

Contributing Factors Affecting Nurses' Practice of Safe Blood Transfusion in Surgical and Critical Care Units

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Abstract

Background: Blood transfusions are an important part of nursing procedure. Nurses play a key role in safely administering blood products to patients in surgical and critical care units. **The aim of the study** was to evaluate nurses' employment conditions as contributing factors affecting nurses' practice of safe blood transfusion in surgical and critical care units in Alexandria Main University Hospital. **Subjects and Method: Study design:** Descriptive analytical design; an observational research design. **Setting:** Surgical and critical care units in Alexandria Main University Hospital. **Subjects:** The study was carried out on 350 nurses and 1000 processes of blood transfusions. **Study tools:** Data were collected using factors affecting safe blood transfusion questionnaire and nurses' practice of safe blood transfusion observational checklist. **Results:** The nurses' employment conditions affected the practice of safe blood transfusion among nurses in surgical and critical care units. A positive significant relationship and direct impact were found between nurses' practice and many factors as working in critical care units (OR= 1.29), professional (OR=1.72), technical (OR=1.12), trained nurses (OR= 1.60), working experience between 10 to 19 years (OR= 1.21) and more than 20 years (OR= 1.53), working 36 hours per week (OR=1.42) and day (OR= 1.66) and fixed shifts (OR=1.57). Staff ($r=-.682$; OR=.92) and untrained nurses (OR=.25), working in surgical care units (OR=.84), working duration less than 10 years (OR=.81), long (OR=.23), night (OR=.16) and rotated shifts (OR=.68) and more than 36 hours per week (OR=.13) had negative relationships and indirect effect on the nurses' practice. Two third of the studied nurses did not attain sufficient levels of practice of safe blood transfusion (66.6%). **Conclusion:** Nurses' employment conditions were contributing factors affecting the practice of safe blood transfusion among nurses in surgical and critical care units. **Recommendations:** Establishing training programs related to safe blood transfusion, creating safety measures for blood transfusion practice and providing blood transfusion policies are essential strategies for enhancing nurses' practice of safe blood transfusion in surgical and critical care units.

Keywords: Nurses, employment, contributing factors, practice, blood, transfusion

Introduction

Blood transfusion (BT) is an essential part of patient care and safety. Blood transfusions are a life-sustaining and life-saving treatment. It is a procedure conducted frequently in hospitals, especially in surgical and intensive care units (Pavenski et al., 2018; Hsieh et al., 2018). More than 50% of patients hospitalized in intensive care units and 50% to 70% of patients in surgical and orthopedic wards may need a blood transfusion (Juffermans & Wash, 2014; Vincent et al., 2018).

BT safety has a priority in healthcare systems across the world and is the focus of increasing

attention from The World Health Organization (WHO) and national and international accreditation agencies (Joint Commission on Accreditation of Healthcare Organizations, 2002; National Blood Transfusion Services, 2007; General Authority for Healthcare Accreditation and Regulation, 2019; World Health Organization, 2018). Although BT is life-saving and health-promoting in many circumstances, its use is associated with a significant risk to the patient and escalating costs to the blood system and hospital (Aly et al., 2020). Adverse outcomes associated with BT are reactions, circulatory overload, infection, acute lung injury, blood group incompatibility and

incorrect transfusion of blood products (Aly et al., 2020).

BT errors may occur during any step in the BT process beginning with physician's orders and ending with the actual administration of the blood ordered (Aly et al., 2020). Holmberg (2015) reported that 87.3% of total serious adverse blood reactions and events were due to human errors. The **Serious Hazards of Transfusion survey in the United Kingdom (2018)** revealed that every 13,000 BT patients, one error occurred most often due to human errors.

Nurses' practice is crucial for safely and efficiently administering blood components (Bealer, 2016). Nurses are responsible for the most fundamental aspects of safe BT and patient care. Their responsibilities include understanding the indication to transfuse blood products, pre-transfusion sampling, administration of blood products, patient monitoring for adverse reactions, and proper documentation of blood transfusion-related matters (Bealer, 2016; Majeed et al., 2020; Iqbal et al., 2021).

Proper nursing employment conditions and nurses' practice of BT are necessary for safe BT and avoiding BT errors. Ensuring patient safety during each BT depends on nursing staff and nursing organizational factors, especially working conditions. Nursing workplace conditions consist of a web of organizational employment factors that interact in a complex way leading to direct effects on nurses' practice of safe BT (Jogi et al., 2021).

Multiple employment contributing factors may influence nurses' safe practicing, including nurse personal characteristics (nurses' qualification and years of clinical experience), hospital workplace; type and time of shift; average working hours, and in-service training of blood transfusion. Therefore, a clear understanding of such factors is critical for improving nurses' practice and providing safe BT to patients in surgical and critical care units (Bayoumi et al., 2020).

Significance of the study:

The World Health Organization (2011) reported that nine million patients in 90 different countries received blood products in a year, where about 70% of all reported adverse events were related to improper blood administration.

Additionally, half of these events involved more than one transfusion error (García-Roa et al., 2017). In Germany (2017), BT failures were recorded in about 34.1 % of patients in the operating room, 25.2 % in the intensive care units, and 18.5 % in all hospital wards and had been enlisted as higher adverse events (Frietsch et al., 2017). National Blood Service, Ghana (2017) reported that transfusion events were higher in about 213 per 1000 processes of BTs (Owusu-Ofori et al., 2017).

Multiple factors predisposing to BT errors were related to human and organizational employment conditions, therefore, health care organizations should positively enhance nursing employment conditions to reduce errors associated with administration of BT among nurses in surgical and critical care units (Gurses et al., 2018, Bayoumi et al., 2020).

There is a growing interest of national and international studies focusing on safe BT practice among nurses (Ibrahim, 2012; Asal, 2014; Saif Al-Nas et al., 2016; Abd Elhy & Kasemy, 2017; Hendy & Marzouk, 2017; Sapkota et al., 2018). Many studies examined the relationship between nurses' characteristics and BT practice (Hijji et al., 2010; Al-Nas 2016; Cable et al., 2019; Majeed et al., 2020; Panchawaght et al., 2020; Iqbal et al., 2021). Globally and in Egypt to our knowledge, the relationship between nurses' employment conditions as contributing factors and the practice of safe BT was not comprehensively studied yet. Therefore, the present study tried to fill the gap and take the necessary action to evaluate nurses' employment conditions as contributing factors affecting nurses' practice of safe blood transfusion in surgical and critical care units in Alexandria Main University hospital.

Aim of the study:

The present study aimed to evaluate nurses' employment conditions as contributing factors affecting nurses' practice of safe blood transfusion in surgical and critical care units through:

(a) Describing overall levels of nurses' practice of safe BT in surgical and critical care units.

(b) Assessing the relationship between nurses' employment conditions as contributing factors and the nurses' practice of safe BT in surgical and critical care units.

Operational definitions:

- **Nurses' employment conditions:** are contributing factors that influence nurses' practice of safe blood transfusion in surgical and critical care units. Nurses' employment conditions are hospital workplace; qualification of nurses, type and time of shift; average working hours, years of clinical experience and in-service training of blood transfusion.
- **Nurses' practice of safe blood transfusion:** is the scope of practice regarding the nurse's ability to prepare, administer, monitor and document BT in a safe manner within surgical and critical care units.

Research questions

The current work identified two research questions as follows:

- (1) What are the levels of safe BT practice among nurses?
- (2) What are the nurses' employment conditions as contributing factors affecting nurses' practice of safe BT?

Subjects and Method:**Research design:**

Descriptive analytical design was carried out in the present study; an observational research design.

Settings:

The study was implemented in 12 surgical care and 6 critical care units in Alexandria Main University hospital.

Subjects:

The study sample included nursing staff and blood transfusion (BT):

- **Nursing staff:** A convenience sampling was utilized to recruit 350 nurses from surgical and critical care units who were willing to participate in the study. The inclusion criteria comprised nurses who provided direct nursing care and had a minimum of six months of clinical experience.
- **The process of blood transfusion (BT):** Assuming an average BT rate in surgical care and critical care units to be 30 % of total BT in the hospital based on the data obtained from the study units, α of 0.05, and absolute precision of 3%. 897 BTs were chosen to achieve an adequate measure of observations. The actual observed BTs amounted to 1000 transfusions.

