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Relation between Nurses' Workload and Patients' Safety in Surgical and Neurological Intensive Care Units

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ABSTRACT: *Patient safety is one of the most important indicators of quality in healthcare; sustainable nursing workloads improve the quality of healthcare institutions. Patient safety is about applying evidence based practices, to achieve positive health outcomes, and avoiding unsafe acts so as to reduce mortality and morbidity. For the nurses, patient safety is a fundamental part of their job. Aim: The aim of the study was to evaluate the relation between nurses' workload and patients' safety in surgical and neurological ICUs. Study design: a descriptive corelational design was utilized to fulfill the aim of the study. Sample: the sample consisted of the total number of all admitted patients in a period of three months; 112 patients at surgical ICU and 111 patients at neurological ICU; and total number of nurses was 34 at surgical ICU and 23 at neurological ICU. Tools: self administered questionnaire; nursing activities workload score assessment scale; patient safety guidelines observational checklist; and patient's safety outcomes assessment sheet. Results: the percentage of patients' safety level was (75% and 51%) at surgical and neurological ICUs respectively. Moreover,* the mean of nurses' workload was (62.40±11.20) in the surgical ICU compared to (54.17±12.29) in the neurological ICU *with highly statistically significant difference. Conclusion: there was a statistically significant negative correlation between nurses' workload and patients' safety and outcomes. Recommendations: applying of nursing activities workload assessment score in intensive care units to retain nurses staffing, enhancing the patient safety level, and avoiding waste of nurses' time and consequently.*

I. Introduction

According to (Gurses & Carayon, 2016) there are several important consequences of high nursing workload. Research shows that a heavy nursing workload adversely affects patient safety. Furthermore, it negatively affects nursing job satisfaction and, as a result, contributes to high turnover and the nursing shortage. In addition to the higher patient acuity, work system factors and expectations also contribute to the nurses' workload: nurses are expected to perform nonprofessional tasks such as delivering and retrieving food trays; housekeeping duties; transporting patients; and ordering, coordinating, or performing ancillary services (Needleman, Buerhaus & Mattke, 2006). Nurses' work is a major factor in producing positive patient health outcomes and overworked nurses are less able to provide the close monitoring required for safe care.(Beau,2006 & Bhagwanjee & Scribante,2008)

Patient safety refers to the prevention of errors and adverse effects to patients associated with health care (WHO, 2014).Essential practices to keep patient safe include: identifying patients correctly, using medicines safely, avoiding surgical errors, utilizing good hospital design principles, rapid response systems, sharing data for quality improvement and fostering an open-communication culture (Kreimer, 2010). The intensive care units (ICUs) provide care to patients with highly critical medical conditions e.g. invasive surgery, accidents, trauma or organ failure (Jacksonville University, 2014). Duties of ICU nurses include: continuous monitoring patients, coordinating care provided by other members of health care team; and developing discharge planning for the patient and family (Needleman & Hassmiller, 2009). Performance obstacles are barriers that hinder nurses' capacity to perform their jobs that affect negatively on patient safety (Gurses & Carayon , 2016).

The association between compromised patient safety and nurse exhausted and fatigue, partly related to excess working hours, has been rigorously demonstrated over many years in a multitude of scientific studies; for instance, when nurse's shifts are longer than 12 hours the expectations of an adverse event are three times higher (Bray et.al., 2010). Additionally, communication barriers, particularly at transfer and shift change, create significant hurdles to effective patient care. Also, overburdened nurses are less able to perform the complex tasks of clinically monitoring and coordinating patient care (Canadian Nurses Association, 2013). Nurses are the "backbone" of all healthcare system; as nursing goes, so goes the rest of the system their workload is multifaceted and complex. (Debergh et.al., 2012)

Workload increases when hospitals are filled beyond capacity (Conishi & Gaidzinski, 2007). One of the most useful indicators of excessive nursing workload and its impact on patient safety is failure to rescue (it measures

the healthcare system's ability to respond to complications that have arisen while patients are admitted to hospital). Nurses play a key role in monitoring patient progress since they are usually the first to encounter early signs of patient deterioration (Dias, 2016).

Researchers from different nations have identified the consequences for patients when nurses are onerous: each patient added to nurses', workloads (beyond four patients), is associated with a seven percent, increase in mortality following common surgeries (Ducci, Zanei, & Whitaker, 2014). High failure to rescue rates are a call for nurses to provide more direct-care nursing, as well as teaching people about their illnesses and how to manage them (Silva, Sousa,& Padilha, 2011)

II. Significance of the study

From the researchers observation and reviewing related researches it was found that patient safety is about applying evidence based practices, to achieve positive health outcomes, and avoiding unsafe acts so as to reduce mortality and morbidity. For the nurses, patient safety is a fundamental part of their job, when patient care is unsafe, nurses experience moral distress. Furthermore, when nurses' workloads are balanced they have higher rates of job satisfaction, mental/physical well being and continuous employment. This reduces costs related to nurse burnout, absenteeism, recruitment and retention. In conclusion, the effective management of nursing workload produces: safer patients, higher quality of (work) life for nurses, and cost savings. So this study was formulated to study the relation between nurses' workload and patient safety in ICUs.

III. Aim

To evaluate the relation between nurses' workload and patients' safety in surgical and neurological intensive care units through:

- Measuring nurses' workload in surgical and neurological ICUs.
- Identify factors affecting patients' safety related nurses practice in surgical and neurological ICUs.
- Identify the patients' safety level and the outcomes of patients in surgical and neurological ICUs.
- Evaluate the relation between nurses' workload and patients' safety in surgical and neurological ICUs.

IV. Research questions/hypothesis

- What is the level of nurses' workload in surgical and neurological ICUs?
- What are the factors affecting patients' safety related nurses practice in surgical and neurological ICUs?
- What is the level of patients' safety in surgical and neurological ICUs?
- What are the outcomes of patients' safety in surgical and neurological ICUs?
- Is there a relation between level of nurses' workload and nurses' practice regarding patients' safety in surgical and neurological ICUs?

V. Material & Methods

Study design: A descriptive correlational study was utilized to fulfill the aim of the study.

Sample: A convenient sample consisted of the total number of all admitted patients in a period of three months; 112 patients at surgical ICU and 111 patients at neurological ICU; and total number of nurses was 68 at surgical ICU and 23 at neurological ICU.

Setting: the study was conducted in surgical and neurological ICUs at Ain Shams University Hospital, Egypt.

- The surgical ICU units consisted of two main units: the 1st unit was in the 2nd floor and consisted of 60 beds and divided to three separate areas one of them was for isolation (25beds for patients with HCV & HBV, Pneumonia, and infected wound) and the other two areas for immediate post operative (10 beds) and post operative patients (25 beds). The 2nd unit was in 1st floor and consisted of 24 beds and divided to three main areas one for isolation (10 beds for patients with HCV & HBV, pneumonia, and infected wound) and the other two areas for immediate post operative (5 beds) and post operative patients (9 beds). The nurse patient ratio was nearly 1:4 or 1:5.

- The neurological ICU units consisted of two main units: the 1st unit was in the 2nd floor and consisted of 24 beds and the 2nd unit was in 1st floor and consisted of 15 beds. The nurse patient ratio was nearly 1:2 or 1:3.

Tools: Four tools were designed to collect data pertinent to the study: **a)** self-administered questionnaire; **b)** nursing activities workload score assessment scale (NAS); **c)** patients safety guidelines observational checklist; and **d)** patients' safety outcomes assessment sheet.

I. Self administered questionnaire: it was developed by the researchers guided by the original tool (Nursing Work Index Revised NWIR) developed by **Aiken & Patrician, (2000).** It consisted of two main parts:

1**. Part one:** concerned with demographic characteristics of nurses which included: age, gender, educational level, and years of experience in surgical and neurological ICU units.
2. Part two: concerned with nurses' opinion about factors affecting patients' safety related nurses practice, it is consisted of 63 questions in a form of Likert scale; that included social & psychological factors (14 items),physical work environment factors (20 items), work satisfaction related factors (14 items) and work system related factors (15 items). It was developed by the researchers based on reviewing of literatures **(Alahmadi, 2009; Awases, Bezuidenhout & Roos, 2013; and Tesfaye et al., 2015**)

Scoring system

- This part consisted of 63 statements, which were grouped to four subgroups i.e. work system, work satisfaction, social &psychological, and physical work environment factors. The response was on four-point liker scale ranged from 1 (strongly-agree) to 4 (strongly-disagree).
- The scores of the items in each subgroup were summed-up and the total divided by the number of items, giving a mean score for the subgroup, and a total mean for nurses' opinion was categorized into negative or positive effect. The total score was 252 and divided into two categories as follows:
  - <80 % was considered positive effect.
  - ≥ 80 % was considered negative effect.

II. **Nursing Activities workload Score assessment scale:** this is a standard tool developed by (Miranda et al., 2003; Armstrong, 2001; and Yoder-Wise, 2003). . translated by the researcher into Arabic language and it used to estimate nursing workload by determining the percentage of time spent in patient care during 24 hours and collectively during the period of data collection. Nursing activities score is based on 23 nursing activities items and shows the percentage of times that are devoted by a nurse to the direct care of the critically ill patient during 24 hours in the ICUs. It consisted of the following:

I- General activities, divided into (8 sub items):

1. Monitoring and titration
   - **1a** Hourly vital signs, regular registration and calculation of fluid balance (score 4.5).
   - **1b** Present at bedside and continuous observation or active for 2 hrs or more in any shift, for reasons of safety, severity, or therapy such as noninvasive mechanical ventilation, weaning procedures, restlessness, mental disorientation, prone position, donation procedures, preparation and administration of fluids or medication, assisting specific procedures (score 12.1).
   - **1c** Present at bedside and active for 4 hrs or more in any shift for reasons of safety, severity, or therapy such as those examples above (1b) (score 19.6).
2. Laboratory, biochemical and microbiological investigations (score 4.3).
3. Medication, vasoactive drugs excluded (score 5.6).
4. Hygiene procedures
   - **4a** Performing hygiene procedures such as dressing of wounds and intravascular catheters, changing linen, washing patient, incontinence, vomiting, burns, leaking wounds, complex surgical dressing with irrigation, and special procedures (e.g. barrier nursing, cross-infection related, room cleaning following infections, staff hygiene) (score 4.1).
   - **4b** The performance of hygiene procedures took >2 hrs in any shift (score 16.5).
   - **4c** The performance of hygiene procedures took >4 hrs in any shift (score 20.0).
5. Care of drains, all (except gastric tube) (score 1.8).
6. Mobilization and positioning
   - **6a** Performing procedure(s) up to three times per 24 hrs (score 5.5)

- **6b** Performing procedure(s) more frequently than 3 times per 24 hrs, or with two nurses, any frequency (score 12.4).
- **6c** Performing procedure with three or more nurses, any frequency (score 17.0).

7. Support and care of relatives and patient
   - **7a** Support and care of either relatives or patient requiring full dedication for about 1 hr in any shift such as to explain clinical condition, dealing with pain and distress, difficult family circumstances (score 4.0).
   - **7b** Support and care of either relatives or patient requiring full dedication for 3 hrs or more in any shift such as death, demanding circumstances (e.g., large number of relatives, language problems, hostile relatives)(score 32.0).

8. Administrative and managerial tasks
   - **8a** Performing routine tasks such as processing of clinical data, ordering examinations, professional exchange of information (e.g., ward rounds) (score 4.2).
   - **8b** Performing administrative and managerial tasks requiring full dedication for about 2 hrs in any shift such as research activities, protocols in use, admission and discharge procedures (score 23.2).
   - **8c** Performing administrative and managerial tasks requiring full dedication for about 4 hrs or more of the time in any shift such as death and organ donation procedures, coordination with other disciplines (score 30.0).

II- Ventilatory support, divided into (3 sub items):

9. Respiratory support: any form of mechanical ventilation/assisted ventilation with or without positive end-expiratory pressure, with or without muscle relaxants, spontaneous breathing with or without positive end-expiratory pressure with or without endotracheal tube supplementary oxygen by any method (score 1.4)
10. Care of artificial airways: endotracheal tube or tracheostomy cannula (score 1.8)
11. Treatment for improving lung function: thorax physiotherapy, incentive spirometry, inhalation therapy, intratracheal suctioning (score 4.4)

III Cardiovascular support divided into (4 sub items):

12. Vasoactive medication, disregard type and dose (score 1.2)
13. Intravenous replacement of large fluid losses. Fluid administration >3 L/m2/day, irrespective of type of fluid administered (score 2.5)
14. Left atrium monitoring: pulmonary artery catheter with or without cardiac output measurement (score1.7)
15. Cardiopulmonary resuscitation after arrest, in the past period of 24 hrs (single precordial thump not included) (score 7.1)

IV- Renal support divided into (2 sub items):

16. Hemofiltration techniques, dialysis techniques (score 7.7)
17. Quantitative urine output measurement (e.g., by indwelling urinary catheter) (score 7.0)

V- Neurologic support, (1 item):

18. Measurement of intracranial pressure (score 1.6)

VI- Metabolic support, divided into (3 sub items):

19. Treatment of complicated metabolic acidosis/alkalosis (score 1.3)
20. Intravenous hyper alimentation (score 2.8)
21. Enteral (Enteric) feeding through gastric tube or other gastrointestinal (score 1.3)

VII- Specific interventions divided into (2 sub items):

22. Specific intervention(s) in the intensive care unit: endotracheal intubation, insertion of pacemaker, cardioversion, endoscopies, emergency surgery in the previous 24 hrs, gastric lavage; routine interventions without direct consequences to the clinical condition of the patient, such as: radiographs, echography, electrocardiogram, dressings, or insertion of venous or arterial catheters, are not included (score 2.8)
23. Specific interventions outside the intensive care unit: surgery or diagnostic procedures (score 1.9)

Scoring system

- The weights of nursing activities score represent the percentage of time spent by one nurse on the activity mentioned in the item, if performed. Items 1, 4, 6, 7, and 8, only one sub item and the score calculated when chose (a, b, or c). Performed items were coded as "1" and un-performed items were coded as "2". Total score (workload) calculated by the actual NAS score for each item as mentioned in the tool, to calculate the mean of workload for each patient and then collectively to all patients during data collection period.

- A total score of 100.0% indicates the work of one nurse over a 24 hours period. The sum of the 23 items ranged between 0 and 177 (0 when no items were done and 177 when the nurse did all items by the help of other nurses two or more as mentioned in the tool).
- Mean of workload resulted were used to calculate the standard hours produced then it was divided by the productive hours by calculation of all nurses' attendance days during three months (the period of data collection) and the non-productive hours were excluded (i.e., vacations, holidays, average sick leave times, orientation times and teaching times).

Notes:
The following productivity formula was used for measuring nurses' productivity:

$$\text{Nurses' mean workload ratio} = \frac{\text{Actual hours worked *}}{\text{Standard hours produced **}}$$

* Actual hours worked is the productive hours.
** Standard hours produced is the nurses' workload.
Productive hours = paid hours – non-productive hours.
Non-productive hours = Sum. Vacations + holidays + average sick times + orientation time + teaching time.

III. Patients' safety guidelines observational checklist: A modified observational check list was developed by the researchers guided by the original tool (General Practice Safety) by Bowie & Pract, (2015). It was used to assess patients' safety level in selected ICUs and consisted of 78 steps, divided into six main categories:

a) Medication management: (21 steps)
- As controlled drugs (4 steps), emergency drugs & equipment (10 steps), prescriptions & pads (3steps) and vaccinations (4 steps).

b) Standards infection precautions: (23 steps)
- As infection control (9 steps), stoking of clinical room (10 steps), confidential waste (one steps), and clinical equipment maintenance (3 steps).

c) Information system: (8 steps)
- Practice checklist and procedure book are available, the backup of all significant IT system is available, isolation of infected patients, and Boosters are up to date (for example; Hepatitis, CPR, and Hand washing,..etc) and Accurate and up-to-date record keeping are available,…etc.

d) Practice team: (10 steps)
- As registration checks (4 steps), CPR and anaphylaxis training (3steps), and induction processes (3steps).

e) Patient access & identification: (4 steps)
- Availability of standardized patient identification (ID) verification and the practice team has a patient ID process by using two approved patient identifiers,..etc.

f) Health and safety: (12 steps)
- As building safety & insurance (4 steps), environmental awareness (2 steps), and staff health and well being (6 steps).

