



## Clinical Assessment and Outcome

## Outcomes of an emergency department intensive care unit in a tertiary medical center in Taiwan: An observational study



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## ABSTRACT

**Purpose:** The boarding of critically ill patients in the emergency department (ED) could reduce quality of care and increase mortality. An ED intensive care unit (ICU) was set up in a 3715-bed medical center to facilitate timely delivery of critical care. This study reports comparative outcomes of EDICU patients with specialty ICU patients. **Materials and methods:** Medical records of adult nontrauma ED patients admitted to nonsurgical ