

## Nurses' Workload and its' Impact on Productivity in Trauma and Post Operative Intensive Care Units at Assiut University Hospital

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**Abstract:** Productivity of nurses is an important matter. Nurse's productivity is well connected to nurses' workload. Through measuring workload productivity can be easily measured. This **study aims** at measuring nurses' workload at trauma and post operative intensive care units and identifying the impact of nurses' workload on nursing productivity. **Methods:** the subject consisted of the total number of admitted patients 112 patients at trauma ICU and 111 patients at post operative ICU and total number of nurses was 68 at trauma ICU and 23 at post operative ICU. Data collected for the period of three months by observation of nursing care given to all admitted patients at the selected sites for 24 hours from admission to discharge and by interviewing nurses for nurses' personal data. Data collected using: Patient Information sheet; nurses' information sheet; Nursing Activities Score; and productivity formulas. **Results:** Trauma ICU patients had about 60% of workload, while post operative ICU patients had more than 50% of workload. Performance ratio (productivity) was about 50% and 75% for trauma and post operative ICUs respectively. There was negative correlation between workload and productivity at trauma and post operative ICUs. **Recommendations:** applying of nursing activities score (NAS) to retain nurses staffing, enhance productivity, and avoid waste of nurses' time. Productivity should be measured annually and comparing the results against productivity standards. Informing staff with patient care results and provide annual productivity indices for them and incentives should be based on the results of measured workload.

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### 1. Introduction

Nurses not only coordinate the care they provide to the patient, but also they coordinate the patient's stay in hospital in part by integrating a wide variety of information in the hospital from many sources (**Registered Nurses Association of Ontario Hospital, 2005**). Accurate definition and quantification of the nursing work is critical to the identification of appropriate nursing resource requirements (**Graf et al., 2003**). Workload can be defined as the time spent on patient care by health care worker during a specific period of time (**Nijssen et al., 2002**). Also workload can be defined as the amount of care allocated to patients based on an assessment of their nursing needs and the care they require (**Hadley et al., 2005**).

The use of actual workload can facilitate calculation of staff ratio that is, done by dividing the actual numbers of staff on the expected staff number, which results in the actual workload pressure on health workers. Workload is the amount of work performed or assigned by nurses at a period of time (**Yoder-Wise, 2007; Ministry of health and social welfare, 2008**).

Workload is the major characteristic of the work environment of critical care nurses. It is also one of the most job stressors among intensive care unit nurses, which may have negative consequences for nurses and the patients they care for (**Carayon and Alvarado, 2007**). Nurses are facing higher workloads due to the following reasons: increased demand for nurses; inadequate supply of nurses; reduced staffing and increased overtime; and reduction in patient length of stay. When a nursing shortage occurs, the workload increases for those who remain on the job (**Hughes, 2008; Jaspers, 2009**).

Factors that influence nursing workload and organizations' response include: patient demand; environmental complexity; medical complexity; quality; nursing sensitive outcomes (a standard of measurable outcomes that can be used to evaluate nursing practice in all settings); nursing intensity; nursing skill mix; and work systems. These factors illustrate the complexity of measuring nursing workload, indicating that only some of these factors are likely to be measured by a well developed tool (**George, 2003; Walker and Hendry, 2009**).

Role overload (increase workload) is divided into two separate types, quantitative role overload and qualitative role overload. 1) **Quantitative tasks**: are within the capabilities of the individual but because of some limits (mostly time) the individual may not be able to complete the task. 2) **Qualitative tasks**: are dependent on the abilities of the individual and the rate of difficulty of the tasks at hand (**Jaspers, 2009**).

**Carayon and Alvarado, (2007)** added that the dimensions of workload for critical care nurses emerge from seven origins: 1) physical workload: the amount of physical work including patient handling. 2) Cognitive workload: the information overload. 3) Time pressure: working under temporal constraints and tight deadlines. 4) Emotional workload: dealing with emotional issues such as patient death; end-of-life care and family demands. 5) Quantitative workload: the amount of work. 6) Qualitative workload: the difficulty of work. Lastly, 7) workload variability: the changes of workload that may include increase in workload (e.g., code situation "most health care facilities call the various types of emergencies codes" **Hegner et al. (2008)** added or decrease in workload (e.g., night shift).