Scoring system:
- Each item categorized into either fully compliant "took one grade" or not "took zero grade". The total scores of the checklist were 78 grades. The scoring system was classified as follows;
  - Scores equal or more than 70.5 (≥ 90%) was considered as a high patient safety level.
  - Scores less than 70.5 (< 90%) was considered as a low patient safety level.

IV. Patients' safety outcomes assessment sheet: it was developed by the researchers guided by the original tool developed by Silva, M., Sousa, R. and Padilha, K. (2011). It consisted of two main parts:

1. **Part one:** concerned with demographic characteristics of patients in surgical and neurological ICU units which included: age, gender, marital status, educational level…, etc.
2. **Part two:** concerned with patients' outcomes which includes; length of stay, morbidity (complications), readmission and mortality (death).

Tools validity and reliability: content validity was done to identify the degree to which the used tools measure what was supposed to be measured. Content and face validity of the tools were tested through subjecting tools to a panel of experts. It is consisted of seven faculty members in medical surgical nursing specialty. Each expert

was asked to examine the tools for content coverage, clarity, and whether the included items are suitable to achieve the aim of the current study. Reliability of the tools was done by Chronbach Alpha test (P-value > 0.001) the proposed tools had a good internal consistency & tests reached (0.78, 0.85, 0.89, and 0.90) for self administered questionnaire, nurses activities workload score assessment scale (NAS), patients' safety guidelines observational checklist and patients' safety outcomes assessment sheet respectively.

Pilot study: A pilot study was carried out on 10% the total number of the study sample to test the applicability, clarity, efficacy, and to identify problems that may be encountered during the actual data collection of the tools. Accordingly minor modifications were made so those nurses were included in the study.

Ethical consideration: for ethical reasons, a primary permits was granted from the hospital director to apply this study and from the head nurses of both surgical and neurological ICUs. Also at the initial interview, each legible nurse was informed about the aim of the study and its importance. The researcher emphasized that participation in the study is entirely voluntary, and anonymity and confidentiality were assured through coding the data. Oral approval consent was taken from each nurse who agreed to participate in the study; also they were assured that they have the right to withdraw from the study at any time. As well as the obtained information will be used only for the purpose of the study. Also, approvals of selected nurses for helping in data collection were secured.

Field work: The current study was carried out in two phases; including preparation and implementation.

1. Preparation phase:

Preparation phase was concerned with the construction and preparation of data collection tools after extensive review of literature, previous studies, preparation of a collection tools and seeking expert's advice. The content of data collection tools were translated in Arabic language and retranslated and reviewed by a panel of medical surgical nursing and medical experts to ensure its validity. Then, official approval to carry out this study obtained from the different authorities, namely the general director and nursing director of Ain Shams University Hospital, the heads of surgical and neurological ICUs, and finally from the nurses who participated in the study at the selected units. Nursing managerial meeting was carried out by the researcher to clarify the aim and the nature of the study to gain their cooperation, afterwards the pilot study was carried out.

2. Implementation phase:

The data collection phase of the present study was carried out within three months period started from August to October 2017.

- Firstly the researchers observe patients' safety by using safety guidelines observational checklist (Tool 3) in surgical and neurological ICUs. It took for about 30-45 minutes to full fill it.
- Than the nurses who agreed to participate in the study were interviewed to fulfill the self-administered questionnaire (Tool 1) by the researchers to collect data about their opinion about factors affecting patients' safety related nurses' practice in surgical and neurological ICUs. This interview done for each nurse individually and allowed the researcher to offer a protection against ambiguous or confusing questions. It took for about 15-20 minutes, during which the researcher was clarifying any obscure questions.
- The researchers selected two nurses from each ICU unit who had administered role in the selected ICU units, to participate the researchers in observing and calculating the nurses' workload by full filly Nursing Activates workload Score assessment scale (NAS) data (Tool 2). The researchers trained them for the period of two weeks before the starting of data collection. The training included:
    - Explaining each item included in the study tools, accompanying the selected nurses in collecting the data in different shifts after assuring that they understood and comprehend the tool correctly, and worked with them to collect the real data.

Statistical analysis: obtained data were tabulated, computed and analyzed using the statistical package for social sciences (SPSS) program version 21, Excel software used in calculation of productivity formulas: descriptive statistics including frequency and percentage distribution, mean, standard deviation. Qualitative variables compared using chi-square test to compare differences in distribution of frequencies among groups; T test applied to compare means values; and correlation coefficient were utilized. The level of significance was considered at the 5% level (P = 0.05).

VI. Results

Table (1) illustrates that (80.4%) of surgical ICU patients were males compared to (63.1%) for patients of neurological ICU and the difference was statistically significant P>0.001. As regards age the mean age in surgical ICU was (31.52±16.41). In comparison, for the neurological ICU the mean was (39.80±17.56) with highly statistically significant P<0.000. Regarding the causes of discharge for surgical and neurological ICUs the percentages of patients discharged were (43.8%, 45.5%, and 10.7%) compared to (31.5%, 50.5%, and 18.0%) as improvement, transfer, and death respectively, the difference was statistically significant P<0.05.

