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Nurses` safety practices provided for patients undergoing external fixation surgeries

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Abstract: **External fixation (EF) is an external metal frame connected to bone fragments, in which skeletal pins or wires are inserted into the bone through incisions of the skin. This study aimed to: assess nurses` safety practices provided for patients undergoing (EF) surgeries.Research Question: What are the nurses`safety practices provided for patients undergoing external fixation surgeries? Research design: A descriptive research design was used. Setting: This study was conducted at all the Inpatient Orthopedic Wards in addition to the Operating Theaters of EL-Hadra Orthopedic and Traumatology University Hospital Alexandria, Egypt. Subjects: A convenient sample of all nursing staff (a total of 95 male and female nurses) involved in providing direct care for patients were included in the study. Tools: One tool was used: "Nurses` Safety Practices Provided for Patients Undergoing External Fixation Surgeries Observational Checklist". Results: The highest level of safety measures provided for patients undergoing external fixation surgeries preoperatively was related to psychological safety followed by chemical, biological, and physical safety preparations. Statistical significant correlations were declared between the studied nurses` "Preoperative safety preparation practices mean scores" and studied "Orthopedic ward physical set up mean scores. Conclusion: The highest level of safety measures provided for patients undergoing external fixation surgeries intraoperatively was related to instrumental and mechanical safety followed by physical, psychological, and biological safety preparations. Recommendations: Developing standards regarding nursing care for safe external fixation surgeries.**

Keywords: **external fixation, patient safety.**

1. INTRODUCTION

Orthopedic patients' safety is an essential component of quality care (Pinney, Page, Jevsevar, & Bozic, 2016). The World Health Organization (WHO) defined patient safety as the absence of preventable harm to a patient during the process of health care and the reduction of risk of unnecessary harm associated with health care to an acceptable minimum level(Angassa, 2016; Elrefaee,2012). It involves establishing operational systems that are minimizing the likelihood of errors and maximizing the likelihood of intercepting them when they occur (Ivanovic, 2015, EL-okda, 2015).

Treatment of fractures surgically underwent important alterations around the middle of the last century. For many years, external fixation devices have been the gold standard for the treatment of many types of fractures that cannot be treated by traction or cast (Lenza, Buchbinder, Johnston, Ferrari& Faloppa, 2019).External fixators provide stabilization of an injured limb segment through the use of pins or wires connected to rods via clamps or rings (Grubor& Borrelli, 2020).

The use of an external fixator to treat fractures enables the modification and preservation of the length of the limbs and facilitates the restoration of soft tissues. Besides, the early operation of muscles and joints is allowed, and the comfort of

patients is improved (Tawfiq & Radhi, 2016).It also promotes early ambulation as an immediate movement of the proximal and distal joints is permitted and helps delay capsular fibrosis, joint stiffening, muscle atrophy, thus reducing the risk of immobilization complications (Dancer, Stewart, Coulombe, Gregori, & Virdi, 2012)

The long-term and invasive nature of the external fixator will increase the impact of the pins on the surrounding tissues (Dan&Kemper, 2014). Approximately 70% of patients with external fixing devices encounter complications with high incidence rates (Tawfiq & Radhi, 2016), restrict patient operation, prolong hospitalization, interrupt the healing process, and impact the quality of life (QOL) (Touissaint, Gitajn & Kwon, 2013). These complications include infection of the pin tract, neurovascular impairment, impairment of the muscle or tendon, contractures of the muscle, delayed union, compartment syndrome, refractures, and deviation of the mechanical axis. (MacDonald, Firoozabadi, Routt& Kleweno, 2017)

Health hazards in hospital settings in which nursing care is provided to patients can be categorized into physical hazards that include: exposure to radiation from sources of x-rays and radioisotopes, discomfort, hazardous transfer to the patient, and the use of equipment that has been poorly maintained or inappropriately used and is not appropriate for the purpose. Biological hazards include any infectious viruses and bacteria, such as exposure to infected blood and body fluids, exposure to airborne pathogens, needle stick injury, and ergonomics (Amer, 2015). Chemical hazards include chemicals used in cleaning, disinfecting, sterilizing agents, medical gasses, any medication abuse, and skin irritation due to latex allergy due to exposure to natural latex gloves or other medical devices containing latex(Hathaway & Proctor, 2014).Psychological hazards include: family separation, psychological stress and financial costs (Abd-Elaty, 2015) and electrical hazards included: proximity of the patient to an electrical generator device (electrocautery) and electrical outlets in the operating room (Elrefaee, 2012).

During the perioperative phases of external fixator surgery, as part of the health care team, the orthopedic nurses are responsible for providing the patient with certain activities to maintain and ensure patient safety based on the American Society of Peri Anesthesia Nurses ' practice Rheumatology (Ranhoff et al., 2019).

The pre-operative physical safety preparations should include Assess the patient's about:The usual pattern of exercise, work activity, leisure, and recreation. Asking the patient about his or her ability to perform activities of daily living and note any specific problems. Obtaining a 24-hour diet recall from the patient. Patient`s nutritional status and identifying factors that can affect the patient’s surgical courses, such as obesity, weight loss, malnutrition, deficiencies in specific nutrients, metabolic abnormalities, and the effects of medications on nutrition (Brunner, Smeltzer, Bare, Hinkle& Cheever, 2014).

The pre-operative biological safety preparations should include: hand disinfection before and after each patient, use of personal protective equipment (PPE) Health care providers should take precautions to prevent needle injury and other sharp tools by placing them in suitable containers that are clearly labeled, punctured, and leak-proof and conform to AS4031 (non-reusable containers for collecting sharp medical devices used in healthcare areas1992/AMDT 1 1996). Health care providers should prevent needle recapping and avoid hand-to-hand movement of sharp instruments (Vilariño, 2013).

Related to the chemical safety preparations, medication safety requires the active involvement of nurses, other providers, administrators, policymakers, educators, and consumers (Mahdi, Z. S., & Ahmed, S. A. 2018). To reduce the incidence of medication errors, nurses must apply the nine rights of medication administration: right patient, right drug, the right response, right dose, right response, right form, and documentation. (Atia, 2015).

Related to the psychological safety preparations, patient comfort and safety are essential to recovering from surgery and wound healing, to increase their physiological and psychological distress, and to reduce anxiety (Puchalski & Ferrell, 2011).Nurses have to introduce themselves; give their titles and brief synopsis of their role. Every patient should be treated as a person and his / her needs assessed (Fawzy, 2016). The nurses should support, convey the emotional state of the patient to other related health care team members (Hinkle & Cheever, 2013), and provide patients with a full explanation of the procedure and planning needed (Zastrow, 2011). There should be ample time to ask questions and express concerns about the operation (Cuzzocrea et al., 2013).

Related to the intra-operative physical safety preparations the circulating nurse is responsible for correctly identifying patients, ensuring the second form and site verification of the operation(Rothrock, 2018), confirming consent is received, enforcing fire safety protocol (Marshall,2016), Managing the operating room, maintaining cleanliness, correct temperature, humidity and lighting, testing the air quality of the operating room, consistent implementation of fire measures, surveillance, coordination of operating team activities, protecting patient safety and health, identifying patient signs and symptoms of complications and implementing effective interventions (Marshall,2016).The circulating nurse also helps the patient to assume proper positioning to ensure easy access to the surgical site, airways, intravenous lines, and all monitoring devices in compliance with the operation site. (EL-okda, 2015; Elrefaee, 2012).

Related to the intra-operative biological safety preparations, the circulating nurse should ensure that spills are cleaned as soon as they occur: wear appropriate personal protective equipment while handling spills, spray the contaminated area with high concentration disinfectant solutions, keep the solution for a few minutes, rinse the contaminated area with clean water, and then dry it with paper towels. The scrub nurse should pour blood and body fluid in the toilet and then flush it. Finally, it is the responsibility of the scrub nurse to perform alcohol-based hand rub (ABHR) (Fawzy, 2016).

Related to the Instrumental and mechanical safety preparations:the circulating nurse is responsible for checking the availability of supplies and materials required for the operation, such as sponges, drains and other equipment, setting up sterile tables, preparing sutures, ligatures and special equipment (such as a laparoscope), routinely checking the efficiency and maintenance of safe equipment by inspecting and testing this equipment such as monitoring devices, connectors and grounded pad before each use and immediately reporting of malfunctioning equipment (Willingham, 2014).

Related to the Psychological safety preparations, the intraoperative orthopedic nursing staff will continue to evaluate the emotional state of the patient, provide the patient with emotional support, knowledge, and reassurance, stand, close or contact the patient during operations, and continue preoperative nursing care. Orthopedic nurses must promote coping strategies and improve the capacity of the patient to affect the outcomes by Encouraging active participation in the treatment plan (Meehan et al., 2018)**.**

Related to the **physical safety preparations** post-operatively, the nurse should check the patient chart for competence during the initial assessment, review the operating notes and carry out a post-operative assessment that includes: assessment of the patient's airway, respiration, and circulation status (ABC) every 30 minutes if the patient is stable and less if the patient is unstable, monitoring the patient's body temperature every 4 hours and identifying signs of inadequate oxygenation and ventilation (Tawfiq & Radhi, 2016).

Certain other activities include level of consciousness assessment; sensory and motor status, pupil size, equality and reactivity, and urinary system assessment based on intake/output, and fluid balance. Note the presence of all IV lines, all irrigation solutions and infusions; and all output devices including catheters and wound drains (Sweson, 2020).

Other nursing steps include assessment of the surgical site, a close examination of the incision site, notice of the state of any dressings, including the type and quantity of any drainage, log the type, quantity, color and odor of the drainage, evaluate the impact of changes in the position on drainage, Note the number and form of drains present and prevent the drains from dislodging.

Neurovascular assessment of the affected extremities should be done daily for the first 24 hours following the application of the fixator for the presence of pain which is the most predictor of neurovascular compromise. It is generally constant but worse with the passive extension movement, an opioid is not relieved of it(Newton-Triggs, Pugh, Rogers, & Timms, 2014).

Patients with external fixators need cleaned and cared-for pin/wire sites to prevent infection and facilitate optimal healing. Patients and families must be taught how, where possible, to clean pin/wire sites to facilitate self-care and minimize the risk of infection. The nurse will advise the patient and his or her family to take care of the pin site as follows: assess the patient at risk for pin site infection for the presence of infection signs and symptoms, use of corticosteroids, and presence of any coexisting infection. The nurse will conduct pin site dressing measures with stress on metal frame cleaning and dryness, wipe away from the skin, clean the cleanest pin sites, then exude crushed pin sites and clean each pin (Kazmers, 2016).

