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Characteristics and outcomes of critically-ill medical patients admitted to a tertiary medical center with restricted ICU bed capacity

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ABSTRACT

Background: In the emergency department (ED) critically-ill medical patients are treated in the resuscitation room (RR). No studies described the outcomes of critically-ill RR patients admitted to a hospital with low capacity of intensive care unit (ICU) beds.
Methods: We included all medical patients above 18 who were admitted to a RR of a tertiary hospital during 2011–2012. We conducted multivariate logistic and Cox regressions and propensity score (PS) matched analysis to analyze parameters associated with the study outcomes.
Results: In-hospital mortality rate was 32.4% in ICU admitted patients compared to 52.0% of the non-ICU critically-ill patients ($p<0.001$). Age above 80, female and recent ED encounters were associated with non-ICU admissions ($p<0.05$ for all). ICU admission had a statistically significant effect on in-hospital mortality in PS matched analysis (OR 0.36, 95% CI 0.21–0.61). A marginal effect was evident in one-year survival in PS matched landmark analysis (HR 0.50 95% CI 0.23–1.06).
Conclusion: ED critically-ill medical patients who were treated in the RR had high mortality rates in an institute with restricted ICU beds availability. However, those who were admitted to an ICU showed prolonged short and perhaps long term survival compared to those who were not.

1. Background

Over the past several decades, population aging and the increase in the morbidity burden, together with an accelerated adoption of new technologies, are reflected in a growing utilization of expensive medical resources [1]. An increase in emergency department (ED) visits and admissions to intensive care units (ICUs) are well-documented examples [2,3]: from 2001 to 2009 the annual ED visits of patients older than 65 increased by almost a quarter and the ICU admissions more than doubled in the United States (US) [4].

Triage decisions in the ED impact the outcomes of critically-ill patients, as those admitted to an ICU showed higher in-hospital survival rate [5,6]. Parameters that were reported to influence ICU admission decision were the patient's age, diagnosis, functional status, illness severity index and the need of vassopressors [6-9].

Due to the high cost of ICU beds, the growing demand frequently surpasses the supply [10]. This discrepancy is region- and country-specific: the number of available ICU beds in the US and Europe is highly variable, from 25 beds per 100,000 people in the US, to 5 beds per 100,000 in the UK and 4.6 beds per 100,000 in Israel [11,12]. In low ICU resource environments, a so-called "closed door policy" for ICU admissions is frequently used, in which the ICU admission is conditional on the intensive care physician's decision. Previous studies examined the association between ED treatments of critical patients, intensive care admissions, and mortality in health systems with relatively high ICU beds availability [13-15].

Among ED patients, the most critical ones ("sickest of the sick") are often treated in the resuscitation room (RR) [16,17]. The aim of the present study is to analyze the characteristics of medical patients who are treated in the RR in a low ICU beds availability environment and to investigate which parameters are associated with ICU admissions and with short and long term survival.

2. Methods

2.1. Study population

We obtained health data of all patients admitted to the Soroka University Medical Center (SUMC) ED and treated in the medical RR during the years 2011–2012. SUMC is an 1100-bed tertiary medical center in

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Southern Israel (950 non-pediatric acute beds), serving a population of approximately 700,000 as the only hospital, and nearly 1.2 million as a tertiary hospital. SUMC has two general ICUs with 20 beds and an intensive cardiac care unit (ICCU) with 8 beds.

SUMC internal ED has over 150,000 annual visits. Approximately 500 critically-ill patients are treated in 6 beds RR annually [18]. Patients may either enter the RR directly when arriving to the ED after a quick triage or be transferred from the ED due to a deterioration in their medical condition. The treatment in the RR may include diagnostic and therapeutic measures, such as definitive airway, defibrillation, various medications, vasopressors, blood products, central lines, x-rays, point of care ultrasound, and additional imaging studies. Patients are then presented to the ICU physician and if not admitted to ICU can be mechanically ventilated and receive vasopressor therapy in an internal medicine ward. The decision of ICU admission is based solely on the intensivist opinion.

2.2. Data extraction

The study was approved by SUMC's Ethics Committee. We excluded patients whose age was below 18, who were dead upon arrival, and who were remained anonymous during their RR stay. We extracted demographic, medical history, laboratory, and clinical data from the computerized outpatient-inpatient database. We used Initial vital signs and laboratory tests that were recorded upon RR arrival. Therapeutic data, i.e., medications and medical procedures that were conducted, were extracted from the RR records.

