Effectiveness of Simulation-Based Training on Nurses' Performance, Self-Confidence, and Satisfaction Regarding Blood Transfusion

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Abstract

Background: Blood transfusion is the direct administration of whole blood and/ or blood components Additionally, blood transfusions can pose a serious risk to life if safety precautions are ignored. Nurses play a dynamic role in the administration of blood transfusions, with correct and safe usage of blood and its components the probability of incidence of blood transfusion risks will be reduced to a minimum rate. This study aimed to evaluate the effectiveness of simulation-based training on nurses' performance, self-confidence, and satisfaction regarding blood transfusion. **Research design:** A quasi-experimental design (one group pre/ post-test design) was used. **Setting:** The study was carried out in the hematology unit, at Mansoura University Hospital. **Subjects:** All fifty available nurses who provide patients with direct clinical care in the previously selected settings have agreed to take part in the study. **Three Tools were used for data collection: Tool I:** A Structured Interviewing Questionnaire: Included nurses' socio-demographic characteristics and knowledge about blood transfusion that consisted of five parts: Part 1. Nursing activities before initiation of blood transfusion, Part 2. Nursing activities for initiation of blood transfusion, Part 3. Nursing activities during and after blood transfusion, Part 4. Adverse reactions of blood transfusion, and Part 5. Nursing management for blood transfusion adverse reactions, **Tool II:** Blood transfusion Observational Checklist and **Tool III:** Satisfaction and self-confidence in learning scale **Results**: There was a highly statistically significant difference between the studied nurses' knowledge, practice, self-confidence, and satisfaction. The study result revealed that three-fifths of studied nurses had a poor level of knowledge, and more than half of them had an unsatisfactory level of practice about blood transfusion before the implementation of the simulation-based training. The vast majority of the studied nurses had a good level of knowledge and most of them had a satisfactory level of practice after implementing simulation-based training. There was a highly statistically significant difference and improvement in nurses' performance after simulation-based training than pre-training. **Conclusion**: The present study concluded that simulation-based training had a positive effect on improving nurses' performance, self-confidence, and satisfaction regarding blood transfusion. **Recommendations**: The study recommended that simulation-based training should be integrated as an effective method in nurses' education about blood transfusion.

Introduction:

Blood transfusion can be a lifesaving intervention or a life-threatening and is often a vital need for many therapeutic and surgical procedures to manage hematologic diseases. Nonetheless, blood component therapy only temporarily supports the patient until the underlying problem is resolved. Further, transfusions are not free from hazards, blood transfusion should be used only if needed and with caution (**Harding et al., 2020**).

According to the **World Health Organization (2020)**, there is no complete and accurate data on clinical transfusions, and utilization of blood or its products is limited. In addition, information collected from some countries suggests that national guidelines are often not adhered to be applied by clinicians or may not be effectively distributed and updated. Quality systems and management for the clinical transfusion process are not well-developed in many countries.

Blood transfusion therapy or blood replacement is the intravenous (IV) administration of whole blood, its components, or plasma-derived products for therapeutic purposes. Blood transfusion restores intravascular volume with whole blood or albumin, restores the oxygen-carrying capacity of blood with red blood cells (RBCs), and provides clotting factors and/or platelets (**Perry and Potter, 2019**).

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A transfusion reaction is an immune system reaction to the transfusion that ranges from a mild response to severe anaphylactic shock or acute intravascular hemolysis, both of which can be fatal (**Harmening, 2019**). In addition, these can be placed into two general categories: acute and delayed. First, acute reactions may occur during the infusion or within minutes to hours after the blood product has been infused. Second, delayed reactions may last for days or longer. Moreover, these reactions can be preventable through nursing education which includes the appropriate procedures for a safe and effective transfusion and is considered a highly important goal of patient safety (**Nettina, 2018.**

Adherence to standards and policies and ongoing education are essential to maintain the quality of patient care and reduce potential negative transfusion outcomes. Therefore, nursing care for patients receiving blood transfusions is a nursing priority. As well, the role of nurses is critical, articular, and imperative and one of the most important aspects of that role is to demonstrate accurate and careful attention to detail (e.g., preparation, administration, and monitoring) to prevent life-threatening transfusion outcomes (**Perry et al., 2018**).

To implement blood transfusion safely, health institutions need to use national transfusion guidelines and establish blood banks, transfusion laboratories, and blood transfusion protocols (**World Health Organization, 2020**). Developing high-quality and safe blood transfusion services can be achieved through collaboration, developing multidisciplinary strategies, and implementing standards based on evidence-based practice. The knowledge and skills of healthcare professionals are fundamental to developing and strengthening the quality of blood transfusion procedures. A lack of knowledge by health care professionals may lead to an increased risk of mortality and morbidity associated with blood transfusion. For the safety and quality of blood components and transfusion, determining healthcare professionals' knowledge is necessary for developing educational programs (**Hijji et al., 2018**)

To implementing blood transfusion safely, health institutions need to adopt national transfusion programs and establish blood transfusion protocols because many hospital transfusion protocols and related nursing competencies have been based on traditions and assumptions rather than on scientific evidence. Furthermore, it can be achieved through collaboration, developing multidisciplinary strategies,

and implementing standards based on evidence-based practice (**Encan and Akin, 2019**).

Nursing simulation-based clinical education encompasses more than just manipulating mannequins; it also includes a range of activities utilizing pediatric patient simulators, skilled personnel, lifelike virtual environments, and role-playing. "An activity or event replicating clinical practice using scenarios, high-fidelity manikins, medium-fidelity manikins, standardized patients, role-playing, skills stations, and computer-based critical thinking simulations" is how the National Council of State Boards of Nursing (NCSBN) defines clinical simulation. It has become a crucial component of nursing education (**Powell et al., 2018**).

