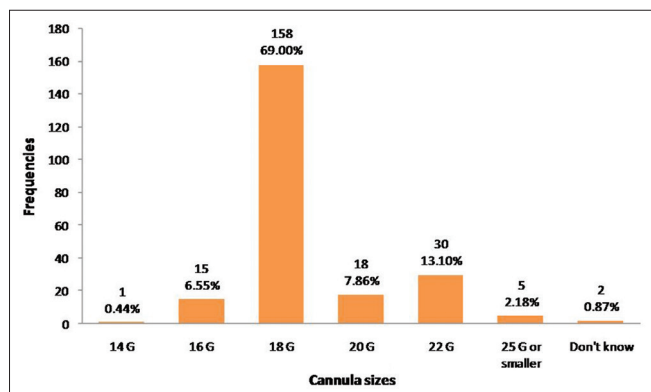


Figure 4: Distribution of theoretical knowledge scores of respondents (n = 229)

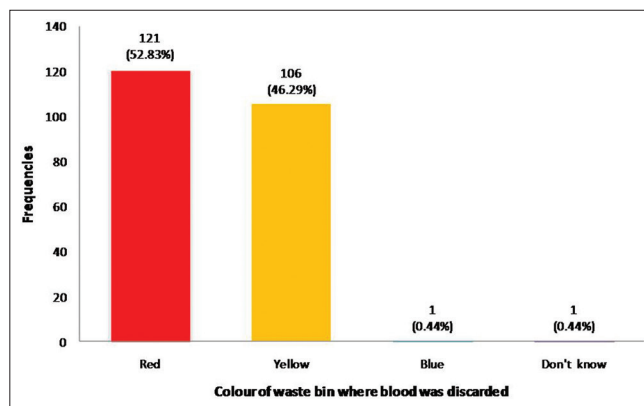


Figure 5: Practice among nurses regarding cannula sizes used for routine blood transfusion (n = 229)

identical practical knowledge (65.94% vs. 66.0%) compared to a recent Indian study among nurses by Panchawagh *et al.*^[11] Another Indian study by Dasaraju *et al.*,^[12] however, reported poor knowledge for almost all steps during blood transfusion among more than half of the nurses, like few international studies among cancer nurses.^[14,15] It must, however, be noted

that the values reported by these studies were not absolutely comparable due to the variations in the questionnaires used for assessment. A study by Hijji *et al.*^[10] using similar questions to assess theoretical knowledge among Jordanian nurses reported lower mean scores (51.8% vs. 58.0%) and lesser

theoretical knowledge (62.0% vs. 84.28% scoring $\geq 50\%$) compared to our study. Hitherto not evaluated in Indian studies, nurses in our study were better aware than nurses in the study by Hijji *et al.*,^[10] (97.38% vs. 83.0%) regarding written hospital policy for the administration of blood. In our study, 93.89% correctly knew the sample tube type to collect blood for cross matching, importance of which needs to be read in line with reports that multiple blood sample collections by itself could lead to anemia in patients.^[16] Whereas other Indian studies did not assess this, Dubey *et al.*^[17] reports that only 38.20% correctly knew the sample tube type to collect blood for cross matching in neonatal transfusions.

Nurses in our study had poor knowledge regarding time taken for cross-matching (44.98%), but this was better than the findings of Kaur *et al.*,^[18] where only 20%–32% clinicians knew it correctly considering routine and emergency cross matching. Knowledge regarding storage temperature of blood was poor among nurses in our study (31.44%) compared to most other Indian studies such as Talati *et al.* (83%),^[13] Panchawagh *et al.* (47.3%),^[11] and also studies from abroad by Freixo *et al.* (63%).^[19] Knowledge assessment about transfusion-transmitted infections (TTI) in our study revealed that only 19.21% nurses correctly knew the mandatory tests done prior to blood transfusion. While Panchawagh *et al.* reported 63%,^[11] others like Mitra *et al.* (8%)^[20] and Kabinda *et al.* (10.7%).^[15] reported far lesser knowledge regarding TTI tests.

Higher percentage of nurses (75.55%) in our study reported as completing blood transfusions within 4 h as opposed to 41% reported by Dubey *et al.*,^[17] 45% by Hijji *et al.*^[10] and 33.9% by Sapkota *et al.*^[21] from Nepal. Majority (60.70%) of the participants in the present study knew that blood must be returned to blood bank within 30 min if not transfused unlike what was observed by Hijji *et al.*^[10] where 50.0% nurses would transfuse the blood kept in the room temperature even beyond 90 min after delivery to the ward. Majority of nurses in our study correctly knew that normal saline was the only intravenous fluid that could be safely administered along with blood and was in stark contrast to the findings of Hijji *et al.*^[10] (82.97% vs. 8.0%). This was a unique question not investigated by other Indian studies, and the only measure of a similar aspect was by Dubey *et al.*^[17] where 78.2% of their study population responded that no medications or drugs could be added with blood.

In our study, 39.30% knew the correct method of warming PRBCs using blood warmer, while 72.0% Jordanian nurses according to Hijji *et al.*^[10] used invalid techniques to warm blood before transfusion and 14% wrongly covered blood with blanket or linen for warming as reported by Hijji *et al.*^[22] among nurses from the United

Arab Emirates. Glaring differences in the practice of disposal of blood bag after the completion of transfusion and usage of uniform size cannula were noted in our study. This could be due to common practices based on the ease of securing cannula through which blood flows to complete the transfusion in 4 h. Our study revealed that years of work experience or qualification of nurses had no significant relation to either their knowledge or practice of bedside transfusion. Panchawagh *et al.*^[11] found no association between practice and years of work experience, but reported a statistically significant association between knowledge and years of work experience. When read in line, these are pointers toward inadequate training in clinical transfusion medicine in nursing curricula that leads to poor transfusion practices and nursing quality exposing patients to transfusion-related risks.

Strengths and limitations

This was the first study assessing bedside blood transfusion knowledge among nurses caring for cancer patients being reported from India. The questionnaire used in this study differed from those used in other studies making exact comparisons difficult. However, the strength of our study was relevance of these questions based on the WHO clinical transfusion practice guidelines which are not limited to blood transfusion in cancer patients alone and makes the results scalable across nurses across other parts of the world. Scoring for individual questions were on a uniform scale and differential scoring for each questions based on their relevance was avoided as almost all similar studies have provided equal weightage to all questions. Hence, for ease and uniformity in comparison across similar studies, this was adopted *a priori*. Quantifying irrational bedside blood handling aspects such as delay in transfusion or improper blood warming techniques that compromise blood quality due to hemolysis or bacterial contamination and lacunae in post-transfusion monitoring are worthy of clinical researches in future.

Conclusions

Our primary aim was to assess the theoretical and practical knowledge of bedside blood transfusion among nurses at a tertiary-level teaching-cum cancer hospital and were both found to be satisfactory. Healthy (theoretical more than practical) knowledge among cancer nurses working in a state with good literacy and health-care indices were on expected lines. However, islets of knowledge gap among nurses related to the key aspects of bedside transfusion like time taken for cross-matching, blood storage temperatures, and mandatory tests before initiating transfusion were revealed. Deficits in key clinical transfusion practices relating to warming of blood products, monitoring of patient following transfusion,

rate of nonemergency blood transfusions, administration of premedications, standard cannula size for blood transfusion and disposal of blood bag identified in our study are deeply concerning as blood transfusions in cancer patients require more vigil. Inconsistent knowledge about bedside transfusion practices among nurses not related to qualification or work experience illuminates inherent lacunae in existing training system and merits urgent redressal for which authors suggest the following recommendations:

1. Inclusion of more periodic assignments in nursing curricula during nursing training and hospital work like clinical audits of blood transfusion practices. This could be followed up with clinical discussions with institutional faculty or blood centers with an emphasis on both theoretical and practical knowledge
2. New postgraduate specialization in transfusion nursing with emphasis on cancer and noncancer blood transfusion aspects as training curricula maybe contemplated by nursing councils
3. Formulation of institutional policies to promote nurses on the basis of assessment scores in rational bedside clinical practices, with transfusion aspects being a key scoring area across the specialties or care zones
4. Mandatory “in-service training” in blood transfusion for nurses to update their knowledge while being still employed across different settings and care zones.

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Conflicts of interest

There are no conflicts of interest.

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