

Patients' characteristics, occupancy rate and quality of performance of Emergency Intensive Care Unit at Zagazig University Hospital, Egypt: A descriptive Study

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Abstract

Background: Intensive care unit (ICU) consumes large amount of resources to manage critically ill patients. It is important to evaluate the Patients' characteristics, occupancy rate and quality of performance of the emergency ICU at Zagazig University Hospital, Egypt for optimization of resource allocation.

Patients and Methods: We analyzed the Patients' characteristics (Age, sex and the primary diagnosis at ICU admission), occupancy rate and quality of performance [length of stay (LOS), premature discharge, early readmission and mortality rate] of our emergency ICU between the 1st of May to 31st of October, 2018.

Results: The number of the admitted patients during the study period was 328. These admitted patients were 179 (54.6%) males and 149 (45.4%) females and their mean age of the patients was 62.54±11.73 years. The admitted patients were 135(41.2%) surgical cases and 193 (58.8%) medical cases. The overall mean occupancy rate was 92.6 %. The overall mean LOS was 224.4±71.57 hours. The overall premature discharge rate was 19.81%. The overall early readmission rate was 26.23%. The overall mortality rate was 38.41%.

Conclusion: This study revealed that: 1. The characters of the admitted patients to Emergency ICU at Zagazig University Hospital were as the following: 54.6% of them were males and 45.4% of them were females, their mean age was 62.54±11.73 years and 41.2% of them were surgical cases and 58.8% of them were medical cases. 2. Occupancy rate was high (92.6 %). 3. Bad quality of performance because of the relatively prolonged LOS, the relatively higher rates of premature discharge, early readmission and mortality.

Key Words: Early readmission; ICU occupancy; Length of stay; Mortality rates; Premature discharge; Quality of ICU performance

Introduction

A hospital intensive care unit (ICU) provides continuous surveillance and highly specialized care to critically ill patients, whose conditions are life-threatening and require comprehensive care. The resources in ICUs are limited and constitute an important part of hospital budgets.⁽¹⁾

Over-occupancy or strained ICUs is a routine occurrence and a growing concern throughout the world. It represents a supply-demand mismatch in the ICU resources.⁽²⁾ Occupancy of ICU is likely influenced by patient's length of stay (LOS) in ICU, the rate of patient's premature discharge, early readmission especially within 48 hours from discharge and mortality.⁽²⁾

LOS in ICU is one of the most important factors affecting occupancy rate. An ICU stay becomes "prolonged" on the day that the daily probability of being discharged first declines. Prolonged LOS is thought to reflect the ICU ability to treat and discharge low-acuity patients quickly. The importance of LOS as an indicator in the ICU process is that it can give an impact on resource utilization because ICU beds are almost limited in any hospital, so, rationalized use for needy patients is a necessity.⁽³⁾ Premature discharges (i.e. before clinically indicated) is common in high bed occupancy ICU.⁽⁴⁾ Premature discharge of patients with high Therapeutic Intervention Scoring System (TISS) scores increases mortality and it has been stated that 'premature' discharge is likely to worsen outcome. Premature discharge can increase mortality and this would be independent of the different TISS scores that were likely to occur.⁽⁵⁾

ICU readmission rates have been advocated as a marker of ICU quality on the basis that early readmissions (within 48 hours) may indicate premature discharge or discharge to an inappropriate clinical area. Moreover, ICU readmission rates affect ICU occupancy rate in a positive relationship.⁽⁶⁾ The reported ICU readmission rate ranged from 1.2 to 14.5% of ICU discharged patents and it was associated with increased mortality and more prolonged LOS.⁽⁷⁻⁹⁾

Strained ICU is associated with disturbed physician decision-making, refusal of or too late ICU admission, transferring patients to another facility, premature patient discharge, increased in-hospital mortality rates, increased night discharges, increased ward cardiac arrest rates and surgery cancellation.^(2,10) Generally, there are no standards dealing with admission requests in case of strained or fully occupied ICU. In this case, the opinion of intensivists can be used to improve decision-making regarding allocation of ICU resources though tailored to each instance.⁽¹¹⁾

The aim of this study was identification of patients' characteristics, occupancy rate and quality of performance of the 18 beds emergency ICU at Zagazig University Hospital, Egypt during six month period in order to put, in future, strategies for optimization of resource allocation.