The benefits of simulation-based educational interventions include the ability to individualize learning, customize learning, adjust the degree of difficulty, and offer quick feedback on practice (**Cant, R.P. and Cooper, 2017**). However, the research indicates that undergraduate degrees usually do not provide many opportunities to practice nursing procedures on real patients. This fact might affect how competent freshly trained healthcare workers evolve in the future, raising the risk of mistakes and endangering patient safety (**Shin & Kim, 2015**).

Assessing students' motivation, fulfillment, and acceptance of the teaching technique all depend on their level of self-confidence and satisfaction. It refers to how well a student can continue to provide patient-centered care, demonstrate teamwork in multifaceted healthcare environments, and deliver exceptional service with a pleasant attitude (**Kada, 2018**).

The administration of safer blood transfusions and the reduction of transfusion-associated morbidities and fatalities are anticipated outcomes for nurses who possess evidence-based knowledge of safe blood transfusion practices. A safe blood transfusion method entails many steps, all of which nurses must be well aware of. The findings of research assessing nurses' knowledge of blood transfusions indicate that there is a need to enhance nurses' proficiency, expertise, and understanding. Questionnaires and observations can be used to gauge their levels of knowledge and blood transfusion procedures. Studies have indicated that nurses lack adequate understanding of safe blood transfusion procedures, preventing adverse responses, and blood transfusion guidelines (**World Health Organization, 2020**). Nurses play an essential role in the blood transfusion process by referring patients pre- and

post-transfusion, undertaking patient assessment and blood sampling, and administering the blood transfusion (**Panchawagh, 2020**).

Significance of the study:

Nurses may give the incorrect blood component o nations, including Egypt, lack transfusion committees in all of their hospitals **(World Health Organization, 2020).** Certain blood components are becoming safer, however, using blood in clinical settings is not safe and can have deadly consequences. In-service training is necessary for nurses to increase their understanding of safe blood transfusion methods, according to **Bolton-Maggs and Watt (2019)**. Transfusion errors can be avoided with the help of clinical guidelines, standard operating manuals, constant monitoring, and policies.

All the steps involved in a safe blood transfusion and blood transfusion criteria (**Lahlimi et al., 2019).** Blood transfusion errors still occur in 2019, according to the majority of studies. These errors account for 84.1% of cases, of which 5.6% may have been avoided and 10.3% are not. According to the Annual Serious Hazards of Transfusion Report (**SHOT), 2019**, patient identification errors during blood sample collection account for 42.6% of transfusion-related deaths, with transfusion-associated circulatory overload being the most common cause at 29.4%. Nurses who do transfusions have a responsibility to ensure the treatment is safe and efficiently performed. Inadequate procedures can result in avoidable risks that endanger the confidentiality of patients.

Operational definitions:

Simulation-based training:

Refers to the training scenario to empower intern nurses to deal with blood transfusion and provide priority of nursing care in the clinical medical-surgical skill lab as in a real situation

Aim of the study:

This study aimed to evaluate the effectiveness of simulation-based training on nurses' performance, self-confidence, and satisfaction regarding blood transfusion.

Research hypothesis:

Simulation-based training is expected to have a positive effect on improving nurses' knowledge, practice, Self-Confidence, and satisfaction regarding blood transfusion.

Subjects and Method:

Research design:
A quasi-experimental design (one group pre/ post-test design) was used.
Setting:
The study was carried out in the hematology unit, at Mansoura University Hospital**.**
Subjects:
All fifty available nurses who provide patients with direct clinical care in the previously selected settings have agreed to take part in the study

Tools for data collection

Tool I: A Structured Interviewing Questionnaire: The researchers created it to evaluate the nurses' demographic data and blood transfusion knowledge after studying relevant literature. It consisted of the next two sections:

 (1) Nurses' demographic data: comprises twelve closed-ended questions that examined the following: the age, gender, qualifications, residential area, years of general experience, attendance at safe blood transfusion training sessions, and the existence of written instructions regarding the ward's safe blood transfusion policy.

 (2) Nurses' knowledge questionnaire: Nurses were evaluated on their knowledge of blood transfusion-related adverse responses, how to treat those reactions, and other related topics. The researchers created it after studying current and past relevant literature (**Abd Elhy & Kasemy, 2017; Kumarage et al., 2017; Kozier et al., 2018**), adapting it from **Hijji et al., (2012**). Five areas of nursing knowledge were addressed in this section, which had "49" multiple-choice and true/false questions as follows:

1. Nursing activities before initiation of blood transfusion, It comprised nine questions: five about patient preparation, such as "when to ask for a blood package from the blood bank, when to make sure that the IV access line is available and in good condition, when to make sure that the nurses follow up on an incomplete physician's order regarding blood transfusion when to provide the patient with information before receiving blood transfusion, and when to record baseline vital signs before starting a blood transfusion," and four about requisitioning blood packages as "information that a nurse needs to make sure they are collecting the appropriate blood for the appropriate patient, the best ways to transfer blood packages from the blood bank to the department, the first thing a nurse does for a patient

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whose blood type is A+ when they acquire an A unit from the blood bank, and what they do in an emergency when they forget to transfuse a blood package for a few of hours".

2. Nursing activities for initiation of blood transfusion: This comprised seven questions about the most crucial nursing actions a nurse must perform about the patient to initiate a transfusion; the situations in which blood warming must indicate prior transfusion; the ideal time to begin a transfusion when receiving blood in the department at 4:00 PM; the appropriate way to handle a blood bag in the ward following its retrieval; the crucial three steps to correctly identify the correct patient before initiating a transfusion; the appropriate filter size of a blood transfusion set; and the situations in which it is acceptable to proceed without first verifying the patient's information at the bedside before administering blood.

3. Nursing activities during and after blood transfusion: There were eleven questions on the following topics: signs of slow blood transfusion; solutions/agents that can be safely mixed with blood transfusion; complications of rapid administration of cold blood through the central venous route in the right atrium; the rate at which to initiate blood transfusion for adult patients; the maximum duration to use blood administration set in continuous multiple transfusions; the time and duration of monitoring the patient for a possible transfusion reaction.