A nursing workload measurement system is a key component of any process to measure nursing resource intensity (**Canadian Nurses Association, 2003**). The workload measurement can be broadly categorized into two types: activity based (measures characteristics of nursing care activities and assigns a time value for them) (**Hughes, 1999; Siew and Ghani, 2006**) and dependency based (measures patient's acuity and/or dependency) (**Hurst et al., 2008; Bray et al., 2010**).

A practical method to quantify workload is a productivity measure. A more realistic unit of production is patient contact hours, a true measure of nursing services. Productivity and cost containment have become top priorities for nurse managers. Consequently the definition and measurement of nursing productivity has become a high priority for most nursing managers (**Sullivan and Decker, 2005; Grohar-Murray and Langan, 2011**).

Managers and workers would be satisfied if increased productivity resulted in adequate financial rewards. Productivity contributes to our overall quality of life and standard of living. Thus, the citizens of a highly productive country will have a better standard of living than people in a less productivity country (**Holcomb et al., 2002; Maniadakis and Thanassoulis, 2004**).

Productivity is the ratio between input and output. Productivity is increased if the ratio of input falls in relation to the measurement of output (**Barnum and Kerfoot, 1995**). Unit's activity or productivity report provides the key statistics that can

be used to project units of service (workload) for the upcoming year and for monitoring the unit's current productivity performance (**Yoder-Wise, 2007**). **Yu (2007)** defined productivity as "workload" over worked hours. This definition actually measures use of nursing resources and thus evaluates an organization's ability to operate to meet patient care standards and needs. **O'Brien-Pallas et al. (2008)** stated that productivity measured the relationship between inputs (nurse worked hours) and outputs (acuity-adjusted patient days).

The way in which output and input are measured can provide very different measures of productivity. It is usually expressed in one of three forms: a total productivity, multifactor productivity, and partial productivity (**Evans, 1993; Inman, 2012**). Effective managers, however, do not focus totally on numbers of personnel, but look at all components of productivity; they examine nursing duties, job descriptions, patient care organization, staffing mix, and staff competencies. Managers also use every opportunity to build a productive and cohesive team (**Marquis and Huston, 2009**).

The success of any productivity program depends on human innovative ideas and creativity. Thus there is an urgent need to look more closely into the human factors and consider their contribution to the improvement of productivity. Formal analysis of the basic productivity factors such as output, input, labor, capital, technology and managerial motivation reveals at once that more than half of these factors are concerned with the quality of the labor force (**Prokopenko, 1990; Omachonu and Einspruch, 2010**).

The nurse-in-charge should have strategies for balancing productivity and patient care demands. That needs two steps: **the first step**: is bed management that involves coordinating the flow of patients in and out of the ICU and managing the number of patients that are cared for in the ICU. **The second step**: is daily staff management that involves maintaining an appropriate level of staffing resources to handle patient demands and distributing nursing resources in an effective and fair manner. Failure can result if patient care dominates because the activity is performed too late or productivity dominates because the activity may be inappropriate for the situation. Successful performance requires maintaining two main productivity goals and two main patient care goals. Productivity goals are: admitting as many patients for the intensive care unit and minimizing nursing staff costs. Patient care goals are: providing a high quality patient care and promoting staff wellbeing (**Hollnagel, 2009; Xiao et al., 2010**).

By reviewing international literature a study done in Queensland in Australia at the aged care,

public and private acute sectors by **Hegney et al. (2003)** revealed that nurses experienced difficulties in meeting patient needs because of insufficient staffing. The outcomes of that study suggest that the majority of nurses perceive current workload to be unacceptable. **Pink et al. (2004)** studied the causes of the emigration of Canadian trained registered nurses to the United States revealed that nurses' shortage imposed real economic costs. The results of nurses' shortage were unavailability of nursing staff, increased sick time, injuries, disability and other forms of productivity loss.