Related to the Psychological safety measures post-operatively the nurse supports the patient and family who work through their anxieties by offering reassurance and post-operative treatment information, outlining hospital procedures, and what to expect in time before discharge and explaining the purpose of nursing evaluations and interventions. The nurse can also change the environment to promote relaxation by providing privacy, noise reduction, lighting modification, providing enough seating for family members, and promoting a welcoming atmosphere (Chan,& Esmailian,2018).

Exercises are an essential part of the post-operative treatment for patients with external fixators as they are useful in improving the range of movement and functional abilities, preventing muscle atrophy, deep vein thrombosis (DVT), and self-care constraints. (Abuomira, Sala, Said, Elshal & Amar, 2018).

The patient should be advised by the nurse to do exercises for the unaffected and affected extremities. Range of motion exercises (ROM) should be taught for the unaffected extremities; straighten and bend one or more joints of the body and move them in all normal directions; (Doğru Apti, Kasapçopur, Mengi, Öztürk& Metin, 2014)

The nurse should ensure that the ROM principles are considered as: all movements should be slow and gentle. The period of rest should be at the end of each motion. The level of movement should be gradually increased. The joint should be pushed before resistance is present. Patients should not go further than pain or exhaustion. Wherever possible, active exercises should be encouraged.2 or 3 t of each exercise sequence should be performed (Vandali, 2018). The nurse should also instruct the patient to perform isometric exercises for the affected extremity.

Nurses have great responsibilities in providing patients undergoing external fixation surgeries with appropriate pre, intra and post-operative nursing interventions in addition to the different safety measures to promote patient health, enhance external fixator application success and ensure patient recovery with minimal preventable complications incidence. No doubt the application of external fixators with a high quality of nursing interventions is closely adhering to positive patient outcomes. Also, if the poor quality of care is provided, dangerous complications that would financially burden the patient and the community are more likely to appear

Aim of the study:

This study aimed to assess nurses` safety practices provided for patients undergoing external fixation surgeries.

Research Question:

What are the nurses` safety practices provided for patients undergoing external fixation surgeries?

2. MATERIALS AND METHOD

Materials:

Research Design:

A descriptive research design was used for this study.

Setting:

This study was conducted at all the Inpatient Orthopedic Male and Female Wards in addition to the Operating Theaters of EL-Hadra Orthopedic and Traumatology University Hospital Alexandria, Egypt.

Subjects:

Subjects of the study included all nursing staff (a total of 95) involved in providing direct care for patients undergoing external fixation surgeries. These constitute 45 Inpatient nurses (those nurses are distributed as 26 nurses in the Male sector, 19 nurses in the Female) who are distributed on 3 shifts and 50 at the orthopedic operating rooms. Their qualifications are 1 bachelor, 12 technical, and 77 diploma holders.

Tools:

One tool were used, based on reviewing the related literature in order to collect the necessary information to assess nurses` safety practices provided for patients undergoing external fixation surgeries.

Tool (I) "Nurses` Safety Practices Provided for Patients Undergoing External Fixation Surgeries: An Observational Checklist"

This tool was developed by the researcher after review of related literature (Ashor, 2016; Tawfiq & Radhi,2016; Fawzy,2016; EL-okda, 2015; Atia, 2015; Dogru Apti, Kasapcopur, Mengi, Ozturk& Metin, 2014). It was used to assess nurses` safety practices provided for patients undergoing external fixation surgeries. It was composed of three parts:

Part (I-a): Ideal physical set up of the orthopedic surgery ward:

This part comprised nineteen items which included the following; the ideal physical set up of the orthopedic surgery ward: maintaining safe hospital environment through a well-ventilated environment, well Lighted environment, clean, quiet environment, minimizing crowdedness, well-arranged patients 'rooms, dry floors and absence of fire and electrical hazards, locker(s) to store patients` personal belongings as well as adequate patient toilet facilities close to patient rooms.

Part (I-b): Nurses` safety practices provided for patients preoperatively.

This part was composed of thirty-two items related to physical, biological, chemical, and psychological safety preparations and was categorized as the following:

A) Physical safety preparations:

This part included sixteen items related to checking for patient`s identification personal information, identifying patient's medical history, requested blood or diagnostic studies, obtaining informed written consent, reviewing the patient medical record for completeness including all diagnostic and laboratory studies results, asking the patient for removing any jewelers or metal objects, nail polish, dentures, contact lenses, prosthesis, asking the patient to be fast 6-8 hours before the operation, monitoring patient`s vital signs.

B) Biological safety preparations:

This part included seven items related to bacteriological studies of the orthopedic ward environment according to hospital policy and schedule, hand hygiene before providing care to the patient, hand rub for 15 to20 seconds till evaporating, ruling out the presence of any infection, protecting against needle stick injury and surgical site infections by the safe discarding of infectious wastes and sharp instruments or moist body substances according to hospital policy, ensuring that patient wearing clean gown and overhead and ensuring health care providers use of personal protective equipment(PPE).

C) Chemical safety preparations:

This part included three items related to safe medication administration (right time, right dose, right route, right patient`s name, right medication`s name, right action, right reaction, right expiry date, and documentation), checking the expiration date of antiseptic solutions and checking for right storage of medication and antiseptic solutions in a specific locker(s).

D) Psychological safety preparations:

This part included six items as introducing himself to the patient firstly, deal with the patient calmly and gently, maintain a therapeutic relationship with the patient, maintain effective communication with the patient, give an adequate explanation before any procedure, answer all patients' questions regarding preoperative preparations, postoperative instruction, and discharge strategies.

Part (II-a): Ideal physical set up of the orthopedic operating rooms:

This part was used to assess the ideal physical set up of the orthopedic operating rooms as checked by the investigator. It was composed of thirty-seven items distributed as the following:

A) Pre-operative preparation area:

The pre-operative preparation area included nine items related: assessing for being in proximity of the operating rooms for immediate transport; the doorway must be with the appropriate size, the stretcher(s) adjustable to both height and position, designed to accommodate imaging equipment. The area should include items as locker(s) to hold adequate patient care supplies, adequate patients monitoring devices, adequate patients imaging equipment, enclosing overhead storage and adequate toilet facilities close to the pre-operative preparation area.

B) The orthopedic operating room:

The orthopedic operating room included sixteen items as being large enough, appropriately and safely wired, adequate hand hygiene supplies, adequate surgical hand scrub supplies, having easy access to a hand hygiene sink, appropriate operating table(s) with appropriate height and side rails as well as different beds.

C) The recovery area:

The recovery area included twelve descriptions as follows: large enough well-ventilated environment, enough light source, adequate patients monitoring devices , other equipment as reclining\wheel chairs, patient toilet(s) close to the recovery area, stretchers adjustable to both height and position, safe laundry system, safe waste disposal according to hospital policy, resuscitation facilities.

Part (II-b): Nurses` safety practices provided for patients during the intraoperative period.

This part was developed to assess nurses` safety practices provided for patients during the intraoperative period. It was composed of twenty-nine items and it was checked for the following:

A) Physical safety preparations:

This part included nine physical preparation activities related to checking orally for identification of the patient, confirming type of operation done, confirming operation site, assisting patients to assume proper position according to the operation site, continuous monitoring for patient vital signs, monitoring patient's nail color and capillary refill, assisting in handling needed equipment and supplies properly and in aseptic, assisting in the administration of anesthesia medication, resuscitation medication as well as performing oral suction if needed.

B) Biological safety preparations:

This part included six activities related to checking for the sterilization date and timing of the patient care instrument and supplies, ensuring sterilization of suction tube for each patient, carrying out hygiene before providing care to and between patients, carrying out using hand rub (AHR) for 15 to20 seconds till evaporating, wearing clean or sterile personal protective equipment (PPE) and ensuring cleaning up spills as soon as they occur according to hospital policy.

C) Instrumental and mechanical safety preparations:

This part included ten activities related to checking for the efficiency of equipment needed for the operations, rechecking for the monitoring devices function, adjusting operation table height, checking its efficiency, adjusting the cardiac monitor at the level of the health care providers, applying the brakes of the stretcher securely, keeping the floor dry at all time of the operation, raising trolley side rails, keeping any electrical cord away from being in contact with the wet ground of the operating room and ensuring the efficiency and patency of the drainage system.

D) Psychological safety preparation

This part included four preparations related to maintaining patient dignity by keeping patient privacy, covering the patient and exposing only the operation site, giving patient instructions in a calm simple manner, and dealing with the patient gently and as a whole.

Part III: Nurses` safety practices provided for patients postoperatively.

This part was developed to assess nurses` safety practices provided for patients post operatively. It was composed of eleven main practices and it was checked as the following:

A) Physical safety preparation:

This part included main five activities related to checking patient personal chart for completence, reading the operative notes, assessing patient`s orientation to person, place&time, post-operative assessment, and recording of vital signs, pain level, the neurovascular status of the affected extremity, swelling at the operation site and wound care assessment, wound drainage system as well as documentation of postoperative assessment. Patient post-operative instructions included eight subcategories related to performing pin site, nutritional status, positioning, exercises, showering and bathing, clothing, smoking and alcoholic consumption

B) Safe patient mobility:

This part included six items related to; safe usage of assistive devices as canes and crutches

C) Psychological safety:

This section included one measure related to continuous reassurance while keeping patient privacy.

Scoring system:

The scoring system related to **"Ideal physical set up" of the orthopedic surgery ward and the orthopedic operating rooms** was measured on a 3-point rating scale for each item as: available and functioning (2),available but nonfunctioning (1). in available (0). All items were formulated in the same direction, **The total score** was classified as ;a score of more than 75% was considered as "Good physical setups ".A score of 50% to less than 75% was considered "Fair physical setups ".A score of less than 50% was considered "Poor physical setups ".

A total scoring system related to "nurses` safety practices" responses throughout the previously cited three phases was checked on a 4-point rating scale for each item as follows: Done correctly and completely (3), done but incompletely (2), done incorrectly (1) and not done (0).**The total score** for nurses` practices was classified as the following; A score of more than 75% was considered "Safe nursing practices". A score of less than 75% was considered "Poor /unsafe nursing practices".

Method:

Written Approval:

Official written approval was obtained from the administrative authorities of the identified setting to take permission to carry out the study after explaining its purpose.