4. Adverse reactions of blood transfusion: Ten questions covered the following topics: causes of acute hemolytic reactions, allergic reactions, febrile reactions, septic reactions, circulatory overload, air emboli, hypothermia during a blood transfusion, and the most common complications of blood transfusions. Patients' typical complaints regarding transfusion adverse reactions were also covered.

5. Nursing management for blood transfusion adverse reactions: It included twelve questions about nursing interventions that could reduce the likelihood of acute transfusion reactions, the nursing interventions for acute transfusion reactions that should be done right away, the nursing interventions that shield the patient from complications from blood transfusions, the first nursing intervention that should be done to address a patient's allergic transfusion reaction, delayed hemolytic reaction, mild and severe febrile non-hemolytic reaction, allergic reaction, bacterial infection, hypocalcemia, hyperkalemia, and air embolism brought on by blood transfusion.

- The knowledge scoring method assigned a "1" for a correct response and a "zero" for an improper response for each item. The overall score for each knowledge area was calculated by dividing the number of items by the sum of the scores. This resulted in the mean score for the area, which was then translated into a percent score. If the nurses' percent score was ≥80%, their knowledge was deemed satisfactory; if it was less than 80%, it was deemed unsatisfactory.

Tool II: Blood transfusion Observational Checklist: The degree of safe blood transfusion practices among nurses was evaluated using this tool both before and after the intervention. It was adapted from **Kozier et al., (2018)** and contained "21steps" divided into three phases: the Preparation Phase ("4 steps") covered the skills of the nurses before blood transfusion, the Performance Phase ("14 steps") covered the skills of the nurses during a blood transfusion, and the Terminate Phase of the transfusion ("3 steps") covered the skills of the nurses after blood transfusion.

Scoring system

The Observational checklist's scoring system was as follows: correctly completed scored (2), incompletely completed scored (1), and not completed scored (0). Total nursing practices were classified into two categories: **Competent Practice** and **incompetent Practice**. If the nurse's score was less than 80%, it was **incompetent** practice and if the nurse's score was more than 80%, it was considered **competent** practice.

Tool III: Satisfaction and self-confidence in learning scale

This instrument was created by Jeffries and **Rizzolo (2006)** and translated into Arabic to evaluate nurses' confidence and level of satisfaction with their learning about blood transfusion simulation-based training. This instrument has 13 items and is divided into two sub-dimensions: "self-confidence" and "satisfaction with learning." The sub-dimension measuring happiness with learning has five items, whereas the sub-dimension measuring self-confidence has eight items.

Scoring system:

Every item received a rating of agree (3), uncertain (2), or disagree (1) on a 3-point Likert scale. - High level of satisfaction/self-confidence > 75%, moderate level of satisfaction/self-confidence 60% - 75%, and low level of satisfaction/self-confidence < 60% classified the total score.

Field Work:

Data was collected through the following faces:

I-Preparatory phase:

Once formal rights to collect data were obtained, the fieldwork was conducted in the aforementioned settings from the end of January to the end of March 2024. After introducing researchers to participants and providing them with a thorough background about the study and its purpose, the actual fieldwork began with meetings between researchers and nurses during work shifts. After that, the pre-test format was distributed to collect the necessary data. During the morning and afternoon shifts, the researchers met with each participant individually to gather pretest data. This involved having them complete a structured questionnaire that assessed their knowledge of safe blood transfusion and their demographic characteristics. After that, the researchers observed the nurses in action as they provided care to patients, gathering information for an observational checklist. Every tool took an average of twenty to thirty minutes to complete.

Before beginning the study, the Mansoura University Faculty of Nursing's ethics committee gave its approval. Official permission for data collection was obtained from the responsible authorities of the study setting after an explanation of the study objective. The researchers created a tool (I), whereas tools (II), & (III), were adopted. A group of five academics with extensive experience in the field of surgical nursing examined the tools for content validity, and no revisions were made. The Cronbach's alpha test was used to assess the reliability of tools two and three and was 0.897 for tools.

Ethical Considerations:

The Mansoura University faculty of nursing's research ethics committee provided formal first approval, which was achieved. Before beginning the research, formal approval was obtained from the directors of the previously listed settings as well as the dean of the nursing faculty. The study was conducted with strict confidentiality maintained. Everyone who works with nurses was given the assurance that their information would only be used for research, and they were all made aware of their freedom to leave the study at any time, for any reason.

Pilot study:

A pilot study was applied on 10% of the total number of nurses to test the clarity and feasibility of the research process and ensure the clarity and applicability of the study tools over time and no modifications were done Nurses in the pilot study were included in the study sample.

II-Implementation phase:
- The theoretical content was given through four theoretical sessions that covered the blood donation process.
- The implementation of simulation-based education was aimed at improving nurses' practices regarding blood transfusion through three practical sessions (around 30-45 minutes for each).
- At the beginning of each session, the researchers started by taking feedback about the previous session, and at the end of each session, the researchers gave a summary.
- The researchers were available in the study settings 3 days per week from 9 a.m. to 1 p.m.
- The study group participants were divided randomly into ten subgroups; which included varying numbers (5-6 nurses in each group) twice weekly for the training course. The training course for each subgroup includes 2 hours of theoretical with a 3-hour practical.
- The simplified booklet was used as supportive material and given to nurses in the Arabic language to cover all items regarding the knowledge and practice of blood transfusion after reviewing the associated literature based on the assessment of the actual needs of the studied nurses.
- Different teaching methods such as lectures, small group discussions, pictures, brainstorming, demonstration, and re-demonstration using the necessary equipment and simulation manikin that was available in a hospital teaching class faculty clinical lab to apply for simulated education program. Several teaching media were used, such as handouts, PowerPoint, figures, flipcharts, and illustrated videos were used about blood transfusion.
- While practical content covered demonstration of safe blood transfusion procedures by researchers. These sessions included clinical demonstration and re-demonstration of studied nurses on the blood transfusion procedure.

- All theoretical sessions were followed by simulation training skills. The program sessions were implemented as follows:
- **Theoretical and practical sessions:**
- Session (1): about basic knowledge about the blood donation process and blood transfusion process.
- Session (2): about blood transfusion adverse reactions and nursing management for adverse reactions
- Session (3): about safety measures during blood transfusion.

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- Session (4): about nurses' responsibilities toward the transfusion process.
- Session (5): about basic knowledge regarding the preparation phase, which covered the studied nurses' preparation skills before blood transfusion.
- Session (6): about basic knowledge regarding the performance phase, which covered the studied nurses' skills during a blood transfusion.
- Session (7): about basic knowledge regarding the termination phase of the transfusion, which covered the studied nurses' skills post-to blood transfusion
- **Debriefing**: Immediately, following the simulation, researchers conducted debriefing as a reflective activity. This lasted about 30 minutes at the end of the debriefing; the team was asked if there were any additional comments.

-Evaluation phase:

The researchers reassessed the effectiveness of simulation-based training on nurses' performance, self-confidence, and satisfaction regarding blood transfusion post one month using the same pretest tools.

Statistical analysis:

A suitable personal computer was used for data entry. It was done using SPSS version 20.0, the Statistical Package for Social Sciences. Each tool's content was coded, grouped, and examined thereafter. For qualitative factors, data were presented as frequencies and percentages, and for quantitative variables, as means and standard deviations. These descriptive statistics were used. The Chi-square test was used to compare the qualitative variables under study. An examination of the Pearson correlation was performed. When the P-value was less than 0.05, a statistically significant difference was deemed to exist, and when the P-value was greater than 0.001, a highly significant difference was determined.

Results:

Table 1 reveals that 44% of the examined nurses were between the ages of 25 and 30, with a mean age of 26.33 ± 3.11. The bulk of them were female, with 86% having attended a nursing technical institute, and 96% residing in metropolitan regions. About prior transfusion training sessions, the majority of them (56%) reported having attended

transfusion training sessions and that written instructions on the ward's safe blood transfusion policy were available.

Figure 1 shows that just 20% of the nurses in the study had more than 10 years of experience, while 44% had less than five years. Of the nurses, 36% had between five and ten years of experience.

Table 2 shows that all knowledge items regarding blood transfusion showed improvement and a highly statistically significant difference at (p=.000) following a simulation-based training intervention.

Figure 2 demonstrates that, before simulation-based training, 80% of the nurses under study had an inadequate level of knowledge, but following the training, 90% of them had a satisfactory level of knowledge.

Table 3 demonstrates that, in comparison to pre-simulation-based training intervention, there was an increase in nurses' competent practices for blood transfusion in all stages of the procedure following the intervention, as well as a highly statistically significant difference (*p*=.000).

According to **Figure 3,** 92% of the nurses who were studied had competent practices after undergoing simulation-based training, compared to 70% who had incompetent practices before the training.

As seen in **Figure 4**, 38% of nurses reported high levels of satisfaction before simulation-based training, but 94% reported high levels of satisfaction following such training.

As seen in **Figure 5**, 36% of nurses reported high levels of confidence before simulation-based training, but 90% reported the same following the training.

Before and after simulation-based training, a statistically significant positive correlation was detected between the overall knowledge score, total practices, satisfaction, and self-confidence at (P ≤ 0.001) as indicated by **Table (4).**

Table 1: Demographic data among the studied nurses (n=50).

Demographic characteristics		No	%
Age :	Less than 25 years	14	28.0
	25- Less than 30 years	22	44.0
	31- Less than 35 years	5	10.0
	More than 35 years	9	18.0
	Mean ± SD:	**26.33 ± 3.11**	
Gender:	Male	7	14.0
	Female	43	86.0
Qualification:	Secondary nursing school	14	28.0
	Technical institute	34	68.0
	Bachelor	2	4.0
Residence:	Urban	48	96.0
	Rural	2	4.0
Attendance of safe blood transfusion training sessions	Yes	22	44.0
	No	28	56.0
existence of written instructions regarding the ward's safe blood transfusion policy	Yes	40	80.0
	No	10	20.0
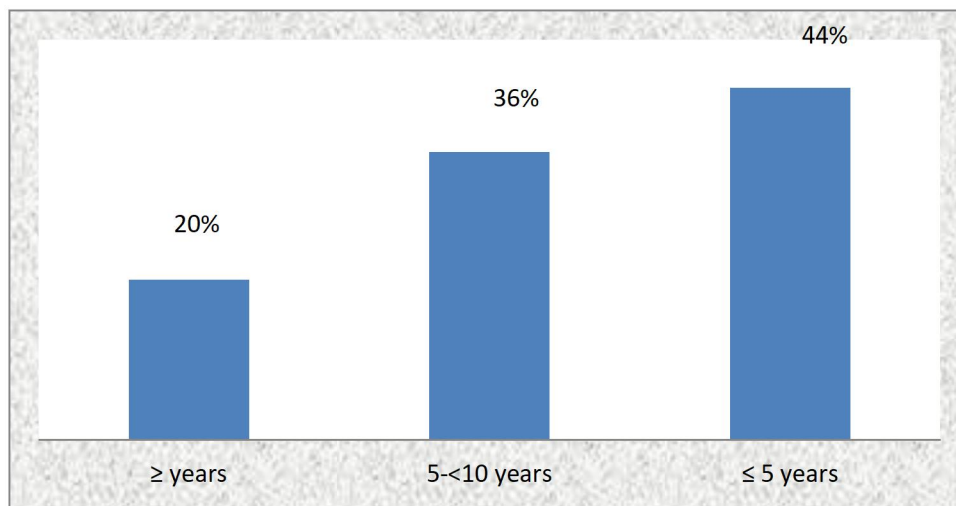
Figure 1: Nurses distribution regarding their years of experience (n=50)

