

DISCUSSION

The speciality of critical care have developed with the recognition that patients with acute life-threatening illnesses or injuries were best treated in a geographically distinct area of the hospital, intensive care unit (ICU) is the designated location for the care of the sickest and most unstable patients in a given hospital ⁽²⁾.

The indications for admission to the ICU remain poorly defined and the identification of the ideal patient who can benefit from intensive care is extremely difficult. This fact and the expansion of clinical practice have led to the inappropriate use of ICU resources.

So, establishing guidelines for admission, discharge and triage of adult ICU patients is of utmost importance and is supported by literature. Providing guidelines based on relevant literature and expert opinion will lay down the ICU policy, procedures, and by laws. Subsequently appropriate utilization of ICU resources will lead to optimizing health care cost.

Because of the marked lack of published data about the utilization of health services indicators (quality indicators) in Intensive Care Units of developing countries in general and in Egypt in particular, this study was conducted in the Third ICU of Alexandria Main University Hospital aimed to assess health services utilization and thus can be used for optimizing the quality of care in the ICU. More specifically, this study aimed to determine admission and readmission rates to the studied unit during the period of the field work, to identify the main causes of admission to the studied unit, to identify the medical characteristics of admitted cases, to calculate the bed occupancy rate and the length of ICU stay among studied patients, and to identify the outcome of studied patients during the period of the field work.

This study was conducted in the Third Intensive Care Unit of the Department of the Critical Care Medicine of Alexandria Main University Hospital. It is a medical-surgical intensive care unit serving all the medical and surgical departments of Alexandria Main University Hospital. All records of patients admitted to the studied unit during the three months period of the field study- starting from the first of January 2014 to the end of March 2014- were followed up from admission till discharge from the unit in order to fulfill the study aim.

On studying **the demographic characteristics of the studied patients**, it was found that slightly more than half (51.2%) of them were females. As regard the age of studied patients, it was found that patients' age ranged from 1 to 85 years demonstrating both extremes of age among patients admitted to the studied unit. The mean age among the studied patients was 39.1 ± 24.7 years with more than one third of them (36.4%) were at or above 55 years of age and (11.6%) of them were below five years of age. The mean age of admitted patients is lower than that reported by Ashry et al, a study conducted in the same ICU during the year 2012, where the mean age among the studied patients was 44.42 ± 21.07 years and slightly more than half (52%) were males ⁽⁴⁰⁾. In respect to the residence of studied patients, about three quarters (76%) of them were living in Alexandria governorate, also there were cases from other governorates representing (24%) of cases as the Main University Hospital is a tertiary care hospital serving mainly the referred

complicated cases from multiple governorates mainly Alexandria, El-Behira, Matrouh, Kafr El-Sheikh (table 2).

The Third ICU is a medical-surgical ICU serving the different departments of the Main University Hospital which is a tertiary care facility. This explains the marked variety in the **primary causes of admission** to the ICU which included medical (48.7%), toxicological (32.2%) , traumatic (15.7%), and surgical(3.3%) causes (table 3) and this is similar to the study conducted by Ashry et al, in the same unit during the year 2012, where the causes of admission were mainly medical, traumatic, and toxicological causes⁽⁴⁰⁾.

Patients with **chronic health problems** are more prone to be hospitalized and admitted in an ICU as a result of acute exacerbation of their problems or due to the related complications. This can explain the suffering of less than half (45.5%) of admitted patients from chronic health problems (fig.5), and about two third (67.2%) of those patients were suffering from multiple comorbid conditions (as DM, hypertension, underlying lung and heart diseases) (table 4). This is in agreement with WHO report in 2010 which stated that non communicable diseases are considered the main leading cause of death and ill-health in developed countries and their prevalence is rising markedly in the rest of the world⁽¹¹⁰⁾.