Patients and methods

I. Technical design:

a. Site and duration of the study: This study was carried out in Emergency Intensive Care Unit at Zagazig University Hospitals, Egypt, over six month period from the 1st of May to 31st of October, 2018.

b. Sample size justification: The overall number of the admitted patients in Emergency Intensive Care Unit at Zagazig University Hospitals (according to its admission policy) over six month period from the 1st of May to 31st of October, 2018 was the sample size.

c. Type of the study: Prospective cross-sectional study.

d. Patients included in the study:

- ***Inclusion criteria:***

All the admitted patients in Emergency Intensive Care Unit at Zagazig University Hospitals (according to its admission policy) over six month period from the 1st of May to 31st of October, 2018 were included in this study.

- ***Exclusion criteria:***

Due to the observational nature of the present study, we did not restrict patients' eligibility in terms of any of their characteristics e.g. age, sex or cause of admission.

e. Ethical Statement:

- **Potential Risk:** The study did not have any physical, psychological, social, legal, economic, or any other anticipated risks to study's participants.
- **Participant's confidentiality:** The study conserved participants' privacy. Investigator was responsible for keeping the security of the the participants' data and not using them for any other purpose outside this study. Personal data (e.g. Name, Contact info) were not entered in data entry software to conserve the participants' privacy, however, each subject got a unique identifier code.
- **Informed consent process:** This study was descriptive in nature, for this reason an informed consent was not needed from the included patients or their relatives.
- **Institutional Review Board:** The study's protocol was reviewed and approved by IRB, faculty of medicine, Zagazig University. Also, this study was carried out according to the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

II – Study design:

The files of the admitted patients in Emergency Intensive Care Unit at Zagazig University Hospitals from the 1st of May to 31st of October, 2018 were inspected and the following data were detected and recorded:

1. The numbers of the admitted patients during the six month study period.
2. Patients demographic data (ages and sex) and the primary diagnosis at time of Emergency ICU admission.

3. The overall occupancy rate during the six month study period.

3. The monthly and the overall occupancy rates during the six month study period:

The monthly occupancy rate was calculated by dividing total LOS of all patients in each month in hours/Total capacity of the ICU at this month (No. of ICU beds x No. of days at this month x 24 hour) in a percentage.

The overall occupancy rate was calculated by dividing total length of stay (LOS) of all patients in six month study period in hours /Total capacity of the ICU at this six month study period (No. of ICU beds x No. of days of these six months x 24 hour) in a percentage. *The number of beds in the ICU of Emergency Hospital at Zagazig University* was 18 beds.

4. Quality of ICU Performance:

It is assessed by determining the following parameters:

a. The mean LOS of patient in Emergency ICU:

The mean LOS in Emergency ICU is the period per hours from the moment of admission to the moment of the discharge from ICU.

b. The overall premature discharge rates from Emergency ICU during the six month study period: Patient discharge was either planned i.e. fulfill all or premature not fulfill all the discharge criteria according to Emergency ICU protocol.

The discharge criteria according to Emergency ICU protocol are the following:

- Hemodynamically stable (off vasoactive drugs) for at least 12hrs.
- No evidence of active bleeding.
- Oxygen requirement is no more than FiO₂ 40% with SpO₂ >90%.
- Acceptable pH.
- Extubated for > 6-24 hrs with no evidence of upper airway obstruction.
- Appropriate level of consciousness to protect the airway or has tracheostomy.

c. The early readmission rates of patients in Emergency ICU at Zagazig University Hospitals during the six month study period.

d. APACHE II scores at initial Emergency ICU admission of early re-admitted patients and not-readmitted patients.

Acute physiology and chronic health evaluation II (**APACHE II**) score (**Tab. 1**) is a severity score and mortality estimation tool.⁽¹²⁾ It consists of 14 variables (12 physiologic, age, and chronic health). It is applied within 24 hours of admission of a patient to an ICU i.e. after getting the results of the requested laboratory investigations. The score is not recalculated during the stay. It is by definition an admission score. If a patient is discharged from the ICU and subsequently readmitted, a new APACHE II score is calculated. APACHE II score of ICU patient is equal the sum of acute physiology score, age points and chronic health points. Minimum score is 0; maximum score is 71. Increasing score is associated with increasing risk of hospital death. The worst value in the past 24 hours is chosen.

Table (1): APACHE II score.⁽¹²⁾

Physiologic variable ^b	Point score									
	+4	+3	+2	+1	0	+1	+2	+3	+4	
1 Temperature	≥41°	39–40.9°	–	38.5–38.9°	36–38.4°	34–35.9°	32–33.9°	30–31.9°	≤29.9°	
2 Mean arterial pressure (mm Hg)	≥160	130–159	110–129	–	70–109	–	50–69	–	≤49	
3 Heart rate	≥180	140–179	110–139	–	70–109	–	55–69	40–54	≤39	
4 Respiratory rate(non-ventilated or ventilated)	≥50	35–49	–	25–34	12–24	10–11	6–9	–	≤5	
5 Oxygenation:										
a) FiO ₂ ≥ 0.5: use A-aDO ₂	≥500	350–499	200–349	–	<200	–	–	–	–	
b) FiO ₂ < 0.5: use PaO ₂ (mm Hg)	–	–	–	–	>70	61–70	–	55–60	<55	
6 Arterial pH	≥7.7	7.6–7.69	–	7.5–7.59	7.33–7.49	–	7.25–7.32	7.15–7.24	<7.15	
7 Serum Na (mMol/L)	≥180	160–179	155–159	150–154	130–149	–	120–129	111–119	≤110	
8 Serum K (mMol/L)	≥7	6–6.9	–	5.5–5.9	3.5–5.4	3–3.4	2.5–2.9	–	<2.5	
9 Serum creatinine (mg/dL): double point score for acute renal failure	≥+++3.5	2–3.4	1.5–1.9	–	0.6–1.4	–	<0.6	–	–	
10 Hct (%)	≥60	–	50–59.9	46–49.9	30–45.9	–	20–29.9	–	<20	
11 WBC (in 1000s)	≥40	–	20–39.9	15–19.9	3–14.9	–	1–2.9	–	<1	
12 Glasgow coma score (GCS)	Score = 15 minus actual GCS									

Acute physiology score is the sum of the 12 individual variable points
 Add 0 points for the age <44.2 points. 45–54 years: three points. 55–64 years: five points. 65–74 years: six points ≥75 years
 APACHE II score = acute physiology score + age points + chronic health points. Minimum score = 0; maximum score = 71. Increasing score is associated with increasing risk of hospital death
 Add chronic health status points: two points if elective postoperative patient with immunocompromise or history of severe organ insufficiency; five points for nonoperative patient or emergency postoperative patient with immunocompromise or severe organ insufficiency^c
 13^d Serum HCO₃(venous-mMol/L) use only if no ABGs² ≥52 41–51.9 – 32–40.9 22–31.9 – 18–21.9 15–17.9 <15

Adapted from Knaus WA, Draper EA, Wagner DP, Zimmerman JB: APACHE II: A severity of disease classification system. *Critical care medicine* 13: 818–829. 1985.
 Interpretation of APACHE II scores (predicted mortality rate).
 0–4 = ~4% death rate 10–14 = ~15% death rate 20–24 = ~40% death rate 30–34 = ~75% death rate.
 5–9 = ~8% death rate 15–19 = ~25% death rate 25–29 = ~55% death rate Over 34 = ~85% death rate.

^a APACHE II Score = acute physiology score + age points + chronic health points. Minimum score = 0; maximum score = 71. Increasing score is associated with increasing risk of hospital death.
^b Choose worst value in the past 24 h.
^c Chronic health status: Organ sufficiency (e.g. hepatic, cardiovascular, renal, pulmonary) or immuno-compromised state must have preceded current admission.
^d Optional variable: use only if no ABGs.

Results

1. The number of the admitted patients to Emergency Intensive Care Unit at Zagazig University Hospitals during the six month study period (from the 1st of May to 31st of October, 2018) was 328.

2. Patients demographic data (ages and sex) and the primary diagnosis at time of Emergency ICU admission:

The overall mean age of the admitted patients was **62.54±11.73 years (Tab. 2)**.

The ICU admitted patients were **179 (54.6%)** males and **149 (45.4%)** females **(Tab. 2)**.

The admitted patients were 135(41.2%) surgical cases and 193 (58.8%) medical cases.

The primary diagnosis in surgical cases were polytrauma in 49 (14.9%) patients, intra-cerebral hemorrhage in 23(7%) patients, acute abdomen in 18 (5.5%) patients, multiple bone fractures in 13 (3.7%) patients, sub-arachnoid hemorrhage in 10 (3%) patients, sub-dural hemorrhage in 5 (1.5%) patients, eclampsia/pre-eclampsia in 9 (2.7%) patients, post partum hemorrhage in 6 (1.8%) patients and ovarian hyperstimulation syndrome in 2 (0.6%) patients **(Tab. 2)**.

The primary diagnosis in medical cases were post cardiac arrest in 52 (15.6%) patients, septic shock in 30 (9.1%) patients, cerebrovasculr accident in 28 (8.5%) patients, diabetic ketoacidosis in 16(4.9%) patients, acute renal failure in 16 (4.9%) patients, pneumonia in 14(4.3%) patients, post-ictal syndrome in 12(3.7%) patients, hepatic coma in 9 (2.7%) patients, pulmonary embolism in 8 (2.4%) patients, melena/haematemsis in 6 (1.8%) patients, thyrotoxic crisis in 1 (0.3%) patients and myxedema coma in 1 (0.3%) patients (**Tab. 2**).

Table (2): Patients' demographic data (ages and sex) and the primary diagnosis at time of Emergency ICU admission.

Category	N (%)
Overall mean age (years)	62.54±11.73
Sex: Males	179 (54.6%)
Females	149 (45.4%)
Primary diagnosis:	
<i>Surgical cases:</i>	135(41.2%)
- Polytrauma.	49(14.9%)
- Intra-cerebral hemorrhage.	23(07.0%)
- Acute abdomen.	18 (05.5%)
- Multiple bone fractures.	13(03.7%)
- Sub-arachnoid hemorrhage.	10 (03.0%)
- Sub-dural hemorrhage.	05(01.5%)
- Eclampsia/Pre-eclampsia.	09(02.7%)
- Post partum haemorrhage.	06(01.8%)
- Ovarian hyper-stimulation syndrome.	02(00.6%)
<i>Medical cases:</i>	193(58.8%)
- Post cardiac arrest.	52(15.6%)
- Septic shock.	30(09.1%)
- Cerebro-vascular accident (CVA)	28(08.5%)
- Diabetic ketoacidosis (DKA).	16(04.9%)
- Acute renal failure.	16(04.9%)
- Pneumonia.	14(04.3%)
- Post-ictal syndrome.	12(03.7%)
- Hepatic coma.	09(02.7%)
- Pulmonary embolism.	08(02.4%)
- Melena/Haematemsis.	06(01.8%)
- Thyrotoxic crisis.	01(00.3%)
- Myxedema coma.	01(00.3%)

The data are presented in the number and the percentage of patients in each category regarding to the overall number of the admitted patients during the study period.

3. The monthly and the overall occupancy rates in Emergency Intensive Care Unit at Zagazig University Hospitals during the six month study period:

Occupancy rates in each month of the six month study period from the highest to the lowest were 99.3% in June, 98.23% in August, 96.3% in July, 91.9% in September, 87.7% in October and 82.2 % in May (Tab. 3).

The overall mean occupancy rate in the six month study period was 92.6 % (Tab. 3).