Tool development:

"Nurses` Safety Practices Provided for Patients Undergoing External Fixation Surgeries: An Observational Checklist to assess nurses` safety practices provided for patients undergoing external fixation surgeries.

Nurse`s socio-demographic datasheet was attached to the developed tool to collect socio-demographic data of the study nurses sample. It included eight items related to age (year), gender, marital status, qualifications, type of working area, type of ward, years of experience, educational\training courses related to patient`s safety, and its duration.

Testing of content validity:

The content validity of the tool was submitted to jury members of five experts in the Medical-Surgical Nursing field, to assure the content validity, completeness and clarity of items, appropriateness of translations and applicability on the Egyptian society. The necessary modifications in phrasing and sequence of some statements were done.

Reliability testing:

A study tool ("Nurses` Safety Practices Provided for Patients Undergoing External Fixation Surgeries: An Observational Checklist) was tested for its reliability on a sample of 8 subjects using Alpha Cronbach's statistical test for internal consistency of tool items. The correlation coefficient was (α= 0.835), so it was reliable.

Pilot study:

A pilot study was carried out on 10 patients in the identified setting to ascertain the clarity and applicability of the study tools and to identify obstacles that may be faced during data collection.

Data collection:

Steps of the study:

1- Every nurse caring for patients undergoing external fixation surgeries was directly watched by the researcher, individually throughout the morning and evening shifts for around 3 hours duration each shift, throughout the perioperative phases of surgery and until discharge, using the developed study tool.

2- Operating room nurses were watched throughout the morning shifts only, according to hospital policies. Concealed observations were followed.

3- Data were collected throughout a period of 3 months starting from the fifth of March to the tenth of June 2019.

Ethical Considerations:

1- Written informed consent of the nurse participants was obtained after explaining the aim of the study.

2- Written witness consents were obtained from the head nurse and the administrative authorities in the identified setting to take permission to carry out the study after explanation of its purpose.

3- Privacy of the nurses and confidentiality of the collected data was assured

4- The anonymity of the study nurses was maintained.

5- The right to withdraw from the study was confirmed.

Statistical Analysis:

- After data collection, data was coded and transferred into a specially designed format so as to be suitable for computer feeding. Following data entry, checking and verification processes were carried out to avoid errors during data entry.

- Data were fed to the computer and analyzed using IBM SPSS software package version 20.0**.** **(**Armonk, NY: IBM Corp**)** Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. Significance of the obtained results was judged at the 5% level.

The following statistical analysis measures were used:

- Descriptive statistical measures, included: numbers, percentages, and averages (Minimum, Maximum, Arithmetic mean, Standard deviation (SD).
- Statistical analysis tests, included: Chi-square, student T-test, Pearson Correlation Coefficient and ANOVA

3. RESULTS

Table (1) displays the distribution of the studied nurses, according to their socio-demographic characteristics

As regards to the "Age of the studied nurses", the table shows that; slightly more than half of the nurses (58.8%) were in the age group from 35-45 years, and the majorities (93.8%) were females. Concerning "Qualification", the results show that; the highest proportions of the studied nurses (83.8%) had diploma degrees. As regards "Training programs", (61,25%) of the studied nurses attended educational courses\ training programs related to patient safety practices.

Table (2) shows the availability and functioning of the studied orthopedics wards physical setup items:

Regarding "The ideal physical set up of the orthopedic ward", the table reveals that; the majority of the items for "Maintaining safe hospital environment" were "available and functioning" (100%) were available and functioning, while "Monitoring devices and resuscitation facilities" (100%) were "not available" at all.

Table (3) depicts the availability and functioning of the studied surgical pre-operative area physical setup items:

The table shows that; the entire total physical set up of the studied orthopedic pre-operative area all items (100%) items" were not available.

Table (4) depicts availability and functioning of the studied surgical orthopedic operating room physical setup items:

The table depicts that; "Radiographic equipment", "Ventilation system", "Anesthesia machine(s)", "Anesthesia carts", "Resuscitation facilities" were available and functioning .The table shows that;"Safe electrical outlets for surgical equipment", "Appropriate operating table with appropriate height and side rails", "Different beds with different positions", "Patient warming devices", as well as "Drainage system"were all "Available" but "Not functioning".

Table (5) presents the availability and functioning of the studied orthopedic recovery rooms physical setup items:

The table illustrates that; "Adequate patient monitoring devices" as well as "The resuscitation facilities" were all "Available but not functioning". "Patient toilets close to the recovery area", "Safe laundry system" as well as "Safe waste disposal system" were all "Not available" in the recovery room.

Table (6) shows the distribution of the studied orthopedic settings according to the total physical set up levels:

The table shows that; the total physical set up levels of the studied orthopedic wards, surgical operative rooms as well as recovery areas were "Fair" representing ;(100% &100 and 100%) respectively. While the total physical set up levels of the studied orthopedic surgical pre-operative area were "Poor" representing ;(100%).

Table (7) presents the distribution of the studied nurses according to their pre-operative safety practices and their mean scores (total no=80):

Regarding physical safety preparation, the table illustrated that; two-thirds of the physical safety preparations" (66.3%) were done unsafely except for" Obtaining informed written consent", "Inserting peripheral intravenous line and ensuring its patency", "Preparing the skin and wrist", which were done safely representing; (43.8%,92.5%,82.5% &93.8%)respectively.

Concerning biological safety preparation, the table reveals that; more than half of the "Biological safety preparations"(66.3%) were done unsafely except for " Discarding of wastes " and for "Ensuring the patient wearing a clean gown, and overhead" which were done safely representing ;(95% &97.5%) respectively.

Regarding chemical safety preparation, the table shows that nearly more than two-third of the studied nurses (76.3%) showed unsafe preoperative preparation practices. However "Safe medication administration" , "Checking for right storage of medication" ,"Checking for expiry date for antiseptic solution" as well as "Storage of antiseptic solution in specific locker(s)" were done safely representing; (45% , 63.7.%,41.2% and 73.7%) respectively.

Concerning psychological safety preparation, the table illustrates that all the studied nurses (100%) showed unsafe preoperative preparation practices. Regarding "Introducing themselves to the patient", "Dealing with the patient in a calm manner", "Giving adequate explanation before any procedure and "Answering all patient questions" were done unsafely representing; (77.5%, 82.5%, 70% & 76.3%) respectively.

Table (8) shows the distribution of the studied nurses according to their intra-operative safety practices (total no=80):

Regarding physical safety preparation practices, the table reveals that; the total scores of the studied nurses (91.3%) revealed unsafe practices. "Checking orally for patient identification", "Confirming type", "site of the operation", and "Monitoring patient`s nail color and capillary refill" were all done unsafely by;(65%, 62.5%, 85.0%&50%) of the studied nurses respectively.

"Assisting patient to assume proper positioning", "Continuous monitoring patient vital signs", "Assisting in the administration of anesthesia medication", and "Assisting in the administration of resuscitation medication" were done safely by;(86.3%.51.3,50%,98.7%, and 88.7%) of the studied nurses respectively.

Concerning biological safety preparation, the table reveals that slightly more than half of the studied nurses (51.3%) had safe practices. The table reveals that; "Checking instruments` sterilization", "Carrying out hand hygiene" as well as "Wearing personal protective equipment "were all done safely by,(91.3%,90%, and 93.7%) of the nurses. While, "Ensuring sterilization of suction tube", "Performing antiseptic hand rub" as well as Cleansing up spills" were all done unsafely representing;(62.5%,70%, and 78.7%)respectively.

Regarding instrumental/mechanical safety preparation, the table reveals that; all of the instrumental safety preparations were done unsafely (100%). " Checking for the efficiency of equipment"," Rechecking for the monitoring devices function" as well as "Applying the brakes of the stretcher securely" were all done safely by; (48.7%,47.5%, 93.7%) of the studied nurses respectively. While, "Ensuring the floor dry all the time of the operation" and Keeping the electrical cord away from being in contact with wet ground" as well as "Ensuring the efficiency and patency of the drainage system of the operating room" were all done unsafely by; (77.5.%,75%, and 95%) of the nurses respectively.

Concerning psychological safety preparation, the table reveals that almost all items of the "Psychological safety preparations practices" were done unsafe (100%). Regarding "Maintaining patient dignity", "Dealing with patients in a calm manner" as well as "Dealing with the patient gently" were all done unsafely by;(90%,96.3%, and 97.5%) of the studied nurses respectively.

Table (9) reveals the distribution of the studied nurses according to the post-operative safety practices and their mean scores (total no=80):

For physical safety practices, the table reveals that; (98.7%) of the total "Physical safety Practices" were done unsafely. While," Checking patient personal chart for completeness' 'Assess the level of consciousness", "assessment of skin integrity" as well as "Giving patient post-operative instructions about the positioning of the affected extremities" which were done safely representing ;(95%,95%,81.3%&68.7%) respectively.

Concerning safe mobility practices, the table reveals that; all of the "Safe mobility Practices were done unsafely"(100%). regarding "Instruction of assistive devices usage ", keeping floors\stair ways free of crowdedness", "Ensuring cleansing up spills" as well as "Presence of a strong handrail on both sides" were all done unsafely by;(100%,85.0%,97,5% &93.8%) respectively**.**

Regarding psychological safety practices, the table reveals that; slightly more than half of the "Psychological safety practices were done unsafely (53.8%)".

Table (10) presents the relationships between the studied nurses' pre-operative safety preparation levels and their socio-demographic characteristics

The table reveals that; there were positive significant relationships between "The studied nurses` "Pre-operative preparation practices levels" and their "Age", "Type of ward they worked in" and "Attendance of educational training courses about patient safety" (where x2=16.603 p=0.001, x2=10.104 p=0.001, x2=6.183 p=0.013) respectively. While, no significant relationship was detected between the "Studied nurses` total pre-operative preparation practices levels" and their "Gender", "Level of education", "Working area". "Years of experience" as well as "Marital status".

Table (11) shows the relationships between the studied nurses' intra-operative safety preparation practices levels and their socio-demographic data:

The table illustrates that; there were no significant relationships between the studied nurses` "Intraoperative safety preparation practices levels" and their "Socio-demographic data".

Table (12) shows the relationships between the studied nurses' post-operative safety preparation levels and their socio-demographic data:

No significant relationships were evidenced between the studied nurses` "Post-operative safety practices levels" and their "Socio-demographic data".