As regard the utilization of ICU resources, it was noticed that there was a high utilization of resources in the Third ICU of Alexandria Main University Hospital manifested as high bed occupancy rate, average daily census, bed turnover rate, average length of stay, as well as other services offered in the ICU such as mechanical ventilation and use of antimicrobial treatment. This high utilization may directly affect the outcome of admitted patients and may in turn be a cause of inappropriate discharge and as a consequence may lead to unplanned readmissions.

The **length of stay** observed among the studied patients varied greatly from one patient to another as it ranged from one to 66 days with a mean of 7.17 ± 10.83 days, depending on their health condition. Furthermore, it was found that about one third (33.9%) of studied patients stayed less than two days duration, while (11.6%) of them stayed for a period of fifteen or above days which is considered a prolonged length of stay (table 5). Although, patients with prolonged ICU stay form a small proportion of ICU patients (11.6%), they are expected to consume a significant proportion of ICU resources. This prolonged stay may be due to the underlying health problem of those patients. This is consistent with the results of a study carried out during the year 2002 in Saudi Arabia, to evaluate the impact of prolonged ICU stay on resources utilization, where patients with prolonged ICU stay formed only 11% of admitted patients, but utilized 45.1% of ICU days, and 55.5% of mechanical ventilation days⁽⁴²⁾.

As regard the **relation between age and length of stay** in the studied unit, it was found that the highest mean length of stay (15.43 ± 17.02) days was found at age group (75-85)years, while the mean LOS (3.71 ± 6.32)days, was found at the age group below five years, which means that the older the age, the more prolonged duration of stay, this is statistically significant ($P=0.009$), (table 6). This is parallel with the fact that older age groups needs a more prolonged periods to recover from their illnesses. A similar study done by Frezza et al, noted that older patients stayed longer in the medical and surgical ICUs, compared to younger age groups⁽¹¹¹⁾, however, Ely et al, found that after adjusting for severity of illness, the length of stay in the ICU did not differ between the elderly and young ages⁽¹¹²⁾.

On studying the **relation between length of stay and the presence of comorbid conditions**, it was found that the mean LOS among patients with comorbid conditions was (9.24 ± 11.43), and the mean LOS among patients without comorbid conditions was (5.44 ± 10.07), (table 7), this means that patients with comorbid conditions have higher length of stay than patients without comorbid conditions, which is considered statistically significant difference ($P < 0.001$). This means that the presence of comorbid conditions directly affects the length of stay in the studied unit. This is consistent with the results reported by Nseir et al, during the year 2005, where the presence of renal and cardiac failure at the time of ICU admission was associated with prolonged ICU stay and higher hospital mortality⁽¹¹³⁾.

As regard the **need for mechanical ventilation**, it was found that slightly more than half (51.2%) of studied patients needed mechanical ventilation (figure 8). The duration of mechanical ventilation required by the studied patients varied greatly from one patient to another as it ranged from 1 to 61 days with a mean of 9.56 ± 11.43 days depending on their health condition. Furthermore, it was found that less than half (45.2%) of patients who needed mechanical ventilation were on mechanical ventilation for a period less than five days (table 8), and this is in agreement with the policy of trying weaning from mechanical ventilation as fast as possible recommended by the critical care consultants worldwide^(114,115) and adopted in the studied unit. These results are nearly similar to the results of the study carried out in the same unit during the year 2012, as the duration of mechanical ventilation ranged from 1 to 66 days with a mean duration of 10.3 ± 11.3 days⁽⁴⁰⁾.

As regard the **relation between age and need for mechanical ventilation** in the studied unit, it was found that the need for mechanical ventilation was higher among older age groups, which was found to be (50%) among patients aged 55 or above years, while the need for mechanical ventilation below five years of age represent 3.2% of patients needed mechanical ventilation (table 9), representing a statistically significant association as the need for mechanical ventilation increases with increasing age ($P = 0.004$).