Nationally in Egypt, a study done on two of Menoufiya hospitals revealed that the workload at the operating theatre at University of Menoufiya hospital was greater than that at Shebin El-Kom teaching hospital (**El-Salam et al., 2008**). **El-Mehrezy, (2001)** evaluated the maternity care and prenatal outcome in Sohag governorate demonstrated that nurses' workload in Sohag governorate was as the following, 81% in the rural health unit, 56% in the combined unit, 33% in the integrated hospital and 56% in the maternal and child health division of the general medical center.

Measurement of nurses' workload helps to enhance effective use of human resources, increase productivity and reduce costs. Because no such research was conducted before in upper Egypt, so it is important to measure nurses' workload and its impact on productivity of nursing care in trauma and post operative intensive care units at Assiut University Hospital.

#### **Aim of the Study**

##### **The study aims to:**

1. Measuring nurses' workload on Trauma and post operative intensive care units.
2. Identifying the impact of nurses' workload on nursing productivity.

#### **2. Subject and Methods**

##### **The methodology pursued in the conduction of this study followed the following designs:**

- I-Technical design
- II-Operational design
- III-Administrative design
- IV-Statistical design

##### **I-Technical design:-**

This design involved the study design, sample, setting, and tools of data collection.

##### **Study design:**

Descriptive and observational designs was followed in the conduction of the study.

##### **Subjects:**

Two types of subjects were included in this study.

1. **Patients:** total coverage of nursing care given to all patients admitted to intensive care units was

carried out by observation for 24 hours from admission to discharge throughout the period of data collection (3 months). (Total number of admitted patients was 112 at trauma ICU and 111 at post operative ICU; total number of patient days was 1026 at trauma ICU and 651 at post operative ICU)

2. **Nurses:** total number of nurses was 68 at trauma ICU.

##### **Setting:**

The study was carried out at trauma and post operative intensive care units (ICUs) at Assiut University Hospital. Trauma ICU had 16 beds. Post operative ICU had 8 beds.

##### **Tools of data collection included: -**

Four tools were used to carry out this study: patient information sheet, nurses' information sheet, Nursing Activities Score, and productivity formula.

- 1) **Patient Information sheet:** Tool consisted of: patient name, date of admission, date of discharge, unit name, patient code, length of stay, gender, age, and cause of discharge from the unit.
- 2) **Nurse's information sheet:** Tool consisted of: unit name, nurse name, nurse code, nurse's qualification, and finally years of experience.
- 3) **Nursing Activities Score sheet:** this tool is aimed to estimate nursing workload by determine the percentage of time spent in patient care during 24 hours and collectively during the period of data collection, adapted from (**Miranda et al., 2003**).

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 intensive care unit. Nursing activities score performed better in 24 hours application than in shifts, and proved to be an interesting tool for patient and nursing workload classification in intensive care (**Conishi and Gaidzinski, 2007**). Due to its scope to measure nursing workload in intensive care units and the fact that its use is free of charge, nursing activities score can be considered an important tool in a clinical setting (**Padilha et al., 2008**).

Nursing activities score can also be used as a managerial tool: 1) for estimating the amount of nursing care required for a patient during the next period of time, 2) for a much more accurate measurement of the work utilization ratio (productivity), 3) for measuring changes in nursing workload as caused by management and policy changes in the unit, and 4) for estimating the money resources (regarding nursing staff) used with patient care (**Miranda et al., 2003**).

A total score of 100.0% indicates the work of one nurse over a 24 hours period. The sum of the 23 items ranges between 0 and 177% (0% when no items done and 177% when the nurse do all items by the help of other nurses two or more as mentioned in the tool).

**Tool consisted of:**

**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/m<sup>2</sup>/day, irrespective of type of fluid administered (score 2.5)
14. Left atrium monitoring: pulmonary artery catheter with or without cardiac output measurement (score 1.7)
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 hyperalimentation (score 2.8)  
 21. Enteral (Enteric) feeding through gastric tube or other gastrointestinal route (e.g., jejunostomy) (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.