Table (3): The monthly and the overall occupancy rates in Emergency Intensive Care Unit at Zagazig University Hospitals during the six month study period.

Period	Total LOS of all patient (hours)	Total capacity of the ICU (hours)	Occupancy rate (Total LOS/Total capacity) %
May	11012	13392	82.2%
June	12873	12960	99.3%
July	12900	13392	96.3%
August	13163	13392	98.3%
September	11908	12960	91.9%
October	11748	13392	87.7%
The whole six month study period.	73604	79483	92.6%

LOS= Length of stay in ICU

4. Quality of ICU performance:

a. The overall mean of length of stay of patient in Emergency ICU during the six month study period:

The overall mean LOS of patient in Emergency ICU at Zagazig University Hospitals during the six month study period was 224.4±71.57 hours (Tab. 4).

Table (4): The overall mean length of stay of patient in Emergency Intensive Care Unit at Zagazig University Hospitals during the six month study period.

Period	The length of stay (hrs) mean± SD.
The overall mean length of stay (hrs).	224.4±71.57

b. The overall premature discharge rates from Emergency ICU during the six month study period:

The overall premature discharge rate from Emergency ICU during the study period was 19.81%. (**Tab. 5**).

Table (5): The overall premature discharge rates from Emergency ICU at Zagazig University Hospitals during the six month study period.

Period	Number of ICU admitted patients	Prematurely discharged patients N (%)	Planned discharged patients N (%)
The whole six month study period	328	65 (19.81%)	137 (41.76%)

c. The overall early readmission rates of patients in Emergency ICU during the six month study period:

The overall early readmission rate in Emergency ICU in the whole study period was **26.23%** (53 out of allover 202 discharged patients) (**Tab. 6**).

The causes of early readmission were worsening of pre-existing conditions in 43 (54.4%) patients and new complications in 36 (45.6%) patients.

Table (6): The overall early readmission rates of patients in Emergency ICU during the six month study period.

Month	Number of ICU discharged patients	Early re-admitted patients N (%)	Non-readmitted patients N (%)
The whole study period.	202	53 (26.23%)	149(73.76%)

d. APACHE II scores at initial Emergency ICU admission of early re-admitted patients and not-readmitted patients:

Statistically, the mean of APACHE II scores at initial Emergency ICU admission of the early readmitted patients was significantly higher than that of not-readmitted patients (**Tab. 7**).

Table (7): APACHE II scores at initial Emergency ICU admission of early readmitted patients and non-readmitted patients.

	Early re-admitted patients (N=53) Mean± SD	Not readmitted patients (N=149) Mean± SD	t	p
APACHE II score at the initial ICU admission	26.69±3.84	19.51±4.33	5.89	0.00**

e. The overall mortality rates in Emergency ICU during the six month study period:

The overall mortality rate in Emergency Intensive Care Unit at Zagazig University Hospitals in the whole study period was 38.41% (**Tab. 8**).

Table (8): The overall mortality rates in Emergency ICU a during the six month study period.

Period	Number of ICU admitted patients	Number of ICU died patients	Mortality rate
The whole six month study period.	328	126	38.41%

f. APACHE II scores at initial Emergency ICU admission of died and survived patients:

Statistically, the mean of APACHE II score at initial ICU admission of the died patients was significantly higher than that of the survived patients (P= 0.00) (**Tab. 9**).

Table (9): APACHE II scores at initial Emergency ICU admission of died and survived patients.

	Died patients N=126 Mean± SD	Survived patients N=202 Mean± SD	t	p
APACHE II score	21.49±4.42	18.28±3.79	6.972	0.00 **

P ≤ 0.05 is statistically significant.

Discussion

The present study was of observational descriptive cross-sectional type. It was conducted on all the admitted patients in the emergency ICU unit of Zagazig University hospitals that contains 18 beds during six month period from the 1st of May to 31st of October, 2018.

In the present study, **54.6%** of the admitted patients (328 patients) between May and October 2018 in emergency ICU at Zagazig University Hospital were males and the overall mean age of all admitted patients was 62.54 ± 11.73 years.