As regard the **relation between the presence of comorbid conditions and the need for mechanical ventilation**, it was found that (62.9%) of studied patients with comorbid conditions needed mechanical ventilation, this represents a statistically significant association ($P < 0.001$) as most patients with comorbid conditions needed mechanical ventilation (table 10).

As regard the **prescription of antimicrobial treatment** in the Third ICU, it was found that more than half (60.3%) of admitted patients received antimicrobial treatment (figure 10). Antimicrobials in the ICU are either prescribed as a prophylactic or therapeutic treatment. Empirical antimicrobial use in the ICU is guided by the Therapeutic Guidelines: Antibiotic version 14,2010⁽¹¹⁶⁾.

On studying the **outcome** of the studied patients, it was found that only (3.3%) of cases were discharged from hospital after improvement of their condition, and more than half (59.6%) of the admitted patients were referred to other departments of the hospital, and (8.3%) of cases were discharged upon request of their families while (28.9%) of cases died, (table 11).

As regard the **relation between age and outcome** in the studied unit, it was found that the mortality rate was higher among older age groups than among young age groups

which represents a statistically significant difference between both extremes of age ($P=0.001$), (table 12). Conflicting results have been reported from many studies about the association between age and mortality outcome, for example, Zilberberg and Epstein⁽¹¹⁷⁾ found that age is an independent predictor of death ($p<0.001$), while Ely et al⁽¹¹²⁾, found no association between age and mortality outcome.

On studying the **relation between length of stay and outcome**, it was found that the mortality rate was highest (54.5%) among patients stayed for a period 10 to less than 15 days, and was lowest (15.2%) among those stayed for a period 2 to less than 5 days (table 13). The relation between length of stay and the mortality outcome is statistically insignificant ($p=0.065$) and this may be attributed to the severity of patients' illness, and the associated co-morbidities.

The **average daily census** was defined as the average number of inpatients treated during a given period of time⁽¹⁰⁶⁾. It is calculated as the total number of inpatient service days during each month of the field work divided by the total number of days of each month. It was found that the average daily census during January 2014 was (13.26 patients served per day) which was the highest census during the three months period of the field work compared to the average daily census found during February (8.7 patients served per day), and that found during March (5.8 patients served per day). This is because the ICU contained more beds during January and served more patients than during February and March, also because patients admitted during January were found to have a longer duration of stay in the ICU in comparison to the other patients admitted during the rest of the field work period.

In respect to the inpatient **bed occupancy rate**, it was defined as the percentage of official beds occupied by the ICU patients for a given period of time⁽¹⁰⁷⁾. It was calculated during every month of the study period which was found to be (88.4%) during January, (124.5%) during February, and (83.4%) during March. The reason for the high bed occupancy rate during February which exceeds a hundred percent (100%) and was the highest percent noticed during the field work period was attributed to the high **bed turnover rate** during the same month (6 patients/month), which was mainly due to the reduction of the total number of beds occurred during this month as the number of beds were reduced from fifteen to seven beds. The bed turnover rate during January was (2.8 patients/month), and that during March was (4.9 patients/month). This is different from what was reported in a study conducted in 97 ICUs in United States from the year 2005 to the year 2007, founded that the total ICU occupancy rates ranged from 57.4% to 82.1%⁽¹¹⁸⁾.

As regard the **mortality rate** that was observed during the field work period, it was noticed that the **gross death rate** was more than quarter (28.9%) of cases admitted during the field work period, the **net death rate** (20.4%) was also calculated in order to exclude deaths that occurred during the first 48 hours where the unit was not responsible of them because of inadequate duration to manage them. These results are nearly similar to a study carried out during the year 2010 in the respiratory ICU at Zagazig University Hospital, where the mortality rate was (30.5%)⁽³⁹⁾. As regard the mortality outcome in developed countries, there was a study carried out in a sample of 69 ICUs in United States reported in year 2014, an average annual ICU mortality of (10.8%) was reported⁽¹¹⁹⁾. This reported low mortality rate was attributed to the daily plan of care review and the low bed-to-nurse

ratio. While the high mortality rate reported in Egypt in particular and in developing countries in general, was probably attributed to the lack of resources and the inappropriate use of available resources.