Table (2) shows that most of surgical ICU patients length of stay highest percentage was (65.2%) for patients stayed less than 10 days while neurological ICU patients (3.6%) stayed in the unit less than 10 days. Regarding mean length of stay it was (10.82±11.25) for surgical ICU compared to (6.50±8.21) for neurological ICU with highly statistically significant P<0.001. As regard to discharge, transferring to ward, complicated and death in surgical ICU patients were (50%, 35.7%, 11.6%, and 2.3% respectively) compared to (30.6%, 40.5%, 19.9%, and 9% respectively) for neurological ICU patients.

Table (3) shows that nurses' level of education at surgical ICU was diploma of secondary nursing school, B.S.C. nurse, and master/doctorate degree in nursing (48.5%, 36.8%, and 14.7% respectively). In compared to (69.6%, 17.4, and 13.0% respectively) for neurological ICU nurses with statistically significant P<0.05. Regarding nature of nurses' work at both surgical and neurological ICUs, (85.3% and 91.3%) of them work as bedside nurses (direct care) and the difference was statistically insignificant P>0.05. For nurses' years of experience at surgical ICU the highest percentage (63.3%) was for the group who had 1-<5 years of experience, and the mean was (7.65±5.19). In comparison, for neurological ICU nurses, (47.8%) had 1-<5 years of experience, and the mean was (10.74±6.71). The difference was statistically significant P<0.05. Regarding gender it was found that the highest percentage in both surgical ICU & neurological ICU nurses were females (76.5% & 78.3% respectively).

Table (4) shows that the mean of nurses' workload was (62.40±11.20) in the surgical ICU compared to (54.17±12.29) in the neurological ICU. The difference was statistically highly significant P<0.001. As regards the median of workload it was (60.89%) for surgical ICU patients and (53.23%) for neurological ICU patients. Moreover, workload range for surgical and neurological ICUs was (18.60-113.80 and 11.10-110.00) respectively.

Table (5) shows mean time spent of the nurses to provide care for each patient during 24 hours was (14.98±2.69) at surgical ICU and (13.00±2.95) at neurological ICU. The difference was highly statistically significant P<0.001. As regards median time it was (15.17 hours) for surgical ICU and (12.98 hours) in the neurological ICU, while time range was (4.46-27.31 and 2.66- 26.40) in the surgical and neurological ICUs respectively.

Figure (1) illustrates that the percentage of patients' safety level was (75% and 51%) at surgical and neurological ICUs respectively.

Table (6) showed mean and standard deviation of the factors affecting patients' safety related nurse practice as; physical work environment related factors was 15.33 ± 3.98 in the surgical ICU compared to 9.70 ± 2.58 in the neurological ICU. In addition, the mean and standard deviation of social & psychological factors was 9.20 ± 5.44, work system was 11.60 ± 3.72 and work satisfaction was 14.53 ± 2.33 for surgical ICU nurses compared to 4.60 ± 3.13, 7.50 ± 3.10 and 6.20 ± 3.58 for neurological ICU nurses. In addition the mean of total factors increasing workload was 50.66±15.47 for surgical ICU nurses compared to 28±12.37 for neurological ICU nurses, with highly statistically significant P<0.001.

Table (7) illustrated that the highest mean of the six patient safety guideline items was toward standard infection precautions (69.9±14.2) in the surgical ICU, compared to 62.8 ± 19.9 in the neurological ICU, while the mean and standard deviation for patient safety level was 59.6±20.4 in the surgical ICU nurses compared to 49.1±21.3 in the neurological ICU nurses. In addition, there were highly statistical significant differences between patient safety guideline and patients' safety level mean P<0.001.

Table (8) shows that there was negative correlation between nurses' workload and (patients' safety level, and patients' safety outcomes) at surgical and neurological ICUs. While, there was a positive correlation between workload and factors affecting patients safety related nurses' practice at surgical and neurological ICUs. With highly statistically significant P<0.001

Table no1 Characteristics of patients admitted surgical and neurological intensive care units for the period of data collection

Patients characteristics	Surgical ICU (n=112)		Neurological ICU (n=111)	
	No	%	No	%
Age				
• 20-	62	55.4	36	32.4
• 30	28	25	38	34.2
• 40	14	12.5	14	12.6
• 50 to 60	8	7.1	23	20.7
Mean±SD	31.52±16.41		39.80±17.56	
Gender				
• Male	90	80.4	70	63.1
• Female	22	19.6	41	36.9
Marital status				
• Married	42		36	32.4
• Unmarried	70		75	67.6
Level of education				
• Uneducated	49	43.8	35	31.5
• High school/ diploma				
• BSC	51	45.5	56	50.5
• Master or PhD	12	10.7	20	18.0
T test	3.6			
P value	0.000***			
Residence				
• Rural	32	28.6	20	18
• Urban	80	71.4	91	82

*The difference is significant at P <0.05, ******* the difference is very highly significant at P <0.001.

Table no2: Patients' safety outcomes at surgical and neurological intensive care units for the period of data collection.

