# The association between ICU occupancy rate and each of premature discharge, early readmission and mortality rate

**Adel Rizk Botros** (MD)*, **Ghada Mohamed Abd El Razik (MD),*  Khaled Mohammed Alanwer (MD),***
**Mohamed Mahmoud Mohamed Abd El salam (M.B.B.Ch.)****

\* Anesthesia & Surgical Intensive care department, Faculty of Medicine, Zagazig University, Egypt.
\*\* Shebein El kom teaching hospital, Egypt.

## Abstract

**Background:** Ocupancy of intensive care unit (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 rate. The aim of this study was evaluation of the *overall* occupancy rate of Emergency ICU at Zagazig University Hospitals, Egypt, during the six month study period and its association with each of premature discharge rate, early readmission rate and mortality rate.

**Patients and Methods:** The files of the admitted patients in Emergency ICU at Zagazig University Hospitals, Egypt, from the 1st of May to 31st of October, 2018 were inspected to evaluate the overall occupancy, premature discharge, early readmission and mortality rates and the association between occupancy rate and each of premature discharge, early readmission and mortality.

**Results:**  The overall occupancy rate was 92.6 %. The overall mean premature discharge rate was 18.6%, the overall mean early readmission rate was 24.1% and the overall mean mortality rate was 38.4%. Premature discharge, early readmission and mortality were associated with statistically significant higher occupancy rates than those associated with planned discharge, no readmission and survival. **Conclusion:** This study revealed that premature discharge, early readmission and mortality were associated with significantly higher occupancy rates than those associated with planned discharge, no readmission and survival.

**Key Words: Early readmission; ICU occupancy; Mortality rate; Premature discharge Corresponding Author Name**: **Mohamed Mahmoud Mohamed Abd El salam**
**Phone Number:**
**Email:**

## Introduction

Ocupancy 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.[1]

Premature discharges (i.e. before clinically indicated) is common in high bed occupancy ICU.[2] 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.[3] 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.[4] 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.[5-7] 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. [1,8]

The aim of this study was evaluation of the overall occupancy rate of Emergency ICU at Zagazig University Hospitals, Egypt, during the six month study period and its association with each of premature discharge rate, early readmission rate and mortality rate.

**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 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 overall occupancy rates during the six month study period:** The overall occupancy rate was calculated by dividing total 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 in 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. 2. The overall premature discharge rates:

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 $FiO_2$ 40% with $SpO_2$ >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.

3. The overall early readmission rate.

4. The overall mortality rate.

5. Association of occupancy rate with each of premature discharge, early readmission and mortality rates.

**Statistical analysis**

SPSS (Statistical Package for Social Sciences) version 22 for Windows® (IBM, SPSS Inc, Chicago, IL, USA). Quantitative data were expressed as mean ± SD (Standard deviation). Independent samples t-test was used to compare between two independent groups of normally distributed variables (parametric data).                **Results**

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

The overall mean occupancy rate in the six month study period was 92.6 % **(Tab. 1).**

**Table (1):** The overall occupancy rate in Emergency ICU at Zagazig University Hospitals during the six month study period.

| Period | Total LOS of all patients (hours) | Total capacity of the ICU (hours) | Occupancy rate (Total LOS/Total capacity) % |
|---|---|---|---|
| The overall occupancy rate | 73604 | 79483 | 92.6% |

LOS= Length of stay

**2. The overall premature discharge rate during the six month study period:**

The overall premature discharge rate from Emergency Intensive Care Unit at Zagazig University Hospitals in the whole six month study period was 19.81%. **(Tab. 2).**

**Table (2):** 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%)** |

**3. The overall early readmission rate 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. 3).**

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 (3):** The overall early readmission rates of patients in Emergency ICU at Zagazig University Hospitals during the six month study period.

| | Number of ICU discharged patients | Early re-ademitted patients N (%) | Non-reademitted patients N (%) |
|---|---|---|---|
| **The whole six month study period** | **202** | **53 (26.23%)** | **149 (73.76%)** |

**4. The overall mortality rates during the six month study period:**

The overall mortality rate in Emergency ICU at Zagazig University Hospitals in the whole study period was 38.41% **(Tab. 4).**

**Table (4):** The overall mortality rates in Emergency ICU at Zagazig University Hospitals 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%** |

5. Association of each of premature discharge, early readmission and mortality with occupancy rate:

Statistically, premature discharge, early readmission and mortality were associated with significantly higher occupancy rates than the occupancy rates that associated with planned discharge, no readmission and survival **(Tab. 5, 6 and 7 respectively).**

**Table (5):** Association of occupancy rate with premature discharge.

|  | Premature discharge N=65 Mean± SD | Planned discharge N=137 Mean± SD | t | P |
|---|---|---|---|---|
| **Occupancy rate (%)** | **94.25±5.25** | **92.94±5.39** | **2.214** | **0.021*** |

N= number of patient in each category.

**Table (6):** Association of occupancy rate with early readmission.

|  | Early readmission N=53 Mean± SD | No readmission N=149 Mean± SD | t-test | P |
|---|---|---|---|---|
| **Occupancy rate (%)** | **94.61±5.18** | **93.17±5.95** | **2.154** | **0.031*** |

**Table (7):** Association of occupancy rate with mortality.

|  | Mortality N=126 Mean± SD | Survival N=202 Mean± SD | t-test | P |
|---|---|---|---|---|
| **Occupancy rat (%)** | **94.48±5.34** | **92.88±6.17** | **2.477** | **0.014*** |

**Discussion**

Occupancy of ICU is likely to be influenced by multiple factors as length of patient stay (LOS) in ICU, premature patient's discharge, early readmission of patient especially within 48 hours from his discharge and mortality rate.[1] 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, the overall mean occupancy rate was 92.6 %, the overall mean premature discharge rate from emergency ICU was 18.6%, the overall mean early readmission rate was 24.1%, 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 and the overall mean mortality rate was 38.4%.

The detected occupancy rate of 92.6% revealed that, the emergency ICU unit of Zagazig University hospitals during this study period was over-occupied because **Tierney and Conroy** [9] reported that the optimal **ICU** occupancy rates were around 70-75%.

The detected premature discharge rate (24.1%) was near to the reported premature discharge rate **(15%)** by **Ofoma et al.**[10]

The detected early readmission rate in the present study was markedly higher than the early readmission rates (1.2 to 14.5%) that were reported by other workers.[5-7, 11, 12]

The detected causes of early readmissions were in agreement with Tam et al..[13] They reported that, the causes of early readmissions were worsening of pre-existing conditions (56.2%) and the occurrence of new complications (43.8%).

The detected mean mortality rate (38.4%) was slightly less than that (43%) reported by **Uysal et al..** [14] However, it was markedly higher than that [11.87% (380 out of 3202 admitted ICU patients)] reported by **Tam et al.**[13] and markedly less than that (52.3%) reported by **Unal et al..**[15] **Weigl et al.**[16] 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 monitor-ring 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, premature discharge, early readmission and mortality were associated with significantly higher occupancy rates than the occupancy rates that associated with planned discharge, no readmission and survival**.** These findings were in agreement with many reported findings. **Blayney et al.**[17] reported that, rates of premature discharge from ICU were greater in over-occupied ICU. Also premature discharge could be considered

indirectly a predisposing factor for ICU over-occupancy by increasing early readmission rate and further increase in occupancy rate. **Long and Mathews** [18] reported that, readmissions were greater in over-occupied ICU. Higher ICU occupancy was significantly associated with early readmissions.

**Lapichino et al.**[19] , **Chrusch et al.**[20] and **Cardoso et al.**[21] reported that, higher mortality rates were associated with higher occupancy rates.

In contrast to the present study findings, **Iwashyna et al.**[22] reported that, patients admitted at higher occupancy levels have the same odds of mortality or early discharge rates. The discrepancy between the present study findings and **Iwashyna et al**. findings was attributed to the time of assessment of ICU occupancy which was on admission with **Iwashyna et al**. **study** and on discharge with the present 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.[23]

**Conclusion**

This study revealed that premature discharge, early readmission and mortality were associated with significantly higher occupancy rates than those associated with planned discharge, no readmission and survival**.**

**Competing interests**
The authors declare that they have no competing interests.
**Funding**
The authors received no financial support for the research, authorship, and/or publication of this article.

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