**4) Productivity formula:**

The following productivity formula was used for measuring nurses' productivity as adapted from **Armstrong (2001)**.

$$\text{Performance ratio} = \frac{\text{standard hours produced} *}{\text{actual hours worked} **}$$

**Calculation:**

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:**

\* Standard hours produced is the nurses' workload.

\*\* Actual hours worked is the productive hours.

Productive hours = paid hours – non-productive hours.

Non-productive hours = Sum. vacations + holidays + average sick times + orientation time + teaching time

**(Yoder-Wise, 2003).**

**II-Operational design:-**

**Preparatory phase: -**

This phase started from July 2010 to April 2011 (about ten months) and included the following:

1. Reviewing the available literature concerning the topic of the study
2. Translation of the used study tools into Arabic.

**Pilot study:-**

To assess tools clarity and applicability and to identify problems that may be encountered during the actual data collection, a pilot study was carried out for the period of two days to all patients admitted in trauma and post operative intensive care units at Assiut University Hospital.

**Phases of data collection:**

The data collection phase of the present study was carried out within three months period started from May to July 2011. The researcher selected ten nurses newly graduated from the faculty of nursing after completing internship year, to participate the researcher in (observation) collecting data. The researcher 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.

**III-Administrative design:-**

Official approval to carry out this study obtained from the different authorities, namely the general director and nursing director of Assiut University Hospital, the heads of trauma and post operative intensive care units, and finally from the nurses who participated in the study at the selected units.

**Ethical considerations:**

- The study proposal took agreement from the ethical committee in the faculty of nursing-Assiut University.
- ICU nurses have the right to participate or to refuse participation in the present study, and then oral agreement was obtained from participated nurses.
- Letter of approval to the heads of trauma and post operative ICUs.
- Approvals of selected nurses for helping in data collection were secured.
- Confidentiality of obtained information secured.
- The nature and purpose of the study explained to all different participants.

**IV. Statistical design:-**

**Data analysis**

Data entry and statistical analysis were done using a computer software package (SPSS version 16), Excel software used in calculation of productivity formulas: descriptive statistics done in the form of means, frequencies, and percentages. 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 used.

### 3. Results

Obtained data were analyzed, tabulated and presented in six parts:

- Part I: Description of sample and characteristics of patients, and nurses (tables 1 to table 3).
- Part II: Workload and time needed for care of one patient presented in tables 4 and 5.
- Part III: Productivity presented in figure (1).
- Part IV: The correlation between workload and performance ratio (table 6).

**Table (1) Characteristics of patients admitted at trauma and post operative intensive care units for the period of data collection**

Patients characteristics	Trauma ICU (No.=112)		Post operative ICU (No.=111)	
	No.	%	No.	%
○ Sex				
- Male	85	75.9	70	63.1
- Female	27	24.1	41	36.9
<b>X<sup>2</sup> test</b>	3.745			
<b>P value</b>	0.053*			
○ Age by years				
- <20	30	26.8	17	15.3
- 20-	32	28.6	19	17.1
- 30-	15	13.4	24	21.6
- 40-	13	11.6	14	12.6
- 50-	14	12.5	14	12.6
- 60 years and more	8	7.1	23	20.7
<b>Range</b>	1-69		3-76	
<b>Mean ± SD</b>	31.52±16.41		39.80±17.56	
<b>T test</b>	3.6			
<b>P value</b>	0.000***			
○ Causes of discharge				
- improvement	14	12.5	27	24.3
- transfer	51	45.5	56	50.5
- death	47	42.0	28	25.2
<b>X<sup>2</sup> test</b>	9.643			
<b>P value</b>	0.022*			

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

**Table (2) Length of stay for admitted patients at trauma and post operative intensive care units for the period of data collection**