Table: (13) Shows the correlations between the ward setup, operating room, and recovery area physical setups and nurses' pre-operative, intraoperative, and postoperative practices mean scores:

The table reveals that; there were statistically significant correlations between the studied nurses` "Preoperative safety preparation practices mean scores" and studied "Orthopedic ward physical set up mean scores representing ;(r=0.593at p=0.042)

There were statistically significant correlations between the studied nurses` "Postoperativeve safety preparation practices mean scores" and studied "Recovery area physical set up mean scores where (r=0.611 at p=0.018).

No significant correlations were detected between the studied nurses` "Intra-operative preparation practices mean scores" and the studied "Operating room physical set up" where, (r=0.185 at p=0.174).

Also, No significant correlations were detected between the studied nurses` "Total nurses` practices mean scores" and the studied "Total physical set up mean scores" where (r=0.169at p=0.135).

Table (14) displays a correlation matrix between the studied nurses' total pre-, intra, and post-operative safety practices scores:

The table reveals that there were statistically significant positive correlations between the studied nurses` total "Pre-operative safety preparation practices scores" and their total "Intra and post-operative safety preparation practices scores since; (r=0.860 at p=0.000 and r=0.719 at p=0.000); respectively. Statistical significance correlations were detected between the studied nurses` "Intra-operative preparation practices scores" and their "Post-operative safety practices scores" where (r=0.719 at p=0.000); respectively.

4. DISCUSSION

As regards to sociodemographic characteristics of the studied nurses: it was noted that; about "Age", slightly more than half of the nurses were in the age group from 35-45 years. This result mismatched with (Mohamed, Mohamed &Ahmed; 2019) at Assuit University Hospital, who reported that; nearly half of the subjects of their study were in the age group (23 -32) years. While, this finding agrees with (Mohamed, Mansour, Mohamed &Moghazy, 2020) who showed that the majority of the nursing staff in the studied orthopedic ward within the age group (28-58) years in Zagazig University Hospitals, Egypt.

Concerning **''Qualification''**, the present study revealed that; the highest proportions of the studied nurses had diploma degrees. This result was supported by (Elreefay, 2012) in Egypt, who reported that all nurses were juniors having a diploma in the secondary nursing school. A similar finding was found by (Suliman&Aljezawi, 2018) at Jordan who stated that more than one-third of nurses were diploma graduates. On the contrary, this finding comes with (Magda & Hassan, 2018) in Egypt who found that the majority of the sample were technical nurses. (McHugh etail., 2016) enhanced the significance of the presence of registered nurses with a bachelor's degree. This is no doubt, points out the need for the presence of bachelor's degree nurses.

About **''Training programs''**, the present study revealed that; more than half of the studied nurses had attended educational course\ training programs related to patient safety practices, this may be due to the increased awareness of the administrator in the studied setting about the patients` safety importance. This result agrees with (Magda & Hassan, 2018) who found that; the majority of the study sample had shared in training sessions related to patient safety.

Concerning the **"Ideal physical set up of the orthopedic ward"**, the present study showed that; the majority of items related to "Maintaining safe hospital environment" were available and functioning. (Ashor, 2016) stated that; the orthopedic surgery unit should be well ventilated and lighted by having enough light source, clean, quiet, low crowdedness, well-arranged patients` rooms, and dry floor with the absence of fire and electrical hazards. The present study also revealed that; all the "Monitoring devices and resuscitation facilities" are not available at all. This finding is in the line with (Abd-Elaty, 2015) who stated that; all the items related to resuscitation facilities were not available in the studied endoscopy units of Alexandria University Hospital, Egypt.

The present study revealed that; **''The total physical set up of the studied orthopedic pre-operative area items''** was not available at all, this result may be related to the fact that the studied setting had no preparation area and the patient is prepared in the inpatient departments. This finding was supported by (Metwally, Abou Donia & Aziz,2016)who stated that; the availability and adequacy of structure and facilities related to the preparation area were higher in the upper GIT endoscopy units at the private hospitals and clinics, compared to governmental hospitals, health insurance hospital, and university hospitals in Alexandria, Egypt.

In relation **to ''The total physical set up of the studied orthopedic operating rooms**, the present study demonstrated the availability and adequacy of "Surgical hand rubs supplies"," Radiographic equipment"," Ventilation system' 'Anesthesia machine(s)", "Anesthesia carts" and "Resuscitation facilities"; this ideal operating room structure no doubt, allows easing out surgical procedures with a high-quality level. This finding is in the line with (Sutton & Park, 2012) who stated that; the operating room must have adequate resuscitation equipment available in addition to the presence of the anesthesia machines, monitors, anesthesia cart, and scavenging system.

Concerning **''The total physical set up of the studied recovery area"**, regarding; the presence of adequate patient "Monitoring devices" and "Resuscitation facilities" the present study revealed that; these items were available but not

functioning. This result disagrees with (Winner,2013) who reported that; the treatment area had adequate "Monitoring devices, oxygen sources, suction devices, and ready access resuscitation facilities" which working properly. The unavailability of the monitoring devices, as well as the resuscitation facilities, will break the continuous monitoring chain of the patient during the recovery phase compromise the patient physical status which in turn preventing the health care providers from early detection of any early postoperative complications (Hannawa, Wendt& Day, 2017).

Regarding **"Physical safety preparation"** provided for patients undergoing external fixation surgeries Concerning "Monitoring patient`s vital signs", the present study showed that; those nursing measures were not carried out by the majority of the nurses. This finding is disagreed with (Salmore&Jenenne, 2012) as they emphasized that; physical examination including the patient`s vital signs pre-operatively is an avital element to patients` health status because it will be used as patient`s baseline data during his hospital stay (Downey, Chapman, Randell, Brown& Jayne, 2018).

About **''Obtaining informed written consent''** from the patients after complete explanation of the operation, the present study revealed that; it was done incompletely by less than half of the nurses.This finding agrees with (Fekry&Ali, 2015) as they estimated that; the circulating nurse didn`t review patient`s surgical consent, While this finding was contradicted with (Kopacova, & Bures, 2012) who illustrated that; the decision to undergo the surgical procedure was confirmed by the patient's signature on a written form of informed consent.

Concerning **"Biological safety preparation"**, provided for patients undergoing external fixation surgeries **pre-operatively,** in relation to **''Hand hygiene"**, the present study showed that; it wasn`t done by the majority of nurses. This finding is in harmony with (Ramadan, 2016) who reported that the majority of the study nurses didn`t comply with performing hand washing before direct contact with the patient and his environment. While they complied with handwashing after touching any body fluids.

Concerning **"Wearing personal protective equipment (PPE)",** the present study mentioned that; the majority of the nurses didn`t wear PPE. This may be due to a shortage of hospital supplies, lack of supervision from the senior nursing staff as well as lack of nurses` knowledge which increases the rate of infection exposure. This finding comes with (Fawzy, 2016) who reported that the majority of the studied nurses didn`t wear PPE during the hemodialysis procedures. Nurses should wear "PPE" to minimize exposure to hazards that may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards (Verbeek, et al., 2019).

Regarding **chemical safety preparation**, provided for patients undergoing external fixation surgeries pre-operatively, concerning "Safe medication administration" and "Checking for expiry date for antiseptic solution" the present study showed that; less than half of the studied nurses did these measures safely. This may be due to the frequent usage of the same medication for all patients. This finding comes with (Ashor,2016) who mentioned that; less than half of the studied nurses only checking sterility as well as the expiry date of medication. While this finding was mismatched with (Elrefay, 2012) who recommended that; the chemical safety practices should be done correctly and adequately and the practitioners must follow the nine medication rights to ensure the risk of patient harm and litigation is decreased.

Concerning **psychological safety preparation,** provided for patients undergoing external fixation surgeries **pre-operatively**, the present study illustrated that; nearly more than two-third of the studied nurses done unsafe **"psychological preoperative preparation practices"**, this could be due to the nurses focus on the patient physical status and neglect the psychological aspect. This finding was congruent with **(**El-okda, 2016**)** who reported that; the psychological safety preparation practices were done safely for about half of the patients.

Regarding **"Physical safety preparation"** provided for patients undergoing external fixation surgeries intra-operatively, the present study revealed that; Regarding "Checking orally for patient identification" and "Confirming type and site of the operation" those practices were done unsafely by the majority of the nurses, this may be due to the adoption of the nurses that the anesthesiologist will check the identity of the patient intra-operatively. This finding was mismatched with (Pysyk, 2018) who estimated that; most near errors which causing harm to a patient in a large Canadian tertiary care hospital arising from identification errors.

It was noted that; "Assessing the capillary refill and colors of nail beds" as well as performing "Oral suction from time to time" were done by only half of the nurses. This result was incongruent with (Refai, Basiony&Ahmed, 2019) who estimated that assessing capillary refill and colors of nails was done to nearly the majority of the patients by the doctor in the Department of Orthopedic Surgery, Aswan University, Egypt, also oral suction only done for more than two-thirds of the patients.

Regarding **biological safety preparation** provided for patients undergoing external fixation surgeries intra-operatively, concerning**, "Ensuring cleansing up spills**" as soon as they occur according to the hospital policy, the present study revealed that; it was done unsafely by the majority of the nurses, this may be due to unawareness of nurses' job description, lack of supervision about the auxiliary staff to clean the area. This finding was in agreement with (Ahmed, Zaghlol& Tawfik, 2018) as they estimated that; the majority of the nurses didn`t deal with the spillage of blood and body fluid.

Concerning carrying out **"Handwashing by using antiseptic hand rub (AHR) for 15 to20 seconds till evaporating"** the present study revealed that; it was done unsafely by the majority of the nurses. This finding was in the line with (Elsaidy, 2019) who reported that; more than three-quarters of the studied nurses had the unsatisfactory levels for hand hygiene especially before donning gloves, contact with the patient, after removing gloves and between tasks and procedures on the same patient.

Regarding **instrumental/mechanical safety preparation,** provided for patients undergoing external fixation surgeries intra-operatively, the present study revealed that**;** In relation to **"Keeping any electrical cord away from being in contact with the wet ground of the operating room",** the present study revealed that; it was done unsafely by the majority of the nurses. This result was mismatched with (Phillips, 2016)who reported that; the operating room health care team personnel are responsible for ensuring patients' physical safety by following safety standards for the prevention of any potential electrical hazards that may encounter from the orthopedic operating room wet area.