Table 2: Comparison between the satisfactory knowledge about blood transfusion of the studied nurse's pre and post-one month of simulation-based training (n=50)

Items	Satisfactory Knowledge ≥ 80				χ^2	P-value
	Pre-intervention		Post-intervention			
	No	%	No	%		
Nursing activities before initiation of blood transfusion	24	48.0	46	92.0	32.44	.000**
Nursing activities for initiation of blood transfusion	23	46.0	43	86.0	52.33	.000**
Nursing activities during and after blood transfusion	21	42.0	42	84.0	47.54	.000**
Adverse reactions of blood transfusion	26	52.0	44	88.0	43.23	.000**
Nursing management for blood transfusion adverse reactions	25	50.0	45	90.0	47.22	.000**

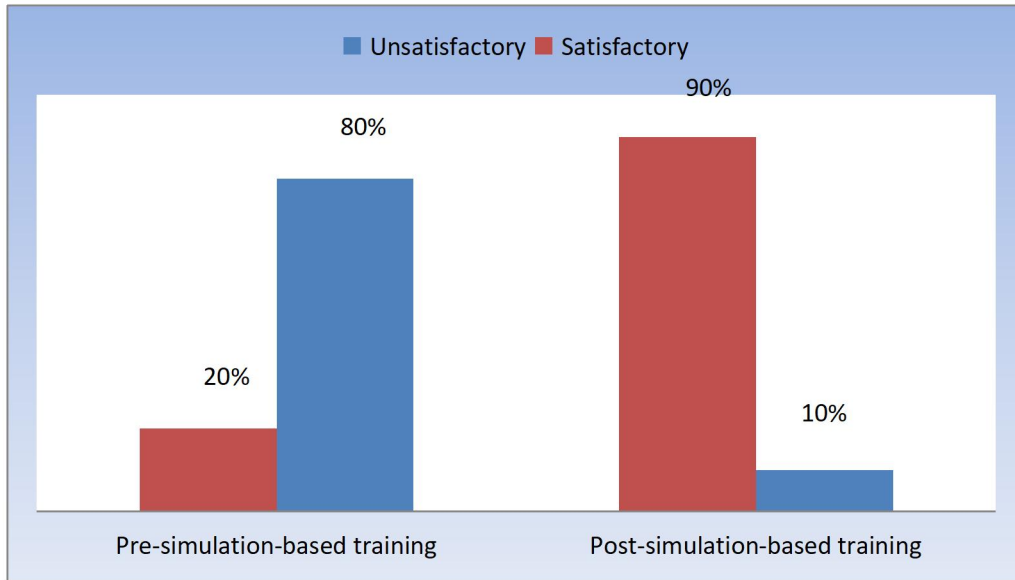**(*) Statistically significant difference at p≤ 0.00**

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Figure 2: Total knowledge level of studied nurses pre and post-simulation-based training

Table 3: Comparison between the competent practices about blood transfusion of the studied nurse's pre and post-one month of simulation-based training (n=50)

Blood transfusion phases	Competent Practice ≥ 80				χ^2	P- value
	Pre - simulation-based training		Post - simulation-based training			
	No	%	No	%		
Preparation Phase[4]*	30	60.0	45	90.0	39.22	.000**
Performance Phase [14]*	32	62.0	44	88.0	49.33	.000**
Terminate Phase of the transfusion[3]*	35	70.0	47	94.0	52.24	.000**