Length of stay	Trauma ICU (No.=112)		Post operative ICU (No.=111)	
	No.	%	No.	%
- <5 days	35	31.3	56	50.5
- 5-9 days	38	33.9	41	36.9
- 10-14 days	15	13.4	7	6.3
- 15-19 days	7	6.3	3	2.7
- 20-24 days	5	4.5	1	0.9
- More than 24 days	12	10.7	3	2.7
<b>Range</b>	1-64		1-48	
<b>Mean ± SD</b>	10.82±11.25		6.50±8.21	
<b>T test</b>	3.27			
<b>P value</b>	0.001**			

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

**Table (3) Characteristics of the studied nurses working at trauma and post operative intensive care units for the period of data collection**

Nurses characteristics	Trauma ICU (No.=68 nurses)		Post operative ICU (No.=23 nurses)	
	No.	%	No.	%
○ <b>Level of education:</b>				
- Bs. C. nurse and higher	21	30.9	1	4.3
- Associate degree in nursing	14	20.6	4	17.4
- Diploma of secondary nursing school	33	48.5	18	78.3
<b>X<sup>2</sup> test</b>	7.805			
<b>P value</b>	0.020*			
○ <b>Nature of work:</b>				
- Administrative duties	9	13.2	1	4.3
- Bedside nurse (direct care)	59	86.8	22	95.7
<b>X<sup>2</sup> test</b>	0.628			
<b>P value</b>	0.428			
○ <b>Years of experience:</b>				
- 1-	8	11.8	6	26.1
- 5-	35	51.5	5	21.7
- 10-	17	25.0	7	30.4
- 15-	5	7.4	4	17.4
- ≥ 20 years	3	4.4	1	4.3
<b>Range</b>	1-30		1-21	
<b>Mean ± SD</b>	7.65±5.19		10.74±6.71	
<b>T test</b>	2.28			
<b>P value</b>	0.025*			

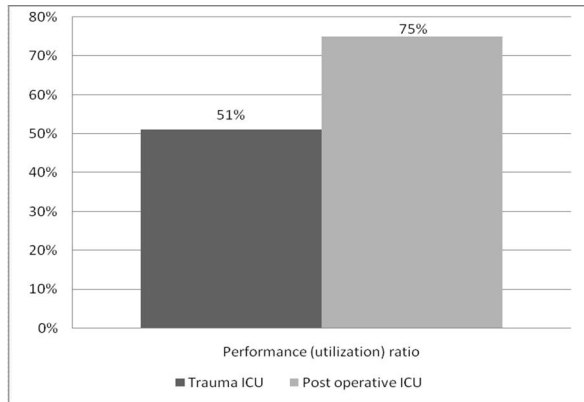
\*The difference is significant at  $P<0.05$ .**Table (4) Workload at trauma and post operative intensive care units for the period of data collection**

Variable	Trauma ICU (patients' days=1026)	Post operative ICU (patients' days=651)
Mean of workload ± SD per 24 hours	62.40 ± 11.20	54.17 ± 12.29
<b>T test</b>	13.82	
<b>P value</b>	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 (5) Mean time spent to provide care for one patient during 24 hours at trauma and post operative intensive care units for the period of data collection**

Variable	Trauma ICU (patients' days=1026)	Post operative ICU (patients' days=651)
Mean time ±SD per 24 hours	14.98 ± 2.69	13.00 ± 2.95
<b>T test</b>	13.82	
<b>P value</b>	0.000***	
Median time	15.17	12.98
Range of time	4.46-27.31	2.66-26.40

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



**Figure (1) Performance (utilization) ratio at trauma and post operative intensive care units for the period of data collection**

**Table (6) The correlation between workload & output ratio, cost ratio, and performance ratio at trauma and post operative intensive care units for the period of data collection**

Variable	Performance ratio	
	r	p
Workload	-1.000	0.00**

\*\* The correlation is significant at  $P < 0.01$ .

**Table (1)** illustrates that (75.9%) of trauma ICU patients were males compared to (63.1%) for patients of post operative ICU and the difference was statistically significant. As regards age distribution, it ranged from (1 to 69) years for trauma ICU and the mean was (31.52±16.41). In comparison, for the post operative ICU the age distribution ranged from (3 to 76) years and the mean was (39.80±17.56). The difference was statistically highly significant.