Concerning psychological safety preparation, provided for patients undergoing external fixation surgeries intra-operatively, the present study showed that; **"Keeping patient privacy"** was done unsafely by the majority of the nurses. This finding is contradicted with (El-okda, 2015; Abd-Elaty, 2015) they mentioned that; this item was done correctly by nurses to the majority of patients.

Regarding **physical safety preparation** provided for patients undergoing external fixation surgeries, **post-operatively**, Concerning **"Assessing patient`s vital signs**", the present study showed that; it was done incorrectly by most of the nurses post-operatively. In this context, (Liddle, 2013) stated that; the postoperative patients must be monitored and assessed closely for any deterioration in condition and the relevant post-operative care plan or pathway must be implemented. The nurse should including the following six physical parameters in her assessment: respiratory rate, oxygen saturation, temperature, systolic blood pressure, pulse rate and level of consciousness.

Concerning **"Assessing pain level" of the patients**", it was noted that; it was done by less than half of the nurses and the rest were dealing with the pain as a pain medication giver when a patient asks. In this context, (Hoogervorst-Schilp et al., 2016) they founded that; sever post-operative pain increases the incidence of postoperative complications, prolongs the length of stay, causes readmissions and significantly reduces patient`s satisfaction and quality of life,

In relation to **"Assessing the neurovascular status of the affected extremity"**, the present study showed that; it was done incorrectly by less than half of the nurses. It was noted that; nurses only observe the patient`s affected extremity for only redness and swelling. while the orthopedic nurse is responsible for continuous monitoring of the affected extremity and notifying the physician of any indicators for impaired tissue perfusion, the nurse should take in consideration the presence of dusky, pale appearance of the exposed extremity; cool skin temperature, delayed capillary refill, paresthesia (Schreiber,2016). This finding within line with (Ashor, 2016) who mentioned that the highest proportion of the nurses had safe practices in checking the patient`s extremity temperature.

About **"Wound care"** and **"Assessing wound site,"** it was noted that; those safety measures were done unsafely by nearly two-thirds of the nurses. This finding is in line with (Ding, Lin, Marshall & Gillespie,2017) who mentioned that; assessing wound site for bleeding was done by fewer than a quarter of the nurses. While, this result disagrees with the post-operative care standards stated by (Khalafallah et al., 2018; Benbow,2016) who recommended assessing the operative site for any bleeding, swelling, cyanotic, or edema in the affected part.

Concerning **"Showering and bathing",** the present study revealed that; those were not done by approximately all of the nurses. This may be due to the nurses relying on the physician to provide the patient with such instructions and lack of nurses` knowledge regarding standards of care found to be followed. In this context, the nursing practice guidelines for the care of pin sites, 2011 recommended that patients should be permitted to shower and dry the fixator with a clean towel to reduce infection (Bisaccia et al., 2016).

In relation **to "Positioning of the affected extremity**", the present study showed that; it was done correctly and safely by nearly two-thirds of the nurses, this may be due to nursing awareness towards the standard of care needed for post-operative external fixator patients. This result is in line with (Mohamed, Mansour, Mohamed & Moghazy,2020) who reported that; more than half of the nurses had safe practices regarding putting the patient in proper position post external fixation surgeries in Zagazig University Hospitals, Egypt. While, this result was mismatched with (El-sharkawy, 2016) who mentioned that; the majority of the nurses in the orthopedic ward provided fair score practices related to patients' limb positioning.

In relation to **"Performing exercises for the affected extremity",** it was noted that; it was not done by all of the nurses; this may be due to lack of nurse's knowledge regarding the types and importance of the exercises post-operatively. This results within the line of (Gouda, 2017) who estimated that; nearly most of the studied nurses at Mansoura University Hospital and Mansoura Emergency Hospital, Egypt had unsatisfactory total practice levels regarding performing exercises for orthopedic patients with traction or internal fixation postoperatively.

Regarding **"Assessment for identification of patients at risk for infection**", the results of the present study illustrated that; only one-third of the nurses had safe nursing practices related to the identification of patients at risk for coexisting infection at anybody site, this may be due to knowledge deficit and increased their workload. These findings were disagreeing with (Alrubaiee, Baharom, Shahar, Daud,& Basaleem,2017) who stated that; most of the nurses in private hospitals in Sana'a City, Yemen had a fair level of knowledge and practices of preventive measures of nosocomial infections including identifying patients with coexisting infection risk factors.

Moreover, the present study revealed that; the majority of nurses didn`t perform the **"Pin site dressing"** correctly and safely. This may be due to lack of pre-training programs for staff about cleaning and disinfection, insufficient supplies used poor knowledge, and lack of supervision as well as relaying on the doctor on performing pin site dressing according to the hospital policy. These results are in agreement with (Bader& Atiyah,2017) who reported that; the majority of staff nurses at Al-Emamin Al-Kadhumian teaching city in Baghdad city had poor knowledge about EF pin site cleaning and disinfection. While, this finding is not matched with (George, 2017) who suggested that; wound dressing is a logical approach for reducing contamination of the wound and preventing particles of dust from entering the wound as well as soaking up any moisture and exudate.

Besides, the present study showed that; a quarter of the studied nurses provided the patient with instructions regarding **"Smoking cessation**". This result was matched with **(**El-sharkawy, 2016) who mentioned that; more than a quarter of the nurses had safe practices level regarding instructing patients about smoking avoidance. In this context, (Azar et al., 2017; Calandruccio et al.,2017)estimated that; nicotine causing vasoconstriction and local tissue hypoxia that can contribute to the development of wound complications as delaying in wound healing and pin site infection.

Concerning **"safe Mobility practices**", it was noted that; approximately all of the items were not done safely by the majority of the nurses. This result mismatched with (Lopes et al., 2019; Graban, 2018) they all reported that; the nurses have educated the patient regarding safe usage of Ambulatory Assistive Devices(AAD_S) as well as ensure that the surrounding environment is safe.

Concerning **"Psychological safety practices"** provided for the patient **postoperatively**, it was noted that; **"Continuous reassurance while keeping patient privacy"** was done safely by only less than half of the nurses, this result may be due to the lack of nurse's attention to the patient psychological status postoperatively. This result was supported by (Abd-Elaty, 2015) who mentioned that; the patient doesn`t receive follow up for his condition after transferring to the recovery area unless the patient himself or one of the relatives called for help. Providing adequate explanation before any procedure.

Concerning **the correlation between the studied nurses' "Pre-operative safety preparation mean scores' and their "Socio-demographic data",** The present study showed that; there was a significant relationship between "The studied nurses` "Pre-operative preparation practices levels mean score" and their "Gender", "Type of ward" they worked in and "Attendance of educational training courses about patient safety". The attendance of educational training courses related to patient safety increases the awareness of the nurses involved in the patient care about following care guidelines standers to ensure delivering the optimal care to the patients which in turn will enhance the physical, psychological status

as well as improve the clinical outcomes of the patients (McNulty& Brady2019). These results are in the line with (Atia, 2015) who reported that; there was a significant statistical correlation between nurses` working area and their practice scores.

While there was no significant relationship between the studied nurses` **"Pre-operative preparation practices levels mean scores"** and their **"Qualifications "and "Years of experience".** This result is in the line with (EL-saidy, 2019) who reported that there was no significant relationship between nurses' practice levels and their qualifications "and "Years of experience. Also, this finding was mismatched with (Atia, 2015) who reported that; there was a significant correlation between the qualification of the nurses and their practice scores.

About **the correlation between the studied nurses'" Intra-operative safety preparation mean scores" and their "Socio-demographic characteristics",** the present study revealed that; there was a significant relationship between the studied nurses` "Intra-operative safety preparation practices levels mean score" and "Type of ward they worked in" and "Attendance of educational training courses about patient safety". In this context; (Lima, Sousa & Da Cunha, 2013) explained as the Professional experience acquired by working in the same department for a long period is a vital factor that can make a difference in the patient procedure outcomes. This result is in the line with (Soliman, Ouda& Mahmoud, 2019) who reported that; there was a statistically significant correlation between the nurses` socio-demographic characteristics and their knowledge and practices in pediatric intensive care units and pediatric inpatient department at Suez Canal University Hospitals and Ismailia General Hospitals, Egypt.

Concerning **the correlation between the studied nurses' "Post-operative safety practices mean scores" and their "Socio-demographic characteristics",** The present study illustrated that; there was a significant relationship between the studied nurses` "Post-operative safety practices mean scores" and their "Gender", "Qualifications", "Type of ward", "Years of experience", "Marital status" as well as "Attendance of educational training courses about patient safety". This emphasize the need for continuous training courses related to safety measures provided for patients post-operatively. while, This result is mismatched with (Zyada, 2015)who reported that; there was no significant correlation between nurses '"Knowledge about body mechanics in all surgical units of Damanhur National Medical Institute El-Behaira Governorate, Egypt and their "Age", "Qualifications" and "Years of experience.

Concerning **the relationship between the "Areas of nursing preparation" and the "Pre-operative nurses' preparation practices mean scores".** The present study revealed that; there was a significant relationship between the studied nurses` "Preoperative safety preparation practices levels scores" and studied "Orthopedic ward and recovery area set up scores". Emphasizing that; the availability of the ideal criteria needed for patients care delivery including the adequacy and well-functioning of equipment and supplies help the nursing staff in performing the nurses' pre-operative activities in the optimal way which in turn will affect the patient clinical outcomes in the following intra and post-operative periods and enhance the patient safety (Ramesh et al., 2017).

In conclusion, nurses` safety practices provided for patients undergoing external fixation surgeries are significantly affected by the physical set up structure of the different orthopedic settings, as well as their sociodemographic characteristics. Any weakness in the safety measures provided to the patients with external fixator would expose the patient to safety hazards following the external fixation surgeries, which could be physical, mechanical, psychological, electrical, biological, or thermal hazards. **Finally**, this study achieved its research question which was "what are the nurses` safety practices provided for patients undergoing external fixation surgeries".

5. CONCLUSION

Based on the findings of the present study, it can be concluded that:

- The highest level of safety measures provided for patients undergoing external fixation surgeries preoperatively was related to psychological safety followed by chemical, biological, and physical safety preparations respectively.
- The highest level of safety measures provided for patients undergoing external fixation surgeries intraoperatively was related to instrumental and mechanical safety followed by physical, psychological, and biological safety preparations respectively.
- The highest level of safety measures provided for patients undergoing external fixation surgeries post-operatively was related to safe mobility followed by physical safety and psychological safety preparations respectively.