** Highly statistically significant difference at p≤ 0.01
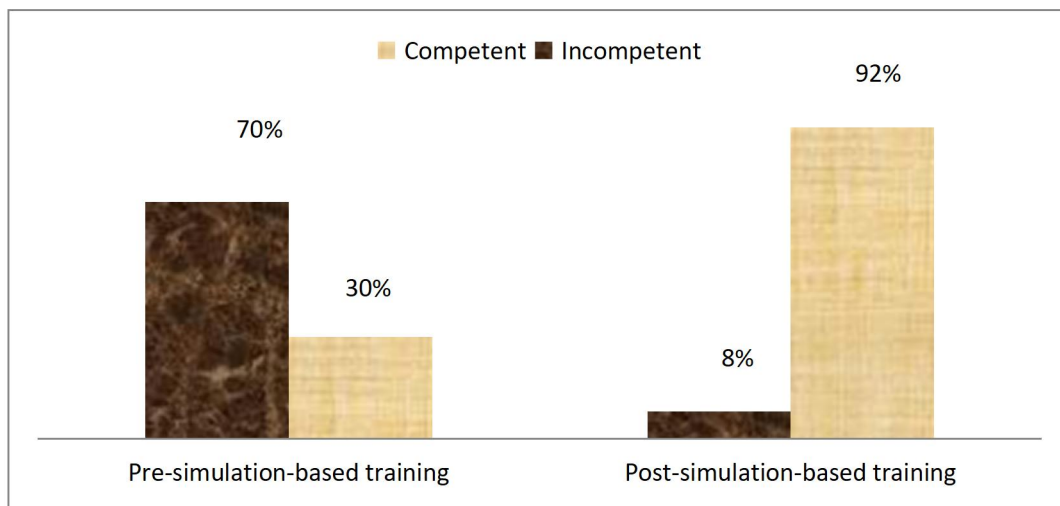

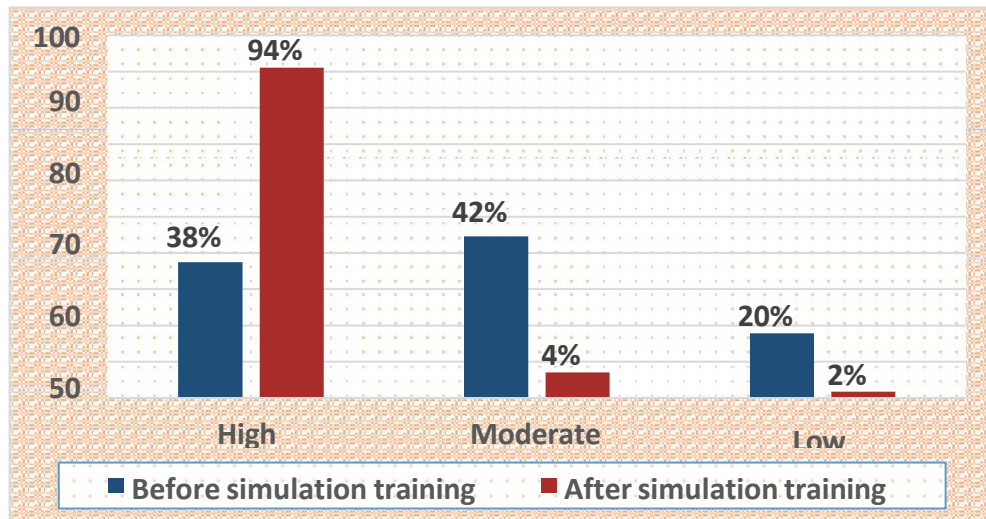**Figure 3. Total practice level of studied nurses pre and post-simulation-based training**

Figure (4): Nurses distribution concerning satisfaction level in learning pre **and post-simulation-based training (n=50)**
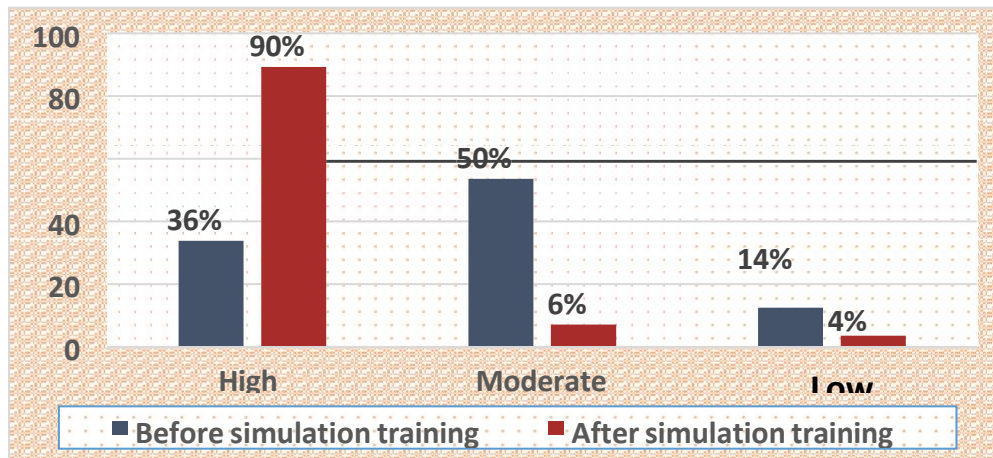

Figure (5): Nurses' distribution concerning self-confidence level in learning pre and post-simulation-based training (n=50)

Table (4): Correlation between total knowledge, practices, satisfaction, and self-confidence scores among the studied nurse's pre and post-simulation-based training (n=50)

Variables	Total knowledge score			
	Before simulation-based training (n= 50)		After simulation-based training (n= 50)	
	r	P	R	P
Total practices score	0.516	0.000**	0.723	0.000**
Total satisfaction score	0.529	0.000**	0.547	0.000**
Total self-confidence score	0.465	0.000**	0.589	0.000**

* A statistically significant difference (P ≤ 0.05)

Discussion

Nursing training can be accomplished effectively and safely with the use of simulation training. Given the chance to practice recently acquired skills and get immediate feedback in a nurturing setting, simulation training is seen as an effective teaching method. Increasing exposure to medical scenarios in simulated environments helps nurses become more confident in their abilities and create best practices for addressing emergencies (**Baayd et al., 2023; Angelina et al., 2021**).

Around the world, transfusions of blood and its byproducts are necessary for millions of people. Therefore, transfusion errors and inadequate patient supervision during blood transfusions can result in the death of those individuals. Nursing personnel are crucial to the transfusion process because they refer patients both before and after the transfusion, assess patients, take blood samples, and blood transfusion administration, and are responsible for the last bedside check before the transfusion, which gives them the best opportunity to avoid an unsafe transfusion. When nurses are ignorant about safe blood transfusion procedures, they may give patients the wrong blood components or engage in hazardous transfusion practices, which could hurt the patients' outcomes (**SHOT, 2019**).

The incorrect transfused blood component is identified as the cause of around 70% of all reported adverse events, according to the Serious Hazards of Transfusion (SHOT) program. To ensure a successful transfusion, enhance the standard of healthcare, and acquire new skills and knowledge, it is imperative to develop a blood transfusion policy and strategy that includes proper guidelines and training programs for nursing staff (**Palmer, 2019**). For nurses to administer blood transfusion and develop their abilities safely and competently, training sessions should be introduced with guided clinical practice (**Tavares et al., 2019**).

About the demographic information of the nurses under investigation, the current study discovered that the majority of the nurses were female and that almost two-fifths of the nurses were between the ages of 25 and 30. Their mean age was 26.33 ± 3.11. This could be explained by the fact that women make up the bulk of nurses employed in hospitals; nursing education used to be exclusively available to women. These results corroborate the findings of **Yesilbalkan et al. (2019)**, who detailed a study done in Turkey called "Assessing Knowledge of Nurses on Blood Transfusion," noting that the participants' mean age was 27.36 and that the majority of the nurses were female. It was also shown by **Abd Elhy & Kasemy (2017)** that the majority of the study's sample consisted of women. They do agree with him about the gender distribution of nurses, since 85.0% of the nurses in his study were female, even though their results differ from those of **Abolwafa et al. (2018)**, who showed that 45% of nurses were between the ages of 31 and 40.