Study tools:**Tool (1): Factors affecting safe blood transfusion questionnaire:**

The study researchers developed a "**factors affecting safe blood transfusion questionnaire**" to obtain data related to nurses' employment conditions, such as hospital workplace (critical care, surgical wards); type of shift (rotated, fixed); shift time (day, long, night); average working hours (36 or >36 hours/week); nurses' qualification and years of clinical experience, in addition to in-service training program attended regarding blood transfusion.

Tool (2): Nurses' practice of safe BT observational checklist tool:

It was based on literature review, researchers developed an observational checklist (**Bayraktar & Erdil, 2000; National Blood Transfusion Services, 2007; Hijji et al., 2010; Ibrahim, 2012; Saif Al-Nas et al., 2016; World Health Organization; 2020; Vlaar et al., 2020**) to assess nurses' practice during administration of BT to patients. This tool contained 40 observation check items of nurses' practice of safe BT, covering pre-BT (10 items), during-BT (20 items) and post-BT (10 items). The scoring of the practice checklist was zero score for not done, 0.5 score for incompletely done and one score for completely done.

Scoring system:

The maximum scores of nurses' practice were 40 points. According to the cut point of nurses' practice scores developed based by **Soliman & Elhapashy (2021)**, the practice score was classified as follows: nurses' practice was at an unsatisfactory level (< 80%) when mean scores of nurses' practice were less than 32 points and nurses' practice was at a sufficient level (\geq 80%) when mean scores of practice were equal or more than 32 points.

For statistical analysis, one point was assigned to each nurse's satisfactory level and zero point was assigned to each unsatisfactory level.

Validity and reliability:

Face and content validity were achieved by five experts in the same field using five-point Likert scales from (1) inappropriate and (5)

appropriate to the study. The expert agreement was tested using the content validity index (CVI). A cut point of expert agreements was $\geq 80\%$. The alpha coefficient measured the internal consistency of the observational tool (.79).

Pilot study:

A pilot study was carried out on the 35 nurses, two times, three weeks apart. The purposes of the pilot study were to test the feasibility of implementation, reveal potential difficulties that may arise and how to deal with them and estimate the time required to fill each questionnaire and observation sheet. As a result of the pilot study, addition, omission, and rephrasing of some BT data were carried out.

Data collection:

Data were collected from the beginning of December 2020 till the end of April 2021. The researchers interviewed nurses to explain the purpose and nature of the study answer any inquiries and clarify questionnaire and observation items. The nurses needed 10 minutes to fill out the "Factors affecting safe blood transfusion questionnaire".

Each nurse was observed three times in an intermittent and unexpected manner on different work shifts. The researchers witnessed nurses while preparing and administering blood products to the patients, and recorded nurses' practice in a specially designed observational checklist exactly what nurses did when preparing and administering BT.

Ethical consideration:

Official permission to conduct the study was obtained from The Faculty of Medicine at Alexandria University and the Faculty of Nursing at Matrouh University. Informed consent was obtained from nurses. They had the right to withdraw from the study at any time. All study data were handled with anonymity and confidentiality. A coding number for the observational sheet of each nurse was provided.

Statistical analysis:

It was implemented by SPSS version 18. Descriptive statistics as percentages, mean and standard deviation were used to describe dependent and independent variables. Student (t) and F tests were used to compare differences between study

variables. Correlation and logistic regression tests were used to identify the relationship and nurses' employment conditions as contributing factors affecting nurses' practice of safe BT. Internal consistency was tested using Cronbach's alpha coefficient.

Results

Contributing factors and Levels of practice

More than half of the studied nurses were staff nurses (54 %) and also more than half were working in surgical wards (54.9 %), whereas the rest were in critical care units (45.1%). More than a third of the nursing staff had more than 20 years of working experience (39.5%), followed by 10-19 years (34.2%). The highest percentage of nursing staff worked more than 36 hours per week (63.7%), in rotated and night shifts (68.6% and 47.1 % respectively). Nurses receiving in-service training program for BT constituted only about a third of the studied nurses (34.3%) (**Table 1**).