- **Statistical significant correlations were declared between:**

▪ The studied nurses` "Preoperative safety preparation practices mean scores" and studied "Orthopedic ward physical set up mean scores

▪ The studied nurses` "Postoperative safety preparation practices mean scores" and the "Recovery area physical set up mean scores

▪ The studied nurses` total "Pre-operative safety preparation practices scores" and their total "Intra and post-operative safety preparation practices scores

▪ The studied nurses` "Intra-operative preparation practices scores" and their "Post-operative safety practices scores

6. RECOMMENDATIONS

The following recommendations are derived and suggested:

▪ Update pre-service and in-service training programs for the orthopedic nurses are highly advocated with emphasis on the newly assigned staff.

▪ Regular annual self-appraisal for the orthopedic nursing staff regarding safety measures provided for patients.

▪ Developing manuals for safety measures provided for patients undergoing external fixation surgeries at the varied Egyptian orthopedic units.

Regarding future researches:

▪ Developing standards regarding nursing care for safe external fixation surgeries.

▪ Developing manuals for safety measures provided for patients undergoing external fixation surgeries at varied Egyptian orthopedic units.

▪ Evaluating the effects of the safety measures applied for the patients undergoing external fixation surgeries on their clinical outcomes.

▪ Identifying the obstacles that encounter the orthopedic nursing staff from applying the safety measures properly in the orthopedic units.

▪ Replication of the study on large probability samples is very important.

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APPENDICES - A

List of Table:

Table (1): Distribution of the studied nurses according to their socio-demographic characteristics

Nurses' sociodemographic characteristics	Total N=80	
	No	%
Age (years)		
▪ < 25	1	1.3
▪ 25-34	5	6.3
▪ 35-44	47	58.8
▪ 45+	27	33.8
Min – Max Mean ± SD	20 – 49 42.53±6.12	
Gender		
▪ Male	5	6.3
▪ Female	75	93.8
Qualifications		
▪ Secondary school diploma	67	83.8
▪ Technical institute diploma	12	15.0
▪ Bachelor degree	1	1.3
Working area		
▪ Male ward	23	28.75
▪ Female ward	17	21.25
▪ Operating theatre	40	50.0
Type of ward		

▪ Private ▪ Public	38 42	47.5 52.5
Years of experience		
▪ < 10 ▪ 10- ▪ >20	4 6 70	5.0 7.5 87.5
Min – Max Mean ± SD	2 – 26 23.37±4.49	
Marital status		
▪ Married ▪ Widowed ▪ Single	74 4 2	92.5 5.0 2.5
Attendance of educational programs/ training courses about patient safety		
▪ No ▪ Yes - Educational courses - Training programs - Workshops	31 49 44 3 2	38.75 61.25 89.7 6.1 4.2
Duration of educational / training courses	**N= 49**	
▪ <one week ▪ One week ▪ >one week	41 4 4	83.6 8.2 8.2

Table (2): Availability and functioning of the studied orthopedic wards physical setup items:

Physical set up items	Available & Functioning		Available &Not functioning		Not available	
	No	%	No	%	No	%
▪ **Maintaining a safe hospital environment**						
- Well ventilated environment.	0	0.0	1	100.0	0	0.0
- Well, Lighted environment.	0	0.0	1	100.0	0	0.0
- Clean, quiet environment.	1	100.0	0	0.0	0	0.0
- Minimizing crowdedness.	1	100.0	0	0.0	0	0.0
- Well-arranged patients` rooms.	1	100.0	0	0.0	0	0.0
- Dry floors.	1	100.0	0	0.0	0	0.0
- Absence of fire and electrical hazards.	0	0.0	1	100.0	0	0.0
▪ Locker(s) to store patients 'personal belongings.	1	100.0	0	0.0	0	0.0
▪ Adequate patient toilet facilities close to patient rooms.	0	0.0	1	100.0	0	0.0
▪ Large ward, enough to accommodate patients' number	1	100.0	0	0.0	0	0.0
▪ The ward has enough light source.	0	0.0	1	100.0	0	0.0
▪ Enough chairs for relatives or companions.	0	0.0	0	0.0	1	100.0
▪ Working station with task light.	0	0.0	1	100.0	0	0.0
▪ A telephone or intercom system.	0	0.0	1	100.0	0	0.0
▪ **Locker(s) for patients 'care supplies.**						
- Alcoholic sponge, clean gowns	1	100.0	0	0.0	0	0.0
- Gloves, linens, and overhead	1	100.0	0	0.0	0	0.0
- A syringe with different sizes.	1	100.0	0	0.0	0	0.0
- I.V sets.	1	100.0	0	0.0	0	0.0
- Traction devices.	1	100.0	0	0.0	0	0.0
- Traction equipment.	0	0.0	1	100.0	0	0.0
- Extra bandages	1	100.0	0	0.0	0	0.0
- Assistive devices as walkers, canes, and crutches,	1	100.0	0	0.0	0	0.0
- Urinary catheters.	1	100.0	0	0.0	0	0.0
- Urinary bags.	1	100.0	0	0.0	0	0.0
- Splints.	1	100.0	0	0.0	0	0.0
- Aseptic wound dressing supplies	1	100.0	0	0.0	0	0.0

▪ **Adequate patients monitoring devices.**						
- Sphygmomanometers.	1	100.0	0	0.0	0	0.0
- Electrocardiographic machines.	0	0.0	0	0.0	1	100.0
- oxygen sources either central or cylinders	0	0.0	0	0.0	1	100.0
- Pulse oximeters.	0	0.0	0	0.0	1	100.0
- Wall or portal suction and tubes.	0	0.0	0	0.0	1	100.0

Table (2): Cont.

Physical set up items	**Available & Functioning**		**Available &Not functioning**		**Not available**	
	No	**%**	**No**	**%**	**No**	**%**
▪ **Resuscitation facilities.**						
- Endotracheal tubes with different sizes.	0	0.0	0	0.0	1	100.0
- Laryngoscopes.	0	0.0	0	0.0	1	100.0
- Ambo bags.	0	0.0	0	0.0	1	100.0
- Defibrillators.	0	0.0	0	0.0	1	100.0
- Emergency medication as atropine, adrenaline.	0	0.0	0	0.0	1	100.0
▪ Safe laundry system.	1	100.0	0	0.0	0	0.0
▪ Safe waste disposal according to hospital policy.	1	100.0	0	0.0	0	0.0

Table (3): Availability and functioning of the studied surgical pre-operative area physical setup items:

physical setup items	**Available & Functioning**		**Available &Not functioning**		**Not available**	
	No	**%**	**No**	**%**	**No**	**%**
▪ Well ventilated environment.	0	0.0	0	0.0	1	100.0
▪ Well, lighted environment.	0	0.0	0	0.0	1	100.0
▪ Must be in proximity to the operating rooms for immediate transport.	0	0.0	0	0.0	1	100.0
▪ The doorway must be with an appropriate size.	0	0.0	0	0.0	1	100.0
▪ Stretcher(s) adjustable to both height and position.	0	0.0	0	0.0	1	100.0
▪ Designed to accommodate imaging equipment.	0	0.0	0	0.0	1	100.0
▪ Locker(s) to hold adequate patient care supplies.	0	0.0	0	0.0	1	100.0
▪ **Adequate patients monitoring devices.**						
- Sphygmomanometers.	0	0.0	0	0.0	1	100.0
- Electrocardiographic machines.	0	0.0	0	0.0	1	100.0
- oxygen sources either central or cylinders	0	0.0	0	0.0	1	100.0
- Pulse oximeters.	0	0.0	0	0.0	1	100.0
- Wall or portal suction and tubes.	0	0.0	0	0.0	1	100.0
▪ Adequate patients imaging equipment (portable x-ray).	0	0.0	0	0.0	1	100.0
▪ Enclosing overhead storage for linen, gloves, gowns.	0	0.0	0	0.0	1	100.0
▪ Adequate toilet facilities close to the pre-operative blocks.	0	0.0	0	0.0	1	100.0

Table (4): Availability and functioning of the studied surgical orthopedic operating room physical setup items:

physical setup items	**Available & Functioning**		**Available &Not functioning**		**Not available**	
	No	**%**	**No**	**%**	**No**	**%**
▪ Large enough to accommodate the surgical equipment.	0	0.0	1	100.0	0	0.0
▪ Appropriately and safely wired.	0	0.0	1	100.0	0	0.0
▪ Safe electrical outlets for surgical equipment.	0	0.0	1	100.0	0	0.0
▪ **Adequate hand hygiene supplies including**:						
- Antimicrobial Liquid Soap	1	100.0	0	0.0	0	0.0
- Disposable towels for dryness	0	0.0	0	0.0	1	100.0
▪ **Adequate surgical hand rub supplies including:**						
- Antiseptic solution	1	100.0	0	0.0	0	0.0
- Nail file.	0	0.0	0	0.0	1	100
- Sterile towel for dryness.	1	100.0	0	0.0	0	0.0

International Journal of Novel Research in Healthcare and Nursing
Vol. 7, Issue 3, pp: (493-523), Month: September - December 2020, Available at: www.noveltyjournals.com

▪ Having easy access to a hand hygiene sink.	1	100.0	0	0.0	0	0
▪ Appropriate operating table(s) with appropriate height and side rails.	0	0.0	1	100.0	0	0.0
▪ Different beds that entail multiple positions as captain`s chair.	0	0.0	0	0.0	1	100.0
▪ Ventilation system.	1	100.0	0	0.0	0	0.0
▪ Airflow and temperature regulation system with taking into account airflow direction and exchange rates as well as humidity.	0	0.0	0	0.0	1	100.0
▪ Patient warming devices such as forced-air warming, fluid warmers, and heating blankets.	0	0.0	0	0.0	1	100.0
▪ Drainage system.	0	0.0	1	100.0	0	0.0
▪ Monitors and alarms for shock detection.	1	100.0	0	0.0	0	0.0
▪ Radiographic equipment as x-ray and ultrasound machine(s).	1	100.0	0	0.0	0	0.0
▪ Anesthesia machine(s).	1	100.0	0	0.0	0	0.0
▪ Anesthesia carts.	1	100.0	0	0.0	0	0.0
▪ **Resuscitation facilities including;**						
- Endotracheal tubes with different sizes.	1	100.0	0	0.0	0	0.0
- Laryngoscopes.	1	100.0	0	0.0	0	0.0
- Ambo bags.	1	100.0	0	0.0	0	0.0
- Defibrillators.	1	100.0	0	0.0	0	0.0
- Emergency medication as atropine, adrenaline.	1	100.0	0	0.0	0	0.0
- Syringes with different sizes.	1	100.0	0	0.0	0	0.0