Patients' safety outcomes	Surgical ICU (n=112)		Neurological ICU (n=111)	
	No	%	No	%
Length of stay				
• 5- < 10 days	73	65.2	4	3.6
• 10<15 days	15	13.4	10	9
• 15<25 days	12	10.7	56	50.5
• 25 days and over	12	10.7	41	36.9
Mean±SD	10.82±11.25		6.50±8.21	
T test	3.27			
P value	0.001***			
Discharged	56	50	34	30.6
Transferred to ward	40	35.7	45	40.5
Complicated	13	11.6	22	19.9
Death	3	2.3	10	9
T test	9.643			
P value	0.022*			

*** The difference is very highly significant at P<0.01, * The difference is significant at P<0.05

Table no3: Characteristics of the studied nurses working at surgical and neurological intensive care units for the period of data collection

Nurses characteristics	Surgical ICU (n=68)		Neurological ICU (n=23)	
	No	%	No	%
Age				
• 20- < 30	40	58.8	16	69.6
• 30- <45	18	26.5	5	21.7
• 45< 60	10	14.7	2	8.7
Mean±SD	22.6± 8.4		20.1± 5.2	
Gender				
• Male	16	23.5	5	21.7
• Female	52	76.5	18	78.3
Level of education				
• Diploma of nursing	33	48.5	16	69.6
• Bs. C. nurse and higher	25	36.8	4	17.4
• Master/doctorate degree in nursing	10	14.7	3	13.0
X^2 test	7.805			
P value	0.020*			
Nature of work				
• Administrative duties	10	14.7	2	8.7
• Bedside nurse (direct care)	58	85.3	21	91.3
X^2 test	0.628			
P value	0.428			
Years of experience				
• 1-<5	43	63.3	11	47.8
• 5-<10	17	25.0	7	30.4
• 10- <15	5	7.4	4	17.4
• 15 to 20	3	4.4	1	4.3
Mean±SD	7.65±5.19		10.74±6.71	
T test	2.28			
P value	0.025*			

*The difference is significant at P<0.05.

Table no.4: Nurses' workload mean at surgical and neurological intensive care units for the period of data collection

Variable	Surgical ICU (patients' days=1040)	Neurological ICU (patients' days=657)
Mean of workload ± SD per 24 hrs	62.40 ± 11.20	54.17 ± 12.29
X^2 test	13.82	
P value	0.000***	
Median of workload	60.89	53.23
Range of workload	18.60-113.80	11.10-110.00

*** The difference is very highly significant at P<0.001.

Table no5: Mean nurses' time spent to provide care for each patient during 24 hours at surgical and neurological intensive care units for the period of data collection

Variable	Surgical ICU (patients' days=1040)	Neurological ICU (patients' days=657)
Mean of time ± SD per 24 hrs	14.98 ± 2.69	13.00 ± 2.95
X^2 test	13.82	
P value	0.000***	
Median of time	15.17	12.98
Range of time	4.46-27.31	2.66- 26.40

Figure no1: Patients' safety level at surgical and neurological intensive care units for the period of data collection

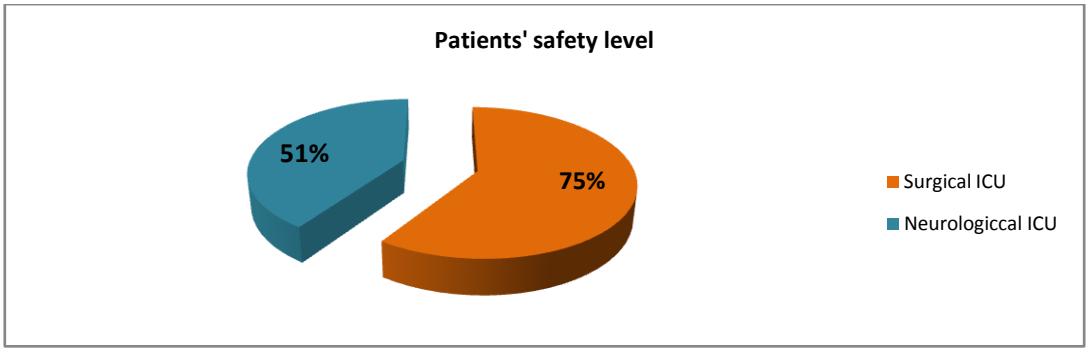

Table no 6: Mean and standard deviation of the factors affecting patients' safety related nurses practice as perceived by nurses at surgical and neurological ICU

Factors	Surgical ICU (n=68)	Neurological ICU (n=23)
	Mean ± SD	
• Work system	11.60 ± 3.72	7.50 ± 3.10
• Work satisfaction	14.53 ± 2.33	6.20 ± 3.58
• Physical work environment	15.33 ± 3.98	9.70 ± 2.58
• Social & psychological	9.20 ± 5.44	4.60 ± 3.13
Total	50.66±15.47	28±12.37
T test	19.47	
P value	0.001***	

******* The difference is very highly significant at P <0.001.

Table no7: Mean and standard deviation of the six items of patient safety guidelines and the patients' safety level at surgical and neurological ICU

Patient safety guidelines	Surgical ICU (n=68)	Neurological ICU (n=23)	T test	P value
	Mean ± SD			
• Medication management	58.3±18.9	40.3 ± 26.5	80.1	0.000***
• Standard Infection precautions	69.9±14.2	62.8 ± 19.9	70.2	0.000***
• Information System	56.0 ± 18.8	53.7±19.9	68.8	0.000***
• Practice team	46.5 ± 18.0	38.3 ± 18.7	48.5	0.000***
• Patient access and identification	65.6±38.7	46.9±19.1	68.8	0.000***
• Health and safety	61.1±14.0	52.8±23.6	56.4	0.000***
Patients' safety level	357.4±122.6	343.9±127.7	94	0.000***

*The difference is significant at P <0.05. **The difference is highly significant at P <0.01. ******* The difference is very highly significant at P <0.001.