Regarding related qualifications, the current findings revealed that just 2% of the investigated nurses held a bachelor's degree, but more than three-fifths held a diploma from a nursing technical institute. This result may be explained by a lack of highly qualified nurses employed by hospitals who were always preoccupied with administrative tasks. These results are consistent with those of **Abolwafa et al. (2018)**, who found that the majority of the nurses under study had education levels equivalent to those of technical institutes. While Abd **Elhy & Kasemy (2017)** stated that a majority of the study subjects held a bachelor's degree in nursing. This outcome conflicts with the findings of **Yesilbalkan et al. (2019)**, who discovered that most nurses had a bachelor's degree and did not belong to a professional group. In addition, **Silva et al. (2016)** found that nearly two-thirds of the participants holding a nursing bachelor's degree were female.

According to the results of the current study, over half of nurses had participated in prior workshops or training on safe blood transfusion practices. This result is consistent with the findings of **Yesilbalkan et al. (2019)**, who stated that over half of the nurses in the study had prior transfusion training. It also aligns with the findings according to **Kavaklioglu et al. (2017)**, 79% of the participants had transfusion training. Additionally, according to **Tavares et al. (2019)**, a coaching program should be offered in addition to guided clinical practice to ensure that new nursing staff members can use blood transfusion safely and competently. Training and education are essential for all staff members participating in the transfusion process to decrease transfusion errors, according to **Kabinda et al. (2019)**. In a similar spirit, this validated the logic underlying the results of this investigation.

This result contradicts the findings by **Abolwafa et al. (2018)**, who reported that none of the nurses under examination had any training related to transfusions; **Khalaf et al. (2017),** who demonstrated that only about one-third of the nurses under examination had; and **Tetteh Ebenezer (2019)**, who found that 72.1 percent of the nurses reported not having any training related to blood transfusions.

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According to the current findings, almost two-fifths of the nurses under study had less than or equal to five years of general experience in the nursing area, and one-third had more than five to ten years of experience. This could be because the majority of the nurses under study are in the youngest age range, which is between 25 and 30 years old. This result is in line with the findings of **Yesilbalkan et al. (2019),** who found that the majority of the participants had worked in their profession for between 0 and 4 years. Furthermore, **Abolwafa et al. (2018**) discovered that 55% of nurses had between one and five years of experience.

Additionally, it was revealed by **Kavaklioglu et al. (2017**) that more than two-fifths of participants had been employed by the hospital for two to five years. In contrast, **Shafik & Abd Allah (201**) noted that the majority of the study participants had worked in hematology units for five to less than ten years.

About the nurses who are taking part in the study, the nurses' level of knowledge regarding the following topics: nursing activities before the initiation of blood transfusion, nursing activities during the initiation of blood transfusion, blood transfusion adverse reactions, management of blood transfusion adverse reactions, and pre-and post-intervention nursing activities. The current findings demonstrated that all knowledge items regarding blood transfusion had improved and there was a highly statistically significant difference following the simulation-based training intervention. The educational bundle's ability to refresh information, the booklet's content items' relevancy and simplicity of language, and the instructional bundle's materials' clarity are all possible causes of this improvement.

This result is consistent with the findings of **Ddungu et al. (2018**), who found that over three-fifths of the sample under study admitted they needed training in transfusion and lacked understanding in the field. Additionally, **Khalaf et al. (2017**) showed that nurses' pre-training understanding of blood transfusion preparation fundamentals and principles was inadequate, but that post-training knowledge improved significantly across all linked disciplines of expertise.

Even though the current findings conflict with those of Abd **Elhy and Kasemy (2017**), who showed that the majority of the nurses in the study had adequate knowledge about the patient's background before blood transfusion, more than half of them had fair to good knowledge about blood packs. **Tetteh Ebenezer (2019**) discovered that nurses possessed

exceptional expertise concerning patient preparation for blood transfusions.

Additionally, **Khouri (2021**) noted that education could strengthen nurses' capacity to provide effective care. Additionally, **Aslani et al. (2020**) investigated that study and found that although nurses are proficient in the use of needles with the proper diameters, they lack precise scientific knowledge regarding blood-heating instructions and procedures and are not well-versed in patient identification in blood transfusions. According to the researchers, patient identification is the foundation for preventing errors and blood transfusion errors, therefore a lack of knowledge puts the patient at risk.

These results corroborate those of **Abolwafa et al. (2018**), who demonstrated a noteworthy enhancement in all knowledge and practice items among the nurses under investigation following the implementation of the educational program, which in turn improved patient outcomes. There was a need for an ongoing, mandatory teaching program to increase nurses' knowledge of transfusion reactions since it allows for prompt intervention and management.

According to the current findings, most of the nurses under study had inadequate knowledge levels before receiving simulation-based training; however, following the training, the majority of them had appropriate knowledge levels. According to the researchers, several factors, including overload in the workplace, a lack of ongoing training in safe blood transfusion, and inadequate preparation during basic education, may have contributed to the studied nurses' inadequate knowledge before program intervention. The good impact of combining theoretical learning sessions with simulation training may account for the nurses' satisfactory level of information acquisition. In addition, the dissemination of Arabic booklets is essential to information acquisition and retention. Similarly, a study conducted in London by **Chou et al., (2022**), which indicated that clinical knowledge improved after scenario simulation; corroborates the findings of the current investigation.

In comparison to pre-simulation-based training intervention, a highly statistically significant difference was found, and improvement in nurses' competent practices regarding blood transfusion in all phases of the procedure regarding safe blood transfusion (p=.000). These results might indicate that simulation-based training was beneficial in achieving the study's primary objective and could improve the examined nurses' ability to make wise

decisions in life-threatening circumstances like blood transfusion reactions. This result supports the findings of **Encan & Akin (2019)**, who claimed that for nurses to become more competent, they need evidence-based professional knowledge and abilities. They also need to practice enough to enhance the therapeutic effects of blood transfusion and reduce unpleasant responses connected to transfusion. Thus, monitoring and safe procedures are crucial to guarantee the safety of blood transfusions. In addition, **Sapkota et al. (2018)** observed that most of the sample lacked understanding about blood transfusion and explained that inadequate training and education result in nurses having inadequate transfusion knowledge.