Table (5): Availability and functioning of the studied orthopedic recovery rooms physical setup items:

Physical Setup items	**Available & Functioning**		**Available &Not functioning**		**Not available**	
	No	**%**	**No**	**%**	**No**	**%**
▪ - Large enough	0	0.0	1	100.0	0	0.0
▪ - Well ventilated environment.	0	0.0	1	100.0	0	0.0
▪ -Enough light source.	0	0.0	1	100.0	0	0.0
▪ **Adequate patients monitoring devices include:**						
- Sphygmomanometers.	0	0.0	1	100.0	0	0.0
- Electrocardiographic machines.	0	0.0	1	100.0	0	0.0
- oxygen sources either central or cylinders	0	0.0	1	100.0	0	0.0
- Pulse oximeters.	0	0.0	1	100.0	0	0.0
- Wall or portal suction and tubes.	0	0.0	1	100.0	0	0.0
▪ **The presence of other equipment as:**						
- Reclining\wheel chairs.	0	0.0	0	0.0	1	100.0
- Splints.	0	0.0	0	0.0	1	100.0
- Skin traction devices.	0	0.0	0	0.0	1	100.0
- Skin traction equipment.	0	0.0	0	0.0	1	100.0
▪ Trolleys separated by curtains.	0	0.0	0	0.0	1	100.0
▪ Lockers for medical supplies and linens.	0	0.0	0	0.0	1	100.0
▪ Patient toilet(s) close to the recovery area.	0	0.0	0	0.0	1	100.0
▪ **Resuscitation facilities including;**						
- Endotracheal tubes with different sizes.	0	0.0	1	100.0	0	0.0
- Laryngoscopes.	0	0.0	1	100.0	0	0.0
- Ambo bags.	0	0.0	1	100.0	0	0.0
- Defibrillators.	0	0.0	1	100.0	0	0.0
- Emergency medication as atropine, adrenaline.	0	0.0	1	100.0	0	0.0
- Syringes with different sizes.	0	0.0	1	100.0	0	0.0
▪ Stretchers adjustable to both height and position.	0	0.0	1	100.0	0	0.0
▪ Safe laundry system	0	0.0	0	0.0	1	100.0
▪ Safe waste disposal according to hospital policy	0	0.0	0	0.0	1	100.0

International Journal of Novel Research in Healthcare and Nursing
Vol. 7, Issue 3, pp: (493-523), Month: September - December 2020, Available at: www.noveltyjournals.com

Table (6): Distribution of the studied orthopedic settings according to the total physical set up levels:

Total physical set up levels	Good		Fair		Poor	
	No	%	No	%	No	%
Orthopedic wards	0	0.0	1	100.0	0	0.0
Pre-operative area	0	0.0	0	0.0	1	100.0
Operative rooms	0	0.0	1	100.0	0	0.0
Recovery area	0	0.0	1	100.0	0	0.0

Table (7): Distribution of the studied nurses according to their pre-operative safety practices and their mean scores (total no=80)

Pre-operative safety practices items	Levels of practices			
	Safe		Unsafe	
	No	%	No	%
A)Physical safety preparation				
1. Checking for the patient`s chart.	50	62.5	30	37.5
2.Identifying patient's medical history	39	48.8	41	51.3
3. Checking for presence of requested blood studies.	73	91.3	7	8.8
3. Obtaining informed written consent.	35	43.8	45	56.3
4.Reviewing patient medical record for completeness including all diagnostic and laboratory studies results	20	25.0	60	75.0
5.Monitoring patient`s vital signs including; pulse, respiration, body temperature, oxygen saturation, blood pressure, pain	8	10.0	72	90.0
6.Checking for neurovascular status for the affected extremity	34	42.5	46	57.5
7. Inserting peripheral intravenous line and ensuring its patency.	74	92.5	6	7.5
8.Marking operation site	44	55.0	36	45.0
9. Preparing skin, removing of hair at operation site.	66	82.5	14	17.5
10. Placing the identification band around the patient wrist.	75	93.8	5	6.3
11. The appropriate nurse is available to remain with the patient after preparation and transport to the operating room.	75	93.8	5	6.3
12.Preoperative teaching about post-operative	0	0.0	80	100.0
Total pre-operative physical safety preparation	**27**	**33.7**	**53**	**66.3**
Min-max Mean ± SD	48-83 64.59±12.12			
B)Biological safety preparation 1. Checking that bacteriological studies of the orthopedic ward/unit environment are carried out according to hospital policy and schedule.	17	21.3	63	78.8
2. Performing hand hygiene before providing care to and between patients.	24	30.0	56	70.0
3. Performing hand rub for 15:20 seconds till evaporating unless the hand is solid.	34	42.5	46	57.5
4. Ruling out the presence of any infections as Urinary tract infection, Respiratory infection, Nosocomial infection.	32	40.0	48	60.0
5.Safe discarding of infectious wastes, sharp instruments, moist body substances	76	95.0	4	5.0
6. Ensuring that patient is wearing a clean gown and overhead	78	97.5	2	2.5
7. Ensuring that nurses using personal protective equipment (PPE) as gloving, gowning, overhead, and face masks.	5	6.3	75	93.7
Total pre-operative biological safety preparation	**27**	**33.7**	**53**	**66.3**
Min-max Mean ± SD	13-28 20.86±3.51			

International Journal of Novel Research in Healthcare and Nursing
Vol. 7, Issue 3, pp: (493-523), Month: September - December 2020, Available at: www.noveltyjournals.com

Table (7): Cont.

Pre-operative safety practices items	Levels of practices			
	Safe		Unsafe	
	No	%	No	%
C)Chemical safety preparation 1.Administrating medication safely such as Right time, dose, route, patient`s name, medication`s name, right action, reaction, right expiry date, and documentation	36	45.0	44	55.0
2. Checking for the right storage of medication in a specific locker(s).	51	63.7	29	36.3
3. Checking the expiry date of antiseptic solutions.	33	41.2	47	58.8
4. Checking for the right storage of antiseptic solutions in a specific locker(s).	59	73.7	21	26.3
Total pre-operative chemical safety preparation	**19**	**23.7**	**61**	**76.3**
Min-max Mean ± SD	20-29 24.96±2.23			
D)Psychological safety preparation 1. Introducing him/herself to the patient first.	18	22.5	62	77.5
2. Dealing with the patient in a calm, gentle manner.	14	17.5	66	82.5
3. Giving adequate explanation before any procedure.	24	30.0	56	70.0
4. Answering all patients' questions regarding preoperative preparations, postoperative instruction, and discharge strategies.	19	23.7	61	76.3
Total pre-operative psychological safety preparation	**0**	**0.0**	**80**	**100**
Min-max Mean ± SD	0-8 6.39±1.93			

Table (8): Distribution of the studied nurses according to the intra-operative safety practices and their mean scores (total no=80):

Intra-operative safety practices items	Levels of practices			
	Safe		Unsafe	
	No	%	No	%
A)Physical safety preparation 1. Checking orally for identification of the patient.	28	35.0	52	65.0
2. Confirming type of operation done.	30	37.5	50	62.5
3. Confirming the operation site.	12	15.0	68	85.0
4. Assisting the patient to assume proper position according to the operation site.	69	86.3	11	13.7
5. Continuous monitoring for patient vital signs including; body temperature, pulse, respiration, blood pressure, and oxygen saturation.	41	51.3	39	48.8
6. Monitoring the patient's nail color and capillary refill.	40	50.0	40	50.0
7. Assisting in the administration of anesthesia medication.	79	98.7	1	1.3
8. Assisting in handling needed instruments and supplies in aseptic technique.	47	58.7	33	41.3
9. Assisting in administer resuscitation medication.	71	88.7	9	11.3
10. Performing oral suction if needed.	44	55.0	36	45.0
Total intra-operative physical safety practices	**7**	**8.7**	**73**	**91.3**
Min-max Mean ± SD	12-36 25.13±5.24			
B)Biological safety preparation 1. Checking for the sterilization date and timing of the patient care instrument and supplies.	73	91.3	7	8.7
2. Ensuring sterilization of suction tube for each patient.	30	37.5	50	62.5
3. Carrying out hygiene before providing care to and between patients.	72	90.0	8	10.0
4. Carrying out hand washing by using antiseptic hand rub (AHR) for 15 to20 seconds till evaporating.	24	30	56	70.0

International Journal of Novel Research in Healthcare and Nursing
Vol. 7, Issue 3, pp: (493-523), Month: September - December 2020, Available at: www.noveltyjournals.com

5. Wearing personal protective equipment (PPE) as a clean or sterile gown, gloves, and face mask(s).	75	93.7	5	6.3
6. Ensuring cleaning up spills as soon as they occur according to hospital policy.	17	21.3	63	78.7
Total intra-operative biological safety practices	**41**	**51.3**	**39**	**48.7**
Min-max Mean ± SD	4-14 11.36±2.91			
C)Instrumental /mechanical safety preparation 1. Checking for the efficiency of equipment needed for the operation.	39	48.7	41	51.3
2.Rechecking for the monitoring devices function	38	47.5	42	52.5

Table (8): Cont.