Regarding the causes of discharge for trauma and post operative ICUs the percentages of patients discharged were (12.5%, 45.5%, and 42.0%) compared to (24.3%, 50.5%, and 25.2%) as improvement, transfer, and death respectively, the difference was statistically significant.

**Table (2)** shows that most of trauma ICU patients length of stay highest percentage was (65.2%) for patients stayed less than 10 days while post operative ICU patients (87.4%) stayed in the unit less than 10 days,. As regards range length of stay for trauma and post operative ICUs patients it was (1-64 and 1-48 days) respectively. Regarding mean length of stay it was (10.82±11.25) for trauma ICU compared to (6.50±8.21) for post operative ICU. The difference was statistically highly significant.

**Table (3)** shows that nurses at trauma ICU was (30.9%, 20.6%, and 48.5%) for percentage of B.S.C. nurse and higher, associate degree in nursing, and diploma of secondary nursing school respectively.

For post operative ICU nurses' level of education was (4.3, 17.4, and 78.3%) for B.S.C. nurse and higher, associate degree in nursing, and diploma of secondary nursing school respectively. The difference was statistically significant. Regarding nature of work at both trauma and post operative ICUs the vast majority of nurses (86.8% and 95.7%) worked as bedside nurses (direct care) respectively and the difference was statistically insignificant.

For nurses years of experience at trauma ICU the highest percentage (51.5%) was for the group who had 5-9 years of experience, range (1 to 30) years while the mean was (7.65±5.19). In comparison, years of experience for post operative ICU nurses, the highest percentage was (30.4%) for the group who had 10-14 years of experience, the range was (1 to 21) years and the mean was (10.74±6.71). The difference was statistically significant.

**Table (4)** shows that the mean of workload was (62.40±11.20) for trauma ICU compared to (54.17±12.29) for post operative ICU patients. The difference was statistically highly significant. As regards the median of workload it was (60.89%) for trauma ICU patients and (53.23%) for post operative ICU patients. Moreover, workload range for trauma and post operative ICUs was (18.60-113.80 and 11.10-110.00) respectively.

**Table (5)** shows that the mean time spent to provide care for one patient during 24 hours was (14.98±2.69) for trauma ICU patients and (13.00±2.95) for post operative ICU patients. The difference was statistically highly significant. As regards median time it was (15.17 hours) for trauma ICU and (12.98 hours) for post operative ICU patients, while time range was (4.46-27.31 and 2.66-26.40) for trauma and post operative ICUs patients respectively.

**Figure (1)** illustrates that the performance ratio was (51% and 75%) at trauma and post operative ICUs respectively.

**Table (6)** shows that there was negative correlation between workload and productivity (output ratio, cost ratio, and performance ratio) at trauma and post operative ICUs.

**4. Discussion**

Critically ill patients require a high degree of acute care resources and nurses who have specialized knowledge and skills, necessitating education and preparation beyond their basic nursing degree to function competently (Penoyer, 2010; St-Pierre et al., 2011). The allocation of patients to a particular nurse can be done depending on the time required. This would help in optimizing both, the care offered for the patients as well as the number of nurses needed



to staff the ICU (**Raj et al., 2006; Irwin, and Rippe, 2008; Stone et al., 2008**).

High workload of nurses in intensive care units has been identified as a major patient safety and worker stress problem (**Beau, 2006; Mugisha and Namaganda, 2008; Hoonakker et al., 2011**). It is important to maintain an adequate, productive nursing workforce to the delivery of high-quality, cost-effective health care (**Letvak et al., 2012**).

The present study findings reveal that more than three quarters of trauma ICU patients and nearly more than two thirds of post operative ICU patients were males. As regards the age of trauma ICU patients, it ranged between one and sixty nine years, while the age of post operative ICU patients ranged between three and seventy six years with mean length of stay was about eleven days at trauma ICU, and about seven days at post operative ICU. Most common causes of discharge for trauma ICU patients were transfer to other unit or death for more than three quarters of patients. The cause of discharge at post operative ICU was transfer in about half of the patients, *table (1 and 2)*.