Similar to **Ayres et al., (2021)** examination of information acquired through simulation training, this data supports that knowledge gained by midwives through simulation training was significantly and sustainably increased in the participants. Simulator-based training is also thought to be an effective instructional technique in the workplace, as noted by **Ameh et al. (2022)**, who also found that it can aid with self-confidence in real-life scenarios and the enhancement of knowledge and abilities. **Agha et al. (2020)** corroborate this finding as well. They note that training based on patient simulators and real patient simulation is highly effective in fostering cognitive knowledge. They also highlight the usage of simulation training as a preferred teaching strategy.

This outcome is consistent with the findings of **Bogne et al. (2020)**, who claim that simulation-based teaching-learning methods result in noticeably better performance among nurses in simulation groups. With the use of pertinent and accurate PPH scenarios, these results provide a paradigm for the successful and efficient application of simulation-based training, allowing nurses to participate in a simulated setting. This finding is consistent with the research conducted by **Kumar et al. (2019)**, which found that simulation-based instruction is a more effective mode of instruction than didactic lectures, particularly in the context of obstetric emergencies. Consequently, the simulated group that performed far better had a significant improvement in overall skills.

According to the current results, before simulation-based training, fewer than 75% of the nurses under study had incompetent practices; however, following simulation-based training, the vast majority of them had competent practices. This outcome could be attributed to the nurses' involvement in a virtual environment, which allows them to gain experience, hone their knowledge and

skills, and make trustworthy clinical decisions. It also offers opportunities for feedback and repeats practice until competency is attained. This outcome could be the consequence of the positive relationship between practice and knowledge.

The results of this study show that, while most nurses had high levels of self-confidence following simulation-based training, slightly over one-third of nurses had high levels of confidence before the training. The results align with **Nahas et al., (2019)** investigation on the impact of clinical simulation on the confidence level of student nurses. The study found that 50% of nursing students felt that engaging in patient simulation enhanced their confidence, and clinical competency, and equipped them for real-world clinical environments. A related study by **Adamson et al. (2019)** revealed that the simulation-based training was well-received by nursing students. They both thought the simulation was inspiring and useful. The materials utilized for the simulation were also praised by the participants. They had faith in their capacity to adapt the information they had learned in the simulation to clinical settings and in their ability to master the skills and knowledge that were presented in it. Furthermore, they believed that it was their duty to ascertain the lessons that should be drawn from the simulation.

According to the results of this study, the majority of nurses exhibited high levels of self-confidence following simulation-based training, although just over one-third of them did so before it. These results are in line with those of **Nahas et al. (2019)**, who investigated the impact of clinical simulation on the confidence levels of student nurses. Their findings showed that half of the nursing students felt that participating in patient simulation enhanced their clinical competency and helped them get ready for actual clinical settings. A related study conducted in 2019 by Adamson et al. revealed that the simulation-based course was well-received by nursing students. They both felt that the simulation was a good source of motivation. Regarding the resources utilized for the simulation, participants also reported satisfaction. They had faith in their capacity to apply the knowledge and abilities they had learned in the simulation to real-world clinical situations, as well as their mastery of the material. They also believed that they should be in charge of figuring out what they should take away from the simulation.

According to the study's findings, the majority of nurses experienced high levels of satisfaction following simulation-based training, although over one-third of nurses reported high levels of satisfaction before the training. In keeping with a study by **Parker et al. (2021)** that demonstrated how

employing the simulation technique boosts self-confidence and contentment. The comprehension and sense of accomplishment that nurses derive from their clinical practices are strongly influenced by their level of self-confidence. Moreover, it was noted that, in comparison to the traditional training group, a notable improvement in the degree of confidence among nursing students receiving clinical skill training through simulation was seen in areas like disease diagnosis and symptoms, patient assessment, nursing interventions, and evaluation. This outcome can be the consequence of the simulation-based training providing a secure and productive learning environment for nurses to acquire skills that boost their confidence and enhance their level of pleasure. The nurses' enjoyment of the simulation training could be the cause of this outcome.

According to the current study's results, there was a statistically significant positive correlation between the total knowledge score, the total practices score, the satisfaction score, and the self-confidence score before and after simulation-based training. These findings are consistent with those of **Lindsey & Jenkins (2020**), who found that knowledge performance and self-confidence were positively correlated. Furthermore demonstrated how nurses increased their confidence by integrating their knowledge and expertise to make precise clinical judgments. Furthermore, the training through simulation affords chances to acquire the necessary knowledge and abilities for fostering self-assurance. According to **Hashem et al. (2022**), this finding showed a highly significant positive link between the nursing students' pre-, immediately after, and one-month simulation training program scores for total knowledge, practice, and self-confidence. This outcome could be attributed to the fact that the use of simulation-based training was linked to an increase in knowledge level that aided in the nurses' mastery of clinical skill performance, and additionally contemplated enhancing their contentment and self-assurance.

Conclusion:

In light of the current study results, it can be said that simulation-based training had a positive effect on improving nurses' performance, self-confidence, and satisfaction regarding blood transfusion. Moreover, there was a highly statistically significant improvement in all items of nurses' knowledge and practices regarding blood transfusion after simulation-based training than before. Also, a statistically significant relation was found between total nurses' knowledge and practice self-confidence and satisfaction regarding blood transfusion post-simulation-based training than before. Therefore, the study hypotheses were supported, and the study aim was achieved.

Recommendations:

Based on the results of the current study, the following recommendations are suggested:

- The study recommended that simulation-based training should be integrated as an effective method in nurses' education about blood transfusion.

- Conduct routine in-service training, monitor nurses' performance, and encourage them to keep up to date on blood transfusion knowledge and procedures.

- The medical-surgical nursing curriculum's clinical training component now includes simulation training based on competency level.

- To generalize the findings, more research with a large number of nurses in various situations should be conducted.

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