The **readmission rate** was defined as the readmission to the ICU within 24 hours of transfer during a single hospital stay ^(81,82). It was found that only two cases representing (1.7%) of studied patients needed readmission which is considered to be low indicating that cases are discharged from the unit only after being physiologically stabilized. Also, low readmission rate is an indicator of post ICU care for patients referred to other departments in the hospital. The cause of readmission was related to the primary cause of admission in both cases. Little is known regarding the epidemiology of ICU readmissions in the United States: how commonly they occur, when, and where they occur, or whether rates have changed over time. Past studies in small numbers of ICUs, in Brazil during the year 2009, using heterogenous definitions of ICU readmission have estimated rates from 4.6-13.4%⁽⁸⁷⁾.

SUMMARY

Intensive care unit (ICU) or critical care unit (CCU) is a special department of a hospital or health care facility that provides intensive care medicine. Intensive care units cater to patients with the most severe and life threatening illnesses and injuries, which require constant, close invasive monitoring and support from specialist equipment and medication in order to ensure normal body functions⁽²¹⁾.

The current study aimed to assess the curative services utilization in the Third ICU of the Critical Care Medicine Department in Alexandria Main University Hospital. The study specific objectives aimed to determine admission and readmission rates to the studied unit during the period of the field work, to identify the main causes of admission to the unit, to identify the medical characteristics of admitted cases. Moreover, this study aimed to calculate some of the quality indicators as bed occupancy rate, the length of ICU stay among studied patients. Also, to identify the outcome of the studied patients, in order to fulfill the study general objective.

This study was conducted in the Third Intensive Care Unit of the Department of the Critical Care Medicine of Alexandria Main University Hospital. It is a medical-surgical intensive care unit serving all the medical and surgical departments of Alexandria Main University Hospital. All records of patients admitted to the studied unit during the three months period of the field study- starting from the first of January 2014 to the end of March 2014- were followed up from admission till discharge from the unit in order to fulfill the study aim.

Results of the present study were presented in five sections:-

Section 1: description of the demographic characteristics of the studied patients:

The present study included a total of 121 patients. The mean age of the studied patients were 39.1 ± 24.7 years, 51.2% were females and 48.8% were males, 76% of studied patients were living in Alexandria governorate and 24% were from other governorates.

Section 2: description of the medical characteristics of the studied patients:

The causes of admission to the studied unit were mainly toxicological, acute respiratory distress syndrome (ARDS), road traffic accidents, and cardiovascular diseases presented as (32.2%, 14.9%, 12.4%, 10.7% respectively).

Only 55 (45.5%) of studied patients were suffering from chronic health problems. About two third (67.2%) of those patients were suffering from multiple comorbid conditions (as DM, hypertension, underlying lung and heart diseases).

Section 3: description of ICU admission of studied patients including length of ICU stay, need and duration of mechanical ventilation, prescription of antimicrobial treatment:

- **length of ICU stay:**

The length of stay in the studied unit ranged from 1-to-66 days with a mean duration of 7.17 ± 10.83 days and a median of 3 days.

- a. Relation between age and length of stay:**

The mean LOS (15.43 ± 17.02) among age group (75-85) years was significantly higher than the mean LOS (3.71 ± 6.32) below five years of age. ($p=0.009$).

- b. Relation between length of stay and presence of comorbid condition:**

Patients with comorbid conditions have a mean length of stay of (9.24 ± 11.43) days and a median of 6 days which was statistically significant ($p < 0.001$) compared to the mean length of stay (5.44 ± 10.07) days and the median of 2 days among patients with no comorbid conditions.

- **Need and duration of mechanical ventilation:**

Slightly more than half (51.2%) of studied patients needed mechanical ventilation. The mean duration of mechanical ventilation was 9.56 ± 11.43 days with a minimum duration of one day and a maximum of 61 days.

- a. Relation between age and need for mechanical ventilation:**

The need for mechanical ventilation was significantly associated with age ($p=0.006$) as the need for mechanical ventilation was (50%) in the age group (55-85) years, compared to the (3.2%) need below the age five years.

- b. Relation between presence of comorbid condition and need for mechanical ventilation:**

The need for mechanical ventilation among patients with comorbid conditions was (62.9%), while the need for mechanical ventilation among patients without comorbid conditions was (37.1%), this was considered statistically significant ($p < 0.001$).

- **Prescription of antimicrobial treatment:**

From the studied patients, 73 patients (60.3%) received antimicrobial treatment during their stay in the studied unit.

Section 4: description of the outcome of studied patients:

From the 121 patients admitted to the studied unit, 72 patients (59.6%) were referred to other departments in the hospital after stabilization of their condition, 35 patients (28.9%) died, 10 patients (8.3%) discharged from the hospital upon request of their families and against medical advice, only 4 patients (3.3%) discharged from the hospital after improvement of their condition.

a. Relation between age and outcome:

The highest mortality rate (59.1%) among the studied patients was encountered among those aged 55 to less than 65 years, followed by (45.4%) among those aged 5 to less than 15 years, while the mortality rate among those age 75-85 years was (42.9%), and no mortalities were encountered among those aged 15 to less than 25 years. Increasing age was significantly associated with the mortality outcome of studied patients where $p=0.001$.

b. Relation between length of stay and outcome:

The highest mortality rate (54.5%) was encountered among patients with a length of stay 10 to less than 15 days, followed by (50%) among patients with a length of stay 15 to less than 20 days, and was the least (15.2%) among patients with a length of stay 2 to less than 5 days. This represents insignificant relation between length of stay and mortality outcome of studied patients where $p=0.065$.

Section 5: description of the health services utilization indicators:

The average daily census during January was 13.26 patients served/day, during February was 8.7 patients served/day, and during March was 5.8 patients served/day.

The bed occupancy rate during January was 88.4%, during February was 124%, and during March was 83.4%.

The bed turnover rate during January was 2.8 patients/month, during February was 6 patients/month, and during March was 4.9 patients/month.

The total length of stay for all patients admitted to the ICU during the period of the field work was 863 days with an average LOS of 7.17 days.

The gross death rate for the admitted patients during the field work period was 28.9%, and the net death rate was 20.4%.

The readmission rate during the field work period was 1.7%.

CONCLUSION

The following could be concluded from the present study:

- The prevalence of chronic illnesses was considered high and the majority of them suffered from multiple comorbid conditions .
- The mean length of stay in the studied unit was considered high, which significantly affected the bed occupancy in the ICU.
- The reduction in the number of beds during the entire period of the field work directly affected the bed occupancy rate and the bed turnover rate.
- Mechanical ventilation is one of the major services offered in the ICU, where the majority of admitted patients needed mechanical ventilation, also, the mean duration of mechanical ventilation was considered high.
- Prescription of antimicrobial treatment in the unit was high, as it was prescribed to the majority of admitted cases.
- The readmission rate to the unit was considered low, which reflects that patients were not discharged from the unit unless they were physiologically stabilized.
- The death rate in the studied unit was considered high. It was comparable to that reported from other developing countries, in contrast to that reported in developed countries, also the death rate among older age groups was higher than among young age groups.
- The bed occupancy rate and the bed turnover rate in the studied unit were considered high due to the limited number of beds in the unit, also due to the fact that Alexandria Main University Hospital is a tertiary care hospital and receives a lot of critically ill patients from multiple other hospitals and governorates.
- The presence of chronic illnesses significantly affected the length of stay and the need for mechanical ventilation in the studied unit.