The nurses in both surgical and critical care units did not achieve a satisfactory level of BT practice (66.6 %). Unsatisfactory levels of nurses' practice of safe BT were recorded in pre (72.8%), during (58.2 %) and post (69.7 %) BT to patients in surgical and critical care units (**Figure 1**).

Different nurses' practice scores of safe BT according to employment conditions as contributing factors

The mean nurses' practice scores were significantly higher in critical care units (10.68 ± 1.48) than those in surgical units (9.80 ± 2.36). Professional nurses (14.00 ± 2.14) then technical nurses (10.44 ± 1.22) had the highest practice scores compared to staff nurses (9.28 ± 2.88). Nurses with experience years between 10 to 19 years (10.56 ± 2.36) and more than 20 years (14.24 ± 3.33) had a significantly higher practice mean scores compared to those with less than 10 years of experience (9.60 ± 1.40) (**Table 2**).

Moreover, the practice scores were significantly higher among nurses working 36 hours per week (14.40 ± 1.22) than nurses working more than 36 hours per week (10.28 ± 2.18). Nurses' practice showed significantly higher mean scores on day (13.60 ± 3.35) and fixed (14.60 ± 1.62) shifts compared to long (10.36 ± 2.08), night (9.64 ± 1.01) and rotated shifts (10.20 ± 2.35) (**Table 2**). The practice scores were highly significant among

trained nurses (13.96±1.66) compared to untrained nurses (9.56±2.92).

Contributing factors affecting nurses' practice

A positive significant relationship and direct impact were found between nurses' practice of safe BT and working in critical care units ($r=.780$; $OR=1.29$), professional ($r=.554$; $OR=1.72$), technical nurses ($r=.171$; $OR=1.12$), trained nurses ($r=.269$; $OR=1.60$), working duration between 10 to 19 years ($r=.215$; $OR=1.21$), more than 20 years of experience ($r=.286$; $OR=1.53$), working 36 hours per week ($r=.171$; $OR=1.42$), day ($r=.112$; $OR=$

1.66) and fixed shifts ($r=.797$; $OR=1.57$) (Table 3).

There were a negative association and effect between nurses' practice and working in surgical care units ($r=-.178$; $OR=.84$), staff nurses ($r=-.682$; $OR=.92$), untrained nurses ($r=-.653$; $OR=.25$), working duration less than 10 years ($r=-.387$; $OR=.81$), working more than 36 hours per week ($r=-.47$; $OR=.14$), long ($r=-.254$; $OR=.23$), night ($r=-.465$; $OR=.16$) and rotated shifts ($r=-.876$; $OR=.68$) (Table 3).

Table 1: Nurses' employment conditions as contributing factors in the study units (Nurses (n=350))

Nurses' employment condition	No. (%)	Nurses' employment condition	No. (%)
Hospital workplace		Working hours per week	
Surgical wards	192 (54.9)	36 hours	127 (36.3)
Critical care	158 (45.1)	> 36 hours	223 (63.7)
Nurses' qualification		Type of shift	
Professional (Bachelor's degree of Nursing)	104 (29.7)	Rotated shift	240 (68.6)
Technical nurse (Diploma of Nursing Technical Institute)	57(16.3)	Fixed shift	110 (31.4)
Staff Nurse (Diploma of Secondary School of Nursing)	189 (54.0)	Shift scheduled	
Working experience (years)		Night	165 (47.1)
< 10	92 (26.3)	Day shift	106(30.3)
10-19	120 (34.2)	Long shift	79 (22.6)
≥ 20	138 (39.5)	Training	
		Trained	120(34.3)
		Untrained	230(65.7)