These findings were nearly in agreement with some reported findings. **Cheng et al.**⁽¹³⁾ reported that, 60.9% of the ICU admitted patients were males and the overall mean age of all admitted patients was 65 ± 18 years. **Toptas et al.**⁽¹⁴⁾ reported that, 55.7% of the admitted patients (3925 patients) between January 2008 and December 2014 in Haseki ICU were males and their overall mean age of all admitted patients was 61.6 ± 18.9 years.

In the present study, the top 10 primary diagnoses of the 328 admitted patients from 1st of May to 31st of October 2018 in emergency ICU at Zagazig University Hospital were post cardiac arrest (15.6%), polytrauma (14.9%), septic shock (9.1%), cerebro-vascular accident (8.5%), intra-cerebral hemorrhage (7%), acute abdomen (5.5%), diabetic ketoacidosis (4.9%), acute renal failure (4.9%), multiple bone fractures (3.7%) and sub-arachnoid hemorrhage (3%). These present study findings were in partial agreement with other reported findings. **Wong et al.**⁽¹⁵⁾ reported that, the top 10 primary diagnoses of the ICU admitted patients (1,960) during 9,298 days were neuromuscular weakness, pneumonia, multiple traumas, septic shock, respiratory arrest, cardiac arrest, congestive heart failure, postoperative mechanical ventilation, airway protection or obstruction, and chronic obstructive pulmonary disease. **Cheng et al.**⁽¹³⁾ reported that, the top 10 primary diagnoses of the ICU admitted patients from March 2004 to February 2009 in Taiwan were ischemic heart disease, pneumonia, stroke, acute respiratory failure, septicemia, heart failure, chronic obstructive airway disease, liver cirrhosis, urinary tract infections and shock. **Toptas et al.**⁽¹⁴⁾ reported that, the top 9 primary diagnoses of the ICU admitted patients between January 2008 and December 2014 in Haseki ICU were multiple diseases (19.5%) as diabetes mellitus, hypertension, vasculitis, etc., cerebrovascular diseases (16.8%), gastrointestinal diseases (13%), respiratory disease (9.5%), cardiovascular diseases (9%), urogenital diseases (8.7%), musculoskeletal diseases (6.8%), hepatobiliary diseases (4.9%), and endocrine diseases (3.7%).

The discrepancy between the order types of primary diagnoses of the ICU admitted patients in the present and in the other studies was attributed to the difference in the length of the study period (six months in the present study, 5 years in **Cheng et al.**⁽¹³⁾ study and 6 years in **Toptas et al.**⁽¹⁴⁾ study), the difference in seasonal involvement (full 4 complete seasons were not involved in the present study, 5 times full 4 seasons in **Cheng et al.**⁽¹³⁾ study and 6 times full 4 seasons in **Toptas et al.**⁽¹⁴⁾ study), the difference in the number of the involved patients (328 in the present study, 1,028,364 in **Cheng et al.**⁽¹³⁾ study and **3925** in **Toptas et al.**⁽¹⁴⁾ study] and

the differences in the prevalence of the diseases between different countries.

In the present study, it was found that, the overall occupancy rate in the 18 beds emergency ICU at Zagazig University Hospital was 92.6 % and the monthly occupancy rates showed seasonal variations. The highest occupancy rates were in summer months (99.3% in June, 96.3% in July and 98.3% in August), the intermediate occupancy rates in Autumn months (91.9% in September and 87.7% in October) and the lowest occupancy rate was in spring month (82.2% in May) and the overall occupancy rate was 92.6 %.

Cheng et al.⁽¹³⁾ reported that, over 5 year study period (March 2004 to February 2009) the overall ICU bed occupancy rate was dependent on season and ICU location. According to the season, the overall ICU bed occupancy rate was highest (87.3%) in winter, followed by 84.3% in spring, 82.2% in autumn, and was lowest (81.5%) in summer and the average overall occupancy rate was 94.4%. According to the ICU location, the average ICU bed occupancy rate was 83.8%, with the highest of 94.4% in large medical centers, followed by 82.5% in regional hospitals, and the lowest is at 67.4% in district hospitals.

The discrepancy between the present study findings with **Cheng et al.**⁽¹³⁾ findings was attributed to the difference in the length of the study period (six months in the present study and 5 years in **Cheng et al.**⁽¹³⁾ study), the difference in the seasonal involvement (full summer, the 1st 2/3 of Fall, and the last 1/3 of spring in the present study and five times full 4 seasons in **Cheng et al.**⁽¹³⁾ study), the difference in the number of the involved patients (328 ICU patients in the present study and 1,028,364 ICU patients in **Cheng et al.**⁽¹³⁾ study) and the difference in the ratio of ICU beds per 100,000 inhabitants (nearly 1:250,000 in the present study and 1:100,000 **Cheng et al.**⁽¹³⁾ study).

In the present study, quality of emergency performance was considered bad because of the relatively prolonged LOS, the relatively higher rates of premature discharge, early readmission and mortality in comparison with the corresponding reported findings.⁽¹⁵⁻²³⁾

In the present study, the overall mean of LOS in emergency ICU was 224.4±71.57 hours and this LOS was relatively longer than LOS that was reported by some workers. **Wong et al.**⁽¹⁵⁾ reported that, the overall mean length of stay of the admitted patients (1,960) during 9,298 days was 4.74± 0.2 days (112.8 hours). **Cheng et al.**⁽¹³⁾ reported that, the overall mean length of stay in ICU varies. It was between 6.6 days (158 hours) in 2004 and 6.3 days (152 hours) in 2008. **Toptas et al.**⁽¹⁴⁾ reported that, the overall mean length of stay of the admitted patients (3925 patients) between January 2008 and December 2014 in Haseki ICU was 10.2 ± 25.2 days (244.8 hours).

The discrepancy between the detected LOS in the present study and those that have been detected by other workers was attributed to the difference in study period (six months in the present study, 9,298 days in **Wong et al.**⁽¹⁵⁾ study, 5 years in **Cheng et al.** study and 6 years in **Toptas et al.**⁽¹⁴⁾ study), the difference in number of the involved patients (328 ICU patients in the present study, 1,960 ICU patients in **Wong et al.** study, 1,028,364 ICU patients in **Cheng et al.** study and 3,925 patients in **Toptas et al.** study) and the difference in the

percents of the admitted patients with long stay diseases as cardiovascular diseases, multiple diseases, nervous system diseases and cerebro-vascular diseases.

In the present study, the detected overall mean premature discharge rate from emergency ICU was 18.6%. This was slightly higher than the rate (15%) which was reported by **Ofomaet al.**⁽¹⁶⁾, the detected overall mean early readmission rate (24.1%) was markedly higher than those reported (from 2.5 % to 7 %) by **Chen et al.**⁽¹⁷⁾, **Cooper et al.**⁽¹⁸⁾, **Rosenberg & Watts**⁽¹⁹⁾, **Tam et al.**⁽²⁰⁾, **Kareliusson et al.**⁽²¹⁾ and **Woldhek et al.**⁽²²⁾

In the present study, the causes of early readmissions were worsening of pre-existing conditions in 43 (54.4%) patients and the occurrence of new complications in 36 (45.6%) patients. These findings were in partial agreement with **Tam et al.**⁽²⁰⁾ reported findings. They reported that, the causes of early readmissions were worsening of pre-existing conditions (56.2%) and the occurrence of new complications (43.8%).

In the present study, the overall mean mortality rate was 38.4%. This rate was slightly lower than the rates which have been reported by some workers and markedly higher than the rates which have been reported by others. **Uysal et al.**⁽²³⁾ reported an overall ICU mortality rate was 43%. **Tam et al.**⁽¹⁴⁾ reported an overall mortality rate of 11.87% (380 out of 3202 admitted ICU patients). **Unal et al.**⁽²⁴⁾ reported an overall ICU mortality rate was 52.3%. **Weigl et al.**⁽²⁵⁾ reported that, a polish ICU mortality rate was 42% and European ICU mortality rate was ranged from 6.7 to 17.8%.