These findings are consistent with the findings of **Padilha et al. (2007)** study 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 who revealed that more than two quarters of patients were males and the mean age was about fifty years. **Padilha et al. (2010)** study who found that the mean length of stay in the ICU was twelve days.

On the other hand, the present study results contradict **Padilha et al. (2008)** study which reported that, the patients' age ranged between sixteen and ninety nine years and about fifty five percent were males. The average length of stay in the ICUs was about five days. In addition **Stafsetha et al. (2011)** study who revealed that the patients' mean age was about fifty years and the average patient length of stay was five days.

According to the present findings, as regards the educational level nearly half of trauma ICU nurses and more than three quarters of post operative ICU nurses had diploma of secondary nursing school. The vast majority of nurses at trauma and post operative ICU worked as bedside nurses (direct care). Also the findings show that the mean years of experience was about eight and eleven years for trauma and post operative ICUs nurses respectively, *(Table 3)*.

The current study findings are consistent with **Kandeel and Tantawy (2012)** study 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 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 **Gurses et al. (2009)** study 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.

From the findings of the present study, it appears that the mean of workload for trauma ICU patients was 62.4%, while post operative ICU patients had 54.2%, *(Table 4)*. The result of the study concluded that, patients workload at trauma ICU was higher than medium, this results may be due to the patients admitted to trauma ICU mostly had motor car accidents and need more care, while the workload was medium at post operative ICU may be due to the patients mostly were conscious and independent in most activities.

The results of the present study are almost consistent with **Silva et al. (2011)** study who revealed that the mean NAS was 61.92%. **Ducci and Padilha (2008)** study who found that mean NAS was 59.6%. **Padilha et al. (2010)** study who found that patients workload was 57.4%. **Debergh, et al. (2012)** study who revealed that nurses' workload per 24 hrs was 54.7 %.

However, these findings are dissimilar with the results of **Goncalves et al. (2006)** study who revealed that mean NAS was 69.3%. **Conishi and Gaidzinski (2007)** study which found mean NAS of 65.5%. **Dias (2006)** study which found that mean NAS was 74.62%. Moreover the current study contradict **Ducci et al. (2008)** study which found that mean NAS was 73.7%. **Padilha et al. (2008)** study revealed that NAS median was 66.4%. And also contradict with **Queijo and Padilha (2009)** study who showed that mean NAS was 67.2%. **Stafsetha et al. (2011)** study which found that each nurse is capable of performing an NAS of 75-90% per shift, depending on which unit is investigated.

As regards 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 trauma 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 post operative ICU it ranged from three to twenty six hours with mean of thirteen hours, *table (5)*.

The present study findings are consistent with **Raj et al. (2006)** study 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 productivity, the present study shows that performance ratio was fifty one percent and seventy five percent for trauma and post operative ICUs respectively, (*Figure 1*). The result of the study concluded that, nurses' performance at trauma ICU was medium, while it was high at post operative ICU.

The current study results are consistent with the findings of **Moreno and Miranda (1998)** study 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., (2004)** study which reported a target of eighty five percent (plus or minus five percent) unit productivity on a daily basis. Sustained productivity outside this range will result in higher costs and poorer quality of care.

The present study shows that there was a negative correlation between workload and productivity at trauma and post operative ICUs, *table (6)*. The result of the study concluded that, patients workload at trauma ICU was higher than medium, this results may be due to the patients admitted to trauma ICU mostly had motor car accidents and need more care, while the workload was medium at post operative ICU may be due to the patients mostly were conscious and independent in most activities. The result revealed that, nurses' performance at trauma ICU was medium, while it was high at post operative ICU.

The current study results are inconsistent with the findings of **Fako et al. (2002)** who revealed that workload was moderately related to nurses' productivity. In the same line **Eid et al. (2007)** who revealed that there was statistically significant correlation between delegation and nurse managers' productivity.