Intra-operative safety practices items	**Levels of practices**			
	Safe		**Unsafe**	
	No	**%**	**No**	**%**
3. Adjusting the operation table height.	25	31.3	55	68.7
4. Checking operating table efficiency.	36	45.0	44	55.0
5. Adjusting the cardiac monitor at the level of the surgical team.	18	22.5	62	77.5
6. Applying the brakes of the stretcher securely.	75	93.7	5	6.3
7. Ensuring the floor dry at all times of the operation.	18	22.5	62	77.5
8. Raising trolley side rails.	10	12.5	70	87.5
9.Keeping any electrical cord away from being in contact with the wet ground of the operating room	20	25.0	60	75.0
10. Ensuring the efficiency and patency of the drainage system of the operating room.	4	5.0	76	95.0
Total intra-operative mechanical safety practices	**0**	**0.0**	**80**	**100.0**
Min-max Mean ± SD	6-21 15.00±5.47			
D)Psychological safety preparation 1. Maintaining patient dignity by keeping patient privacy; Covering the patients and exposing only the operation site.	8	10.0	72	90.0
2. Dealing with the patient in a calm, gentle manner.	3	3.7	77	96.3
3. Giving patient instructions in a calm simple manner.	36	45.0	44	55.0
4. Dealing with the patient gently and as a whole.	2	2.5	78	97.5
Total intra-operative psychological safety practices	**35**	**43.7**	**45**	**56.3**
Min-max Mean ± SD	3-12 8.44±1.59			

Table (9): Distribution of the studied nurses according to the post-operative safety practices (total no=80):

Safety practices items	**Levels of practices**			
	Safe		**Unsafe**	
	No	**%**	**No**	**%**
Physical safety practices 1. Checking patient personal chart for completeness.	76	95.0	4	5.0
2. Reading the operative notes.	39	48.7	41	51.3
3.Carrying out post-operative assessment				
- Level of consciousness	76	95.0	4	5.0
- Vital signs:	1	1.3	79	98.7
- Presence of pain, pain characteristics.	36	45.0	44	55.0
- Neurovascular status of the affected extremity:	36	45.0	44	55.0
- Skin integrity	65	81.3	15	18.7
- Wound care	23	28.7	57	71.3
- Documentation of the assessment findings	30	37.5	50	62.5

4.Giving the patient post-operative instructions which include: - Nutritional status. - The positioning of the affected extremities. - Exercises of the unaffected extremities. - Exercises of the affected extremities. - Showering and bathing. - Clothing. - Smoking.	 20 55 19 0 3 29 20	 25.0 68.7 23.7 0.0 3.7 36.3 25.0	 60 25 61 80 77 51 60	 75.0 31.3 76.3 100.0 96.3 63.7 75.0
5.Performing pin site care which includes: - Assessment for the patient who at risk for pin site infection. - Report any pin site infection warning signs and symptoms. - Performing pin site dressing.	27 20 1	33.7 25.0 1.3	53 60 79	66.3 75.0 98.7
6. Monitoring the external fixation of other complications as neurovascular impairment, delayed union.	0	0.0	80	100.0
Total post-operative physical safety practices	**1**	**1.3**	**79**	**98.7**
Min-max Mean ± SD	117-343 184.92±36.62			
B)Safe Mobility practices 1. Safe usage of assistive devices as canes and crutches.	30	37.5	50	62.5
2. Instructing the patient to place the assistive device on the affected extremity, start walking with the healthy extremity then the assistive device, and finally with the affected one.	0	0.0	80	100.0
3. Ensuring the correct arrangement of the patient`s room.	38	47.5	42	52.5

Table (9): Cont.

Post-operative safety practices items	**Levels of practices**			
	Safe		**Unsafe**	
	No	**%**	**No**	**%**
4.Ensuring adequate lightening	29	36.3	51	63.7
5.Keeping floors\stair ways free of crowdedness,	12	15.0	68	85.0
6. Ensuring cleansing up spills as soon as they occur.	2	2.5	78	97.5
7. Checking that stairways have a strong handrail on both sides.	5	6.3	75	93.8
8.Ensuring Use of fit slippers	36	45.0	44	55.0
Total post-operative safe mobility practices	**0**	**0.0**	**80**	**100.0**
Min-max Mean ± SD	4-15 10.5±2.58			
C)Psychological safety practices 1. Continuous reassurance while keeping patient privacy.	36	45.0	44	55.0
2. Providing adequate explanation before any procedure.	28	35.0	52	65.0
Total post-operative psychological safety practices	**37**	**46.2**	**43**	**53.8**
Min-max Mean ± SD	0-6 4.23±7.36			

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International Journal of Novel Research in Healthcare and Nursing
Vol. 7, Issue 3, pp: (493-523), Month: September - December 2020, Available at: www.noveltyjournals.com

Table (10): Relationships between the studied nurses' pre-operative safety preparation levels and their socio-demographic data:

safety practices items / Socio-demographic data	Levels of pre-operative safety practices				Test of significance
	Unsafe (N=54)		Safe (N=26)		
	No	%	No	%	
Age					
▪ < 25	1	100.0	0	0.0	X^2=16.603
▪ 25-	3	60.0	2	40.0	P=0.001*
▪ 35-	24	51.1	23	48.9	
▪ 45+	26	96.3	1	3.7	
Gender					
▪ Male	5	100.0	0	0.0	X^2= 2.568
▪ Female	49	65.3	26	34.7	P=0.109
Qualifications					
▪ Secondary school diploma	44	65.7	23	34.3	X^2= 2.190
▪ Technical institute diploma	10	83.3	2	16.7	P=0.335
▪ Bachelor degree	0	0.0	1	100.0	
Working area					
▪ Male sector	19	82.6	4	17.4	X^2= 0.546
▪ Female sector	10	58.8	7	41.1	P=0.460
▪ Operating theatre	25	62.5	15	37.5	
Type of ward					
▪ Private	19	50.0	19	50.0	X^2= 10.104
▪ Public	35	83.3	7	16.7	P=0.001*
Years of experience					
▪ < 10	4	100.0	0	0.0	X^2= 2.030
▪ 10-	4	66.4	2	33.3	P=0.362
▪ 20+	46	65.7	24	34.3	
Marital status					
▪ Married	48	64.9	26	35.1	X^2= 3.123
▪ Widowed	4	100.0	0	0.0	P=0.210
▪ Single	2	100.0	0	0.0	
Attendance of educational / training courses about patient safety					

X^2 Chi-Square Test * statistically significant at ≤0.05

Table (11): Relationships between the studied nurses' intra-operative safety preparation levels and their demographic data:

Socio-demographic data	Levels of intra-operative safety practices				Test of significance
	Unsafe (N=79)		Safe (N=1)		
	No	%	No	%	
Age					
▪ < 25	1	100.0	0	0.0	X^2=0.711
▪ 25-	5	100.0	0	0.0	P=0.871
▪ 35-	46	97.9	1	2.1	
▪ 45+	27	100.0	0	0.0	
Gender					

International Journal of Novel Research in Healthcare and Nursing
Vol. 7, Issue 3, pp: (493-523), Month: September - December 2020, Available at: www.noveltyjournals.com

▪ Male ▪ Female	5 74	6.3 93.7	0 1	0.0 100.0	X^2= 0.068 P=0.795
Level of education					
▪ Secondary school diploma ▪ Technical institute diploma ▪ Bachelor degree	67 12 0	100.0 100.0 0.0	0 0 1	0.0 0.0 100.0	X^2= 0.196 P=0.906
Working area					
▪ Male sector ▪ Female sector ▪ Operating theatre	23 17 39	29.1 21.5 49.4	0 0 1	0.0 0.0 100.0	X^2= 2.103 P=0.147
Type of ward					
▪ Private ▪ Public	38 41	100.0 97.6	0 1	0.0 2.4	X^2= 0.916 P=0.338
Years of experience					
▪ < 10 ▪ 10- ▪ 20+	4 6 69	100.0 100.0 98.6	0 0 1	0.0 0.0 1.4	X^2= 0.145 P=0.930
Marital status					
▪ Married ▪ Widowed ▪ Single	73 4 2	98.6 100.0 100.0	1 0 0	1.4 0.0 0.0	X^2= 0.082 P=0.960
Attendance of educational / training courses about patient safety					
▪ No ▪ Yes	30 49	96.8 100.0	1 0	3.2 0.0	X^2= 1.601 P=0.206

X^2 Chi-Square Test * Statistically significant at ≤0.05

Table (12) Relationships between the studied nurses' total post-operative safety preparation practices levels and their socio-demographic data:

Socio-demographic data	Levels of post-operative safety Practices				Test of significance
	Unsafe (N=78)		Safe (N=2)		
	No	%	No	%	
Age					
▪ < 25 ▪ 25- ▪ 35- ▪ 45+	1 5 45 27	100.0 100.0 95.7 100.0	0 0 2 0	0.0 0.0 4.3 0.0	X^2=1.440 P=0.696
Gender					
▪ Male ▪ Female	5 73	100.0 97.3	0 2	0.0 2.7	X^2= 0.137 P=0.712
Qualifications					
▪ Secondary school diploma ▪ Technical institute diploma ▪ Bachelor degree	66 12 0	98.5 100.0 0.0	1 0 1	1.5 0.0 100.0	X^2= 0.398 P=0.820
Working area					
▪ Male sector ▪ Female sector ▪ Operating theatre	22 16 40	28.2 20.5 51.3	1 1 0	50.0 50.0 0.0	X^2= 0.286 P=0.593
Type of ward					
▪ Private ▪ Public	36 42	94.7 100.0	2 0	5.3 0.0	X^2= 2.267 P=0.132

International Journal of Novel Research in Healthcare and Nursing
Vol. 7, Issue 3, pp: (493-523), Month: September - December 2020, Available at: www.noveltyjournals.com

Years of experience					
▪ < 10 ▪ 10- ▪ 20+	4 6 68	100.0 100.0 97.1	0 0 2	0.0 0.0 2.9	X^2= 0.293 P=0.864
Marital status					
▪ Married ▪ Widowed ▪ Single	72 4 2	97.3 100.0 100.0	2 0 0	2.7 0.0 0.0	X^2= 0.166 P=0.920
Attendance of educational / training courses about patient safety					
▪ No ▪ Yes	30 48	96.8 98.0	1 1	3.2 2.0	X^2= 0.109 P=0.741

X^2 Chi-Square Test * Statistically significant at ≤0.05

Table: (13): Correlations between the ward setup, operating theater setup, and nurses' pre-operative, intraoperative, and postoperative practices mean scores:

Area of nursing preparations practices	**The correlation coefficient (r)**	**Significance (P)**
Ward physical setup – nurses' preoperative practices	0.593	0.042*
Operating room physical set up-nurses` intra-operative practices	0.185	0.174
Recovery area physical setup – nurses' postoperative practices	0.611	0.018*
Total physical setup- nurses' - total nurses' practices	0.169	0.135

* r = Pearson Correlation Coefficient * statistically significant at ≤0.05

Table (14): Correlations matrix between the studied nurses' total pre-, intra, and post-operative safety practices scores:

Total safety practices		**Total pre-operative safety practices**	**Total intra-operative safety practices**	**Total post-operative safety practices**
Pre-operative safety practices	**r**			
	p			
Intra-operative safety practices	**r**	**0.860**		
	p	**0.000***		
Post-operative safety practices	**r**	**0.719**	**0.739**	
	p	**0.000***	**0.000***	

r = Pearson Correlation Coefficient * statistically significant at ≤0.05