

# Demographic Factors of Patients who Died in the ICU in Relation to the time of Death

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## ABSTRACT

**Background:** There are various reports on the mortality and morbidity of hospitalization in ICUs.

**Aim:** To evaluate demographic factors of patients who died in the ICU and its relation with time of death in 2014.

**Methods:** The present cross-sectional study used census sampling to investigate the medical records of all the patients who were hospitalized in the ICU of RasoolAkram Hospital in 2014 and then died in the unit. The demographic data of each patient was extracted from his records, including items on age, gender, unit of hospitalization, time of death, duration of hospital stay, cause of the disease, duration of CPR and the number of code announcements. The unit records were used to extract the mean number of employees in each unit, the number of beds in each ICU and the number of patients who died in each shift. The data obtained were then analyzed by SPSS-16.

**Results:** The present study examined 425 patients. The median time of death was 11:30 (IQR: 10), and 31.8% of the deaths had occurred in the morning shift, 23.1% in the afternoon shift and 45.2% in the night shift. The median duration of hospital stay was 10 days (IQR: 15). The number of resuscitations was reported as 1 (IQR: 2) and the median duration of CPR was 45 minutes (IQR: 15). A total of 41.2% of the patients were hospitalized in the BICU, 22.6% in the MICU, 22.6% in the SICU, 7.8% in the PICU and 5.9% in the NICU.

**Conclusion:** The number of deaths was significantly higher in the night shift than that of in the morning and evening shifts. In the BICU ward, although the number of shift nurses was higher in the morning, however mortality rates were higher in the morning shift. Cause of intensive care unit admission following burns, intracerebral hemorrhage, pneumonia, trauma, stroke, brain tumor, cardiac arrest, kidney failure, there were liver failure, breast cancer, and more.

**Keywords:** Demographic factors, ICU, death

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## INTRODUCTION

DESPITE medical advances in patient management, intensive care unit (ICU) mortality remains high with large variations according to patient case mix and organization of care. Mortality is a major end point in epidemiologic and interventional studies in the ICU. However, the causes of death are poorly reported. In adult surgical patients, the mortality rate is largely attributed to multi-organ dysfunction, while withholding and withdrawal of treatments are reported as the main cause of death in the ICU in pediatric patients. There are different reports on the mortality rate and complications associated with ICU admission. Researchers disagree over the reasons for ICU mortality and the relationship between the duration of ICU stay and its complications, and also over the types of complications that could increase or decrease as the duration of hospital stay increases. Several studies have investigated the factors contributing to ICU mortality. Requiring more than 14 days of ventilation in the ICU, being over age 65, having experienced septic shock, suffering from cardiovascular or kidney diseases and developing nosocomial infections were found to increase the risk of ICU mortality<sup>1,2</sup>. The most common causes of ICU admission include car accidents. Traumas can also lead to ICU admission for various reasons<sup>3</sup>.

Hospital mortality is associated with the quality of the health care team's performance, on the one hand, and the type and intensity of the disease and factors such as age

and the spread of chronic diseases in the community on the other. In addition, patients admitted to ICUs have different diseases and may be heterogeneous in this regard and hospital policies affect patient admissions, as well<sup>4</sup>. Recording and investigating the events occurring in the ICU and the conditions in these units appear essential, especially given the high costs of ICU admission and the urgency of the patients' conditions in the ICU. Given the limited number of studies on the subject and the importance of reducing ICU mortality rates, the present study was conducted to investigate the demographic factors of patients who died in the ICU in relation to their time of death in 2014.

## MATERIALS AND METHODS

The present deceptive cross-sectional observational study used census sampling to investigate the medical records of all the patients (n=425) who were hospitalized in the ICU of RasoolAkram Hospital in 2014 and then died. Incomplete file information was excluded. Demographic data were extracted by one of the researchers from each patient's records and were then entered into a checklist, including items on age, gender, unit of hospitalization, time of death, duration of hospital stay, cause of the disease, duration of CPR and the number of code announcements.

The unit records were used to extract the mean number of employees in each unit, the number of beds in each ICU and the number of patients who died in each

shift. The data obtained were then analyzed by SPSS-16 using descriptive statistics such as mean, standard deviation and frequency distribution to report the descriptive variables.

## RESULTS

A total of 38.1% of the patients (n=162) were female 61.9% (n=263 persons) were male. According to the one-sample KS test, age was the only variable that had a normal distribution in this study. According to the results of the descriptive statistics, the mean age was 46.12 years (SD: 26.84) for the entire sample of patients, 45.98 (SD: 27.98) for the female patients and 46.12 (SD: 26.18) for the male patients. The median time of death was 11:30 (IQR: 10). Dividing the death rates by shift showed that 135 (31.8%) of the patients died in the morning shift (i.e. from 7:30 to 13:30), 98 (23.1%) in the afternoon shift (i.e. from 13:30 to 19.30) and 192 (45.2%) in the night shift. The median duration of hospital stay was 10 days (IQR: 15).