Table no8: Correlation between nurses' workload and (patients' safety level, factors affecting patients' safety related nurses practice and patient safety outcomes) at the selected intensive care units for the period of data collection.

Variables	Nurses' workload	
	r	p
• **Patients' safety level**	-1.000	0.00**
• **Factors affecting patients' safety related nurses practice**	0.130	0.29
• **Patients' safety outcomes**	-0.011	0.001**

**The difference is highly significant at P <0.01.

VII. Discussion

Increasing workload of nurses in intensive care units has been identified as a major patient safety and work stress problem (Hoonakker *et al.,* 2011). It is important to maintain an adequate, productive nursing workforce to the delivery of high-quality, and cost effective health care (Letvak *et al.,* 2012).

The present study findings reveal that majority of surgical ICU patients and more than two thirds of neurological ICU patients were males. As regards the age of surgical ICU patients, it ranged between ten and sixty nine years, while the age of neurological ICU patients ranged between three and seventy six years with mean length of stay was about eleven days at surgical ICU, and about seven days at neurological ICU. Most common cause of discharge for surgical ICU patients and neurological ICU patients were transfer to other unit for more than half of patients.

These findings are consistent with the findings of Padilha *et al.* (2008) study entitled "Nursing workload in intensive care units: A study using the Therapeutic Intervention Scoring System "who found that about two quarters of the patients were males and their mean age was about fifty years. The average length of stay was about eight days. Kiekkas *et al.* (2008) study entitled "Health Policy and Systems, Association between Nursing Workload and Mortality of Intensive Care Unit Patients "who revealed that more than two quarters of patients were males and the mean age was about fifty years. Padilha *et al.* (2010) study entitled " Nursing workload and staff allocation in an intensive care unit: A pilot study according to Nursing Activities Score (NAS)"who found that the mean length of stay in the ICU was twelve days.

On the other hand, the present study results contradict Stafsetha *et al.* (2011) study entitled "The characterization of workloads and nursing staff allocation in intensive care units: A descriptive study using the Nursing Activities Score for the first time in Norway" who revealed that the patients' mean age was about fifty years and the average patient length of stay was five days.

As regards the educational level the study finding revealed that, nearly half of surgical ICU nurses and more than three quarters of neurological ICU nurses had diploma nursing school. The vast majority of nurses at surgical and neurological ICU worked as bedside nurses (direct care). Also the findings show that the mean years of experience was about eight and eleven years for surgical and neurological ICUs nurses respectively.

The current study findings are consistent with Kandeel and Tantawy (2012) study entitled" Current Nursing Practice for Prevention of Ventilator Associated Pneumonia in ICUs "revealed that three quarters of the sample had diploma of technical nursing institute and diploma of nursing school and worked as bed side nurses. For years of experience more than eighty percent of the sample had less than 10 years of experience.

In addition, the current study findings are inconsistent with Bhagwanjee *et al.* (2008) study entitled " National audit of critical care resources: How long before we act " who found that more than one quarter of nurses have less than one year to five years of ICU experience. The present study results also contradict Carayon , Alvarado & Brennan (2009) study entitled" Impact of Performance Obstacles on Intensive Care Nurses' Workload, Perceived Quality and Safety of Care, and Quality of Working Life " who revealed that, nurses had about seven years of experience as an ICU nurse, and about three quarters of them having at least a bachelor's degree.

Regarding the workload, the study findings revealed that mean of workload for surgical ICU patients was 62.40± 11.20, while neurological ICU patients had 54.17 ± 12.29. This result concluded that, patients workload at surgical ICU was higher than medium, this results may be due to the patients admitted to surgical ICU mostly post operative with different diagnoses including wounds, abdominal explorations, and connected to many devices and surgical drains while the workload was moderate at neurological ICU may be due to the patients mostly were unconscious and dependent in most activities but their ratio to nurses were appropriate.

The results of the present study are consistent with Silva *et al.* (2011) study entitled "Factors associated with death and readmission into the Intensive Care Unit" who revealed that the mean NAS was 61.92%. Ducci and Padilha (2008) study entitled " Nursing activities score: a comparative study about retrospective and prospective applications in intensive care units " who found that mean NAS was 59.6%. Debergh, *et al.* (2012) study entitled "Measuring the nursing workload per shift in the ICU "who revealed that nurses' workload per 24 hrs was 54.7%.

However, these findings are disagree with the results of Queijo and Padilha (2009) study entitled " Nursing Activities Score (NAS): cross-cultural adaptation and validation to Portuguese language "who showed that mean NAS was 67.2% and Stafsetha *et al.* (2011) study entitled " The characterization of workloads and nursing staff allocation in intensive care units: A descriptive study using the Nursing Activities Score for the first time in Norway "which found that each nurse is capable of performing an NAS of 75-90% per shift, depending on which unit is investigated.

In comparison between total patients' safety at surgical and neurological ICUs there were statistical significant differences between patients' safety level regarding all items of patient safety guidelines at surgical and neurological ICUs. This is consistent with Hughes & Clancy, (2015), in study titled "Working conditions that support patient safety" who found that, significant improvement in safety of patients with trauma post implementing self learning programs. And also with Vassilis , Aletras and Kyriaki, (2014) in study titled" Performance obstacles of nurses in intensive care units of Greek National Health System hospitals" who found

significant improvement in nurses' performance regarding safety of patients in ICUs of Greek National Health System hospitals.

Regarding the time to provide care by nurses, the present study revealed that the range of time spent to provide care for one patient during twenty four hours at surgical ICU was about five to twenty seven hours (that because more than one nurse may participate sometimes to do a procedure for one patient) with mean of fifteen hours, while at neurological ICU it ranged from three to twenty six hours with mean of thirteen hour.

On the same vein, Silva *et al.* (2011) study entitled" Factors associated with death and readmission into the Intensive Care Unit" who reported that the average time spent by a nurse on each patient during the first twenty-four hours of their stay was sixteen hours.

Regarding patients' safety level, the study result revealed that, patients' safety level was fifty one percent and seventy five percent for neurological and surgical ICUs respectively. The result of the study concluded that, nurses' performance at neurological ICU was medium, while it was high at surgical ICU. The current study results are consistent with the findings of Unruh, (2013) study entitled" Licensed nurse staffing and adverse events in hospitals " who found that the intensive care unit utilization ratio was seventy six percent. On the other hand, the findings of the present study contradict with the O'Brien-Pallas *et al.*, (2014) study entitled "Evidence-based Standards for Measuring Nurse Staffing and Performance" which reported a target of eighty five percent (plus or minus five percent) unit performance ratio on a daily basis. Sustained performance ratio outside this range will result in higher costs and poorer quality of care.

Regarding factors affecting patients safety related nurses' practice at surgical and neurological ICUs, the study findings revealed that total mean of factors affecting patients safety related nurses' practice in surgical ICU was 50.66±15.47, while in neurological ICU were 28±12.37. This result may be due to the nature of ICU design and patients' ratio in both intensive care units also related to availability of equipment which was obvious for the researchers that it was more available in surgical ICU than neurological ICU although it wasn't adequate too. Also, nurses in surgical ICU mentioned that there is no advanced equipment or devices and infection' protection substance not available.

This is agreed with El- Bardeny, (2015) study entitled " Organizational Climate versus Commitment among Nurses Working in Tanta University Hospital", who mentioned that work environment have a positive effect on nurses' work and satisfaction. Also, in accordance with the study findings of Metwally, (2016) study entitled " Apply Standards for Nursing Care to Improve the Quality of Nursing Practice at the Labor Unit" who mentioned that, supplies and equipment came as second factors hindering the implementation of care for nurses in intensive care unit.

A number of factors were observed by the researchers during implementation of this study that may explain increasing nurses' workload. For example, system or hospital rules and regulations as the rules clarifying nursing and medical role may have some deficiencies and there is no work description, thus leading to ambiguity of roles, with subsequent dependence on each of them on each other. Also, working during period of rest, writing medical reports, much non-nursing work and have insufficient rewards as mentioned by most of nurses under study.

The present study shows that there was a negative correlation between workload and (patients' safety level and patients' safety outcomes) at surgical and neurological ICUs. The results of the study concluded that, mean nurses' workload at surgical ICU was more than two third, this results may be due to the patients admitted to surgical ICU mostly had stab wounds, motor car accidents, abdominal explorations, on mechanical ventilations, with multiple connections and drains and need more care, while the nurses' workload was more than half at neurological ICU this may be due to the patients/ nurse ratio was appropriate.

The current study results are inconsistent with the findings of Van Bogaert *et al.* (2013) study entitled "The relationship between nurse practice environment, nurse work characteristics, burnout and job outcome and quality of nursing care: a cross-sectional survey" who revealed that burnout among nurses was moderately related to nurses' workload. In the same line Eid *et al.* (2014) who revealed that there was statistically significant correlation between delegation and nurse managers' performance.

Regarding correlation between workload and factors increasing patients' safety related nurses' practice in surgical and neurological ICUs, the finding of the study revealed that there is a positive correlation between them. This result goes in the same line with *Lang, Hodge & Olson (2014)* study titled " Nurse-patient ratios: a systematic review on the effects of nurse staffing on patient, nurse employee, and hospital outcomes" who revealed that nurses are experiencing higher workloads than ever before due to four main reasons: increased demand for nurses, inadequate supply of nurses, reduced staffing and increased overtime, and reduction in patient length of stay. This result also, goes in the same line with Gurses & Carayon, (2016) study titled " Nursing Workload and Patient Safety: A Human Factors Engineering Perspective" who revealed that, heavy nursing workload adversely affects patient safety which depends on many factors as work system, social and environmental. Furthermore, it negatively affects nursing job satisfaction and, as a result, contributes to high turnover and the nursing shortage which adversely affects patient safety. And in the same line with Needleman, Buerhaus & Mattke, (2012) study titled " Nurse-staffing levels and the quality of care in hospitals " the higher patient acuity, work system factors and expectations also contribute to the nurses' workload: nurses are expected to perform nonprofessional tasks such as delivering and retrieving food trays; housekeeping duties; transporting patients; and ordering, coordinating, or performing ancillary services.

VIII. Conclusion & Recommendations

Conclusion: there was a statistically significant negative correlation between nurses' workload and patients' safety and outcomes. Recommendations: applying of nursing activities workload assessment score in intensive care units to retain nurses staffing, enhancing the patient safety level, and avoiding waste of nurses' time and consequently.

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