### Conclusions

**In the light of the study results, the following conclusions can be drawn:**

- More than three quarters of trauma ICU patients and nearly more than two thirds of post operative ICU patients were males. As regards mean length of stay it was about eleven days at trauma ICU, and about seven days at post operative ICU. Causes of discharge for trauma ICU patients were transfer to other unit or death for more than three quarters of patients. While at post operative ICU about half of patients' cause of discharge was transfer.
- Nearly half of trauma ICU nurses and more than three quarters of post operative ICU nurses had diploma of secondary nursing school. The vast majority of them worked as bedside nurses. The mean years of experience was about eight, and

eleven years for trauma and post operative ICUs nurses respectively. Mean salary was about one thousand and one hundred bounds for both trauma post operative ICUs nurses.

- Trauma ICU patients had about sixty percent of workload (nursing care given to the patient take about two thirds of the twenty four hours per day), while post operative ICU patients had more than fifty percent of workload.
- The mean time spent by one nurse to provide care for one patient during twenty four hours was about fifteen and thirteen hours for trauma and post operative ICUs respectively.
- Performance ratio was about fifty percent and seventy five percent for trauma and post operative ICUs respectively.
- There a negative correlation between workload and productivity at trauma and post operative ICUs.

### Recommendations

Based upon the study results, intensive care units must measure nurses' workload to maintain and improve productivity and quality of care. This can be achieved through the following suggested recommendations:-

1. Applying of nursing activities score (NAS) to retain nurses staffing, enhance productivity, and avoid waste of nurses' time.
2. Ensure that all nurses' efforts are concentrated to provide nursing care for patients.
3. Training should be provided for nurses and head nurses about nursing activities score, application and the value of its application.
4. Providing training program to improve nurses' performance, skills, and to avoid time waste.
5. Productivity should be measured annually by the head nurse through monitoring the performance of nurses and comparing it against productivity standards to identify areas for improvement and actions to be taken.
6. Head nurses must regularly inform staff with patient care results and productivity indices, to motivate them and to improve their skills.
7. A system of incentive schemes for ICU nurses should be adequately placed based on the results of measured workload to guarantee productivity improvement and to avoid time waste.

### Summary

Presence of nurses is important and necessary for providing high quality nursing care. Patients expect to receive high quality nursing care delivered from nurses who are satisfied with their work. The patient expectations mostly affected by nurses' workload. Workload can be defined as the time spent on patient care by health care worker

during a specific period of time. Adverse effects of nurses' workload on patients include: increased mortality, length of stay and severity of patient illness. The adverse effects on nurses include increasing job tension, decreasing job satisfaction and increasing the likelihood of turnover. Nurses are undergoing higher workloads due to reasons such as increased demand for nurses that will result in shortage of nurses and increase workload.

Productivity in nursing is an important topic because of its link with quality. Productivity is the ratio between input and output. Productivity in nursing care can be achieved by careful selection of personnel and proper staffing. Controlling labor input is an important productivity issue to measure requirements for nursing care and to schedule nursing personnel for meeting of patient's demand. Measurement of nursing workload is the sponsor for providing high quality nursing care and maintaining nurses' productivity in the accepted level. Nursing activities score is a validated method to measure nurses' workload and consequently the productivity can be measured using suitable formulas to calculate needed output.

The present study aimed to measure nurses' workload and identifies the impact of nurses' workload on nursing productivity. The study was carried out at trauma and post operative intensive care units (ICUs) at Assiut University Hospital.

The results of the present study revealed that: Trauma ICU patients had about sixty percent of workload (nursing care given to the patient take about two thirds of the twenty four hours per day), while post operative ICU patients had more than fifty percent of workload. Performance ratio was about fifty percent and seventy five percent for trauma and post operative ICUs respectively. There a negative correlation between workload and productivity at trauma and post operative ICUs.

In the light of the results of this study, the following recommendations are suggested: Applying of nursing activities score (NAS) to retain nurses staffing, enhance productivity, and avoid waste of nurses' time. Training should be provided for nurses and head nurses about nursing activities score, application and the value of its application. Productivity should be measured annually and comparing the results against productivity standards. Inform staff with patient care results and provide annual productivity indices for them.

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