Characteristics of the treating physician were extracted using the unique electronic login of each physician in the hospital electronic record during the medical engagement. Each physician name was cross matched with the Israeli ministry of health database to receive the type of residency, years of seniority, and gender.

Patients were identified by the national ID number which was encoded prior to the data analysis. The primary outcome of our analysis was ICU admission following RR treatment, and the secondary outcomes were in-hospital and one-year mortality.

2.3. Statistical analysis

Data are expressed as mean ± standard deviation (SD), median ± interquartile range (IQR), or number and percentage. We compared patient characteristics between ICU vs. ward admissions using *t*-test, chi-square and non-parametric tests. We considered "ICU" as either general ICU or Intensive Cardiac Care Unit (ICCU) admissions. To estimate the association of the patients and physician characteristics with ICU admissions, we conducted a forward stepwise conditional logistic regression of the dependent variable. Each set of covariates (demographic, medical history, laboratory, etc.) was entered as separate block to the model. The final model was selected based on model goodness of fit using the c-statistic and plausible clinical explanation. We used the same method to analyze covariates that were associated with in-hospital mortality. We computed a propensity score for the ICU admission. Mortality models were built in the population of ICU admitted and not admitted patients matched in a 1:1 ratio on propensity score (caliper 0.001, greedy matching) adjusted for age, gender, Charlson's comorbidity index (CCI) intubation and vasopressors use in RR. Since the availability of ICU beds is an important factor to determine patient placement, we also computed a variable of vacant ICU beds (presented in quartiles of available ICU beds during patients stay in RR), which was tested with ICU admission and in-hospital mortality. In addition, we conducted subgroup analysis (stratified by age, gender, CCI, albumin diabetes, and primary diagnosis) to analyze in-hospital mortality among ICU vs. non-ICU admissions within these subgroups. For landmark analysis of one-year mortality, we used Cox regression and matched in a 1:1 ratio propensity score (caliper 0.001, greedy matching) for ICU admission, using the same variables from the short term matching. The model was conducted in a forward stepwise conditional method [19]. Data analysis was performed using SPSS version 24.0.

3. Results

3.1. Patients characteristics

A total of 1064 medical treatments in the RR during the study period (2011 — 2012) were examined. After excluding patients who were

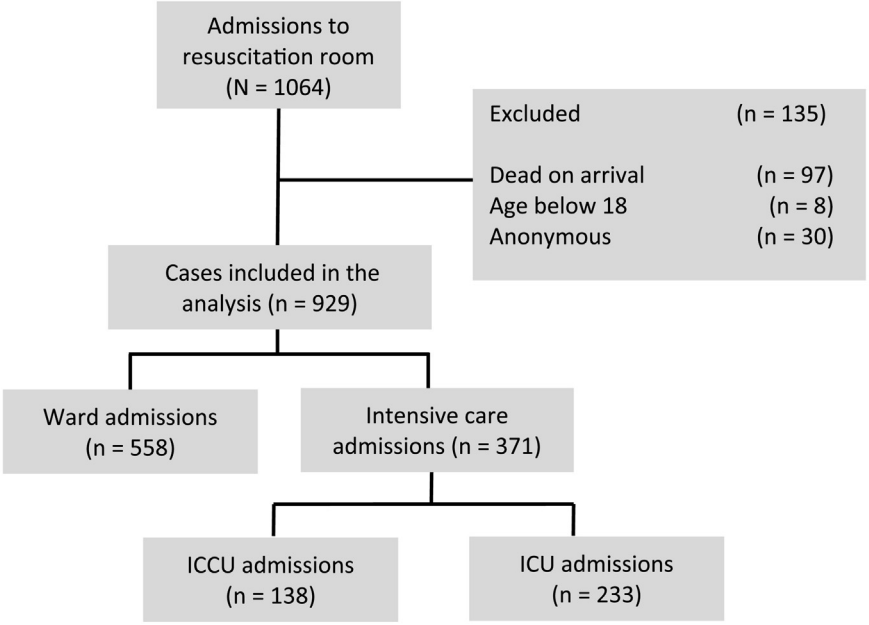

Fig. 1. Flow charts of patients who were admitted to the resuscitation room in the medical emergency department during the years 2011–2012. Abbreviations: ICU – Intensive Care Unit, ICCU – Intensive Cardiac Care Unit.