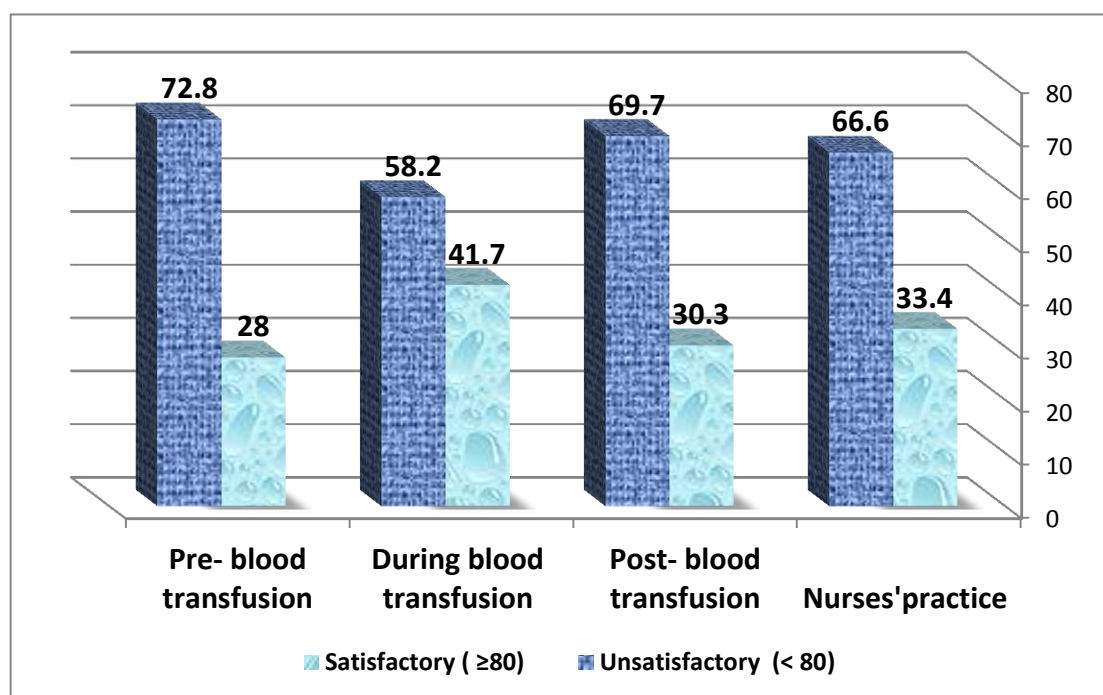


Figure (1): levels of nurses' practice of safe BT

Table (2): Distribution of mean score of nurses' practice of safe BT, according to nurses' employment conditions

Nurse employment conditions	Nurses' Practice Score		Nurse employment conditions	Nurses' Practice Score	
	Mean ± SD	p-value		Mean ± SD	p-value
<i>Hospital workplace</i>			<i>Working hours per week</i>		
Surgical wards	9.80±2.36	0.008*	36 hours	14.40±1.22	0.001*
Critical units	10.68±1.48		> 36 hours	10.28±2.18	
<i>Nurses' qualification</i>			<i>Type of shift</i>		
Professional	14.00±2.14	0.000*	Fixed shift	14.60±1.62	0.000*
Technical nurse	10.44±1.22		Rotated shift	10.20±2.35	
Staff Nurse	9.28±2.88				
<i>Work experience (years)</i>			<i>Shift time (morning/evening)</i>		
< 10	9.60±1.40	0.000*	Day shift	13.60±3.35	0.005*
10-19	10.56±2.36		Long shift	10.36±2.08	
≥ 20	14.24±3.33		Night	9.64±1.01	
			<i>Training</i>		
			Trained nurses	13.96±1.66	.002*
			Untrained nurses	9.56±2.92	

Independent (t) test and (F) test, Sig. (p ≤ 0.05)

Table 3: Nurses' employment conditions as contributing factors affecting nurses' practice of safe BT in the study units

Contributing factors	Nurses' practice		Contributing factors	Nurses' practice	
	Correlation (r)	Odds Ratio: (95 % CL)		Correlation (r)	Odds Ratio: (95 % CL)
<i>Hospital workplace</i>			<i>Working hours per week</i>		
Surgical wards	-.178*	.84 (0.84,1.06)	36 hours	.171*	1.42 (1.02,1.71)
Critical units	.780*	1.29 (1.12,3.52)	> 36 hours	-.467*	.14 (0.07,0.23)
<i>Nurses' qualification</i>			<i>Type of shift</i>		
Professional	.554*	1.72 (1.41,2.67)	Fixed shift	.797**	1.57 (2.75,4.95)
Technical nurse	.171*	1.12 (0.88,1.27)	Rotated shift	-.876*	.68 (0.63,0.98)
Staff Nurse	-.682*	.92 (0.71,0.94)	<i>Shift time (morning/evening)</i>		
<i>Work experience (years)</i>			<i>Receiving Training</i>		
< 10	-.387*	.81 (0.73,1.13)	Day shift	.112*	1.66 (1.06,2.91)
10-19	.215*	1.21 (1.87, 1.40)	Long shift	-.254*	.23 (0.14,0.33)
≥ 20	.286*	1.53 (1.04,2.55)	Night	-.465*	.16 (0.10,0.21)
			Trained nurses	.269*	1.60 (1.46,1.84)
			Untrained nurses	-.653*	.25 (0.21,0.27)

*p-value of Correlation is significant at (p≤0.05), **p-value of Correlation is significant at (p≤0.01)

Discussion

Blood transfusion (BT) is a vital, life-saving process in patients with both acute and chronic conditions in surgical and critical care units, aiming to replace lost components of the blood. BT could be associated with many adverse events in patients. BT is one of nursing procedures, where adequate practice plays a critical role efficient safe blood transfusion. Appropriate nurses' employment conditions are essential for safe blood transfusion (Pavenski et al., 2018; Hsieh et al., 2018). In this respect, the present study aimed to evaluate nurses' employment conditions as contributing factors affecting nurses' practice of safe blood transfusion in surgical and critical care units.

The present study pointed out that the two third of the studied nurses did not achieve a sufficient level of nurses' practice of safe blood transfusion. Unsatisfactory levels of practice among nurses in surgical and critical care units were observed in pre, during, and post-blood transfusion. Lynne et al. (2013) stated that the lack of nurses' practice may be a critical issue in healthcare settings. If nurses have an insufficient level of practice over a prolonged period, they would make continuing errors in blood transfusion and other nurses' practices.

Similar findings were also reported by several studies conducted in Egypt (from 2012 to 2017) (Ibrahim, 2012; Asal, 2014; Saif Al-Nas et al., 2016; Hedy & Marzouk, 2017) and other countries such as the United Arab Emirates (Hijji et al., 2010), Nepal (Sapkota et al., 2018), Pakistan (Majeed et al., 2020) where the overall BT practice among nurses was at insufficient levels. However, the current study was contrasted with the study of India (2021) in Sher-i-Kashmir Institute of Medical Sciences, which used self-report questionnaires to collect nurses' practice data. It was found that 66.7% of nurses had satisfactory practice in blood transfusion (Iqbal et

al., 2021). Differences between the present study and other studies may be explained by the fact that the actual practice score obtained from observation may be less than that obtained from self-reported questionnaires.

From the researchers' point of view, the findings of the present study can be attributed to insufficient nurses' adherence to Egyptian BT guidelines, lack of in-service training provided by hospital management. Moreover, the studied nurses may not be fully aware of the serious risks if an error occurred during the transfusion process. Inappropriate workplace conditions, shortage of nursing staff and BT equipment, lack of supervision and guidance, shortcoming in the quality culture and management in terms of BT procedures, all these could be hindering factors. This study was in agreement with an Egyptian study (2016) conducted in three hospitals affiliated to the Ministry of Health (Saif Al-Nas et al., 2016).

The present study highlighted nurses' employment conditions as contributing factors affecting nurses' practice of safe BT in the study units. Significant differences in the mean scores of nurses' practice of safe BT were recorded with respect to hospital workplace, qualification of nurses, type and time of shifts, work hours, years of experience and receiving training programs.

In context to the nature of the hospital workplace, nurses working in critical care units had higher mean scores of competence in BT practice than those working in surgical wards. These findings were not surprising because patients in critical units were more dependent, requiring complex care and more observation. A similar result was found in the study of Hijji et al. (2010) and Panchawagh et al. (2020). They reported that the nurses who worked in the ICU had significantly

higher BT practice scores than their counterparts in the wards.

On the other hand, insufficient level of nurses' practice was more among untrained and staff nurses compared to trained and technical and professional nurses who might have a high level of knowledge, skills and awareness about the safe BT practice. **World Health Organization (2019)** recommends the training of healthcare workers as the cornerstone of an integrated approach to improve safety and quality of the process of blood transfusion. Training nurses about BT is very important to improve nurses' performance which affects positively the quality of care and prevents complications.

The present study was consistent with the study of **Al-Nasr et al. (2016)**, which reported that there was a significant association of nurses' practice scores regarding BT with their educational level and received training programs. However, the present work was contradictory with an Indian study (2021) which revealed that no relation between the practice score and professional qualification (**Iqbal et al., 2021**). The study setting, method of data collection and sample size were the main differences between the present study and Indian study (**Iqbal et al., 2021**).

Years of clinical experience were also contributing factors affecting the practice of safe BT among nurses in the current study. Safe practice of BT increased among nurses having a work experience of more than 20 years, followed by those with 10-19 years of experience. A similar result was found in the study of **Hendy and Marzouk (2017)**, and **Iqbal et al. (2021)** who reported that there was a statistically significant relation between the clinical experience and practice scores among nurses.

Nevertheless, these results were incongruent with the study of **Panchawagh et al. (2020)** and **Jog et al. (2021)** who found no association

between practice and years of work experience as they were carried out in tertiary care hospital. This discrepancy might be related to different methods of data collection, where the data of present work were collected by observation method in teaching hospital, while the data collection methods of study of **Panchawagh et al (2020)** and **Jog et al. (2021)** were self-reported questionnaires in tertiary care hospital.

Concerning working schedule and hours, a significant relation was recorded with higher mean scores of nurses' practice of safe BT among professional, technical and trained nurses who worked day fixed time shifts and 36 hours per week. On the other hand, lower scores were observed among staff and untrained nurses who worked longer, rotated and night shifts with long working hours. From the researchers' point of view, this might be related to the fact that those nurses had heavier nursing duties and more stressful patient care with a rotating shift schedule. Thus, this could pose a threat to the safe BT administration.

Conclusion:

The present study concluded that nurses' practice of blood transfusion whether pre, during or post-BT, was relatively inadequate. This could be attributed to many factors hindering nurses' competence, especially nurses' related factors as well as organizational and management factors.

The present study highlighted that the nature of nurses' employment conditions played as contributing factors in posing a threat to nurses' practice of safe BT in the study units such as hospital workplace, nurses' qualifications, receiving training programs, working hours, clinical experience and shift schedule.

A positive significant relationship and direct impact were found between nurses' practice of safe BT and working in critical care units, professional and technical, trained nurses, working experience

between 10 to 19 years and more than 20 years, working 36 hours per week as well as day and fixed shifts.

Implications for nursing practice:

To enhance nurses' practice of safe BT, certain strategies in the workplace should be considered as follows: investigating the risks in BT practice; continually monitoring nurses' practice and preparing a periodic statistical report of inappropriate nursing practice; monitoring nurse employment conditions; creating safety measures for safe BT practice to protect patients against BT hazards and providing updated nursing facilities and patient equipment for safe BT.

Accordingly, efficient BT policies should be provided to improve nurses' employment conditions for enhancing BT practice among nurses and establishing the role of nursing leaders in the supervision and guidance of nurses during BT. Establishing training programs related to safe blood transfusion and improving teamwork and collaboration among healthcare providers are additional strategies recommended to enhance nurses' practice of safe BT in surgical and critical care units.

Strength and Limitation of the study:

The strong point of current work was that it was based on intermittent observation of nurses' practice of safe BT. Intermittent observation method has been considered as an efficient method to assess nurses' performance during administration of BT.

A relatively weak point can be addressed in the present study, where the researcher took more time during the observation part of the study than expected because time of observation was influenced by nurses' work pattern in the unit, e.g. the researcher sometimes had to wait until nurses finish other duties as patients' care before preparing and administering BT.

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