The differences between the present study findings regarding to premature discharge from ICU, early readmission rate and ICU mortality rate and the corresponding reported findings were attributed to the great difference in the number of the involved patients, lengths of study periods, policies of admissions and discharges of ICU patients and APACHE II scores at the initial times of ICU admissions, the differences in ICU admission and discharge criteria as well as treatment options in the wards. In practice, a 0 % early readmission rate is scarcely a realistic goal. However, our results indicate that among early readmitted patients are some in whom readmissions could have been avoided if their severity of illness had been more thoroughly assessed before discharge or if monitoring and treatment at the ward had been optimized. In view of this, we believe that the early ICU readmission rate could be decreased further, possibly by a more thorough assessment of the risk of readmission in all patients discharged, followed by a formalized Critical Care Outreach Service (CCOS) consultation in those at risk of early readmission.

In the present study, the mean of APACHE II scores at the initial ICU admission of the early readmitted patients was significantly higher than that of not readmitted patients. These findings were in agreement with some reported findings. **Kramer et al.**⁽⁸⁾, **Rosenberg and Watts**⁽¹⁹⁾, **Alban et al.**⁽²⁶⁾, **Campbell et al.**⁽²⁷⁾, and **Frost et al.**⁽²⁸⁾ reported that, the mean of APACHE II scores at the initial ICU admission of the early readmitted patients was significantly higher than that of not readmitted patients.

In contrast to the present study findings, **Tam et al.**⁽²⁰⁾ reported that, at the times of initial ICU admissions, **APACHE score** of the readmitted patients was matched with that of the non readmitted patients. This discrepancy between the present study findings and **Tam et al.**⁽²⁰⁾ findings was attributed to the great difference in the lengths of the study periods (6 months in the present study and 30-months in **Tam et al.**⁽²⁰⁾ study) and in the number of the admitted patients during the study period (328 in the present study and 3202 in **Tam et al.**⁽²⁰⁾ study).

The present study has some limitations. First, it is a single-center study that was performed in emergency ICU of the tertiary care zagazig University Hospital, Egypt. Therefore, the results of the present study may not be generalizable to other ICUs in other countries, because they have different healthcare systems, ICU admission and discharge criteria and patients characters. Second, it involved a relatively small number of patients (328 patients) with subsequent under power of the study. Third, it was a short study period (six months) that did not cover the all seasons of the year especially winter. Finally, early ICU readmission was defined as that occurring within 48 hours after ICU discharge but other workers defined it as that occurring within 72 hours or more after ICU discharge. Nonetheless, there is no consensus definition of early or late ICU readmission and therefore time definition of ICU readmission can vary markedly.⁽²⁹⁾

Conclusion

This study revealed that: **1.** The characters of the admitted patients to Emergency ICU at Zagazig University Hospital were as the following: 54.6% of them were males and **45.4%** of them were females, their mean age was **62.54±11.73 years** and **41.2%** of them were surgical cases and **58.8%** of them were medical cases. **2.** Occupancy rate was high (92.6 %). **3.** Bad quality of performance because of the relatively prolonged LOS, the relatively higher rates of premature discharge, early readmission and mortality.

Recommendations

From this study we recommend the following: i. Further studies to asses ICUs occupancy should be performed to overcome the rising demand to ICU admission, ii. Rationalization of ICU service to maximize it's efficiency and effectiveness, iii. Using strategies to compensate for shortages in ICU beds as increasing the number of physical and/or staffed/ICU beds, iv. Reduction of the delays in discharge from ICU to free up beds for other admissions and this leads to cost saving for the health care facility, v. Commitment to apply admission and discharge criteria or seeking consultant opinion when these criteria are not conclusive to obtain a clear clinical decision, vi. Intermediate care units may compensate the gap in care between the ICU and general wards and vii. Increasing efficiency of medical service in general wards by initiating Rapid Response Team to deal with time pressing situation.

Competing interests

The authors declare that they have no competing interests.

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