The median number of resuscitations was 1 (IQR: 2). The median duration of CPR was 45 minutes (IQR: 15). Of the total of 425 deaths in the ICUs of the examined hospital, 41.2% (n=175) occurred in the BICU, 22.6% (n=96) in the MICU, 22.6% (n=96) in the SICU, 7.8% (n=33) in the PICU and 5.9% (n=25) in the NICU. Table 1 presents the frequency distribution of the ICUs where the patients died. Of the 425 cases examined, 41.4% of the patients (n=175) were admitted to the ICU due to burns, 8.5% (n=36) due to intracerebral hemorrhage, 6.4% (n=27) due to acute abdomen, 5.6% (n=24) due to pneumonia, 4.9% (n=21) due to sepsis, 3.29% (n=14) due to prematurity, 3.1% (n=13) due to trauma, 2.4% (n=10) due to stroke, 2.4% (n=10) due to brain tumor, 2.1% (n=9) due to heart attack, 1.9% (n=8) due to COPD, 1.9% (n=8) due to blood cancer, 1.4% (n=6) due to kidney failure, 1.2% (n=5) due to liver failure, 0.5% (n=2) due to breast cancer and 9.9% (n=42) for other reasons. Table 2 presents the frequency distribution of the causes of ICU admission in the deceased cases.

The results of the Chi-square test showed significantly different mortality rates among the morning, afternoon and night shifts, as the highest rate of mortality occurred in the night shift, followed by the morning shift, and the afternoon shift had the lowest rate of mortality ( $P < 0.001$ ). The number of nurses in the MICU was 4 during all the shifts, and the number of nurse assistants was 3 during the morning shift and 2 during the afternoon and the night shifts. There were 12 beds in the MICU. The mortality rate in this unit was 19(19.8%) in the night shift, 19(19.8%) in the afternoon shift and 58(60.4%) in the morning shift. The number of nurses working in the NICU was fixed (n=2) in the morning, afternoon and night shifts and the number of nurse assistants was also fixed (n=1) in all the shifts. The number of beds in this unit was 18. The mortality rate in the NICU was 4(16%) in the morning shift, 6(24%) in the afternoon shift and 15(60%) in the night shift.

The number of nurses working in the SICU was fixed (n=4) in all the shifts; however, 3 nurse assistants were working in the morning shift and 2 in the afternoon and night shifts. There were 12 beds in the SICU. The mortality rate in this unit was 26(27.1%) in the morning shift, 31.3% (n=30) in the afternoon shift and 40(41.7%) in the night

shift. The number of nurses was fixed (n=2) in the PICU in the morning, afternoon and night shifts and 1 nurse assistant was working in each of the shifts. There were 7 beds in the PICU. The mortality rate in the PICU was 33.3% (n=11) in the morning shift, 18.2% (n=6) in the afternoon shift and 48.5% (n=33) in the night shift. The number of nurses in the BICU was 9 in the morning shift and 5 in the afternoon and night shifts. The number of nurse assistants was 5 in the morning shift and 2 in the afternoon and night shifts. The BICU had 11 beds and the mortality rate in this unit was 42.9% (n=75) in the morning shift, 21.2% (n=37) in the afternoon shift and 36% (n=63) in the night shift.

**Table 1.** The frequency distribution of the ICUs where death occurred

ICU	Number (Percentage)
BICU	175(41.2%)
MICU	96(22.6%)
SICU	96(22.6%)
PICU	33(7.8%)
NICU	25(5.9%)

**Table 2.** The frequency distribution of the causes of ICU admission

Cause of ICU Admission	Number (Percentage)
Burns	175 (41.4%)
Intracerebral Hemorrhage	36 (8.5%)
Acute Abdomen	27 (6.4%)
Pneumonia	24 (5.6%)
Sepsis	21 (4.9%)
Prematurity	14 (3.29%)
Trauma	13 (3.1%)
Stroke	10 (2.4%)
Brain Tumor	10 (2.4%)
Heart attack	9 (2.1%)
COPD	8 (1.9%)
Blood Cancer	8 (1.9%)
Kidney Failure	6 (1.4%)
Liver Failure	5 (1.2%)
Breast Cancer	2 (0.5%)
Other	42 (9.9%)

## DISCUSSION

The present descriptive cross-sectional study investigated the medical records of 425 patients who died in the ICUs of Rasool Akram Hospital in 2014. The intensive care unit is one of the specialized departments in hospitals that provide special care and treatment services. In this ward, patients are regularly monitored and the required treatments are performed<sup>5-9</sup>. Abrishmakar et al. (2004) reported the highest rate of mortality (40.9%) in patients aged 40-60<sup>10</sup>. In one study, the duration of hospital stay in the ICU was  $2.98 \pm 2.33$  days, with the highest mortality rate from hospital admissions (44.4%) and 86.1% of patients surveyed with no underlying disease<sup>11</sup>. Previous studies stated that it is necessary for physicians and nurses to record the care events<sup>12-16</sup>. The number of male patients who died in the ICUs was higher than the number of female patients (61.9% against 38.1%), which is consistent with the results of previous studies<sup>4,17-19</sup>. Chen et al. (2001) concluded that as the duration of hospital stay increases, then mortality also increased<sup>20</sup>. The mean age of the study subjects was 46.12 (SD: 26.84). A 20-year cohort study

conducted by Zimmerman et al. in the US reported on the mean age of ICU patients during different years and showed an increase from 59.3 years in 1988-1989 to 61.4 years in 2010-2012. In contrast, the results of the present study showed the mean age of the deceased ICU patients to be approximately 15 countries due to the higher infant mortality rates<sup>21</sup>.

The median time of death was at 11:30 (IQR: 10) and a significantly higher number of deaths occurred in the night shift than in the morning or afternoon shifts; however, the number of deaths occurring in the morning shift was also higher than those occurring in the afternoon shift. The separate investigation of each of the ICUs (i.e. the MICU, NICU, SICU and PICU) showed that, despite the equal number of nurses in the morning, afternoon and night shifts, the mortality rate was still significantly higher in the night shift. The nurse-to-bed ratio was 1:3 in the MICU and SICU, 1:9 in the NICU and 1:3.5 in the PICU. In the BICU, despite the higher number of nurses in the morning shift and a mean nurse-to-bed ratio of 1:2, the mortality rate was still higher in this shift, which may be due to the different nature of the reason for which patients are admitted to a BICU (i.e., burns), as it is often during the nurses' morning shift that employees begin their work day and are prone to catching fire.

The median duration of hospital stay was 10 days (IQR: 15). The median number of resuscitations was 1 (IQR: 2). The median duration of CPR was 45 minutes (IQR: 15). Zimmerman et al. also reported that the mean duration of ICU stay had reached 3.58 days in 2010-2012, from 4.64 days in 1988-1989, which is lower than the figures reported in the present study<sup>21</sup>. Abrishmakar et al. reported that 39.4% of the deceased patients were hospitalized for less than 2 days<sup>10</sup>. A study by Moradmand et al. showed that an increase in the duration of hospital stay also increases the rate of mortality, as only 6% of the patients who were hospitalized for just 1 day died, while 75% of those who were hospitalized for 15 days and over were deceased<sup>13</sup>. In another study, Chen et al. reported an average of 5 days of hospitalization in the ICU and concluded that an increase in the duration of hospital stay also increases the rate of mortality<sup>20</sup>.

Of the total of 425 examined cases, the highest rate of admission pertained to the BICU, followed by the MICU, PICU and SICU, and the lowest rate of admission pertained to the NICU. The most frequent causes of ICU admission included burns, intracerebral hemorrhage, acute abdomen, pneumonia, sepsis, prematurity, trauma, stroke, brain tumor, heart failure, COPD, blood cancer, kidney failure, liver failure, breast cancer, etc. In the study conducted by Zimmerman et al., the majority of ICU deaths were caused by heart attack, acute respiratory distress syndrome, head injury, chest trauma, abdominal trauma, pelvic fracture, spinal cord injury, gastrointestinal bleeding surgery and bowel obstruction surgery. Unlike in Zimmerman's study, cancer and infections were among the leading causes of ICU mortality in the present study<sup>21</sup>.

Orban et al. (2015) in a study entitled "Causes and characteristics of death in ICU" investigated the causes and circumstances of death in a general ICU population. They conducted a prospective observational study. Every ICU included all death occurring during a month, demographic

data as well as circumstances of death (organ failure and organ support at this time) were evaluated. Researchers concluded that patients who died in ICU presented, most of the time, at least one organ failure. Expected death patients exhibited more neurologic and respiratory failures whereas cardiovascular failure was more prominent in unexpected cases. In the latter group of patients, the proportion of organ support was higher corresponding to a greater care intensity<sup>22</sup>. In a recent study to compare long-term mortality and causes of death in children post admission to an ICU with a control population of same age, kyösti et al. (2018) concluded that there was an increased risk of death in a cohort of ICU-admitted children even 3 years after discharge. In those who survived 30 days after discharge, medical causes of death were dominant, whereas deaths due to trauma were most common in the control group<sup>23</sup>. In another study, results indicated that the respiratory failure and severe infections are the most common causes of admission and mortality in the PICU and very young children are at risk of high incidence of mortality<sup>24</sup>.

## CONCLUSION

Overall, the rate of mortality was higher among men. The number of deaths was also significantly higher in the night shift compared to the morning and afternoon shifts, even in the MICU, NICU, SICU and PICU, where the number of nurses was equal in each of the three shifts. In the BICU, the mortality rate was higher in the morning shift despite the higher number of nurses in this shift and its higher mean nurse-to-bed ratio of 1:2. The most frequent causes of ICU admission included burns, intracerebral hemorrhage, acute abdomen, pneumonia, sepsis, prematurity, trauma, stroke, brain tumor, heart failure, COPD, blood cancer, kidney failure, liver failure, breast cancer, etc., in order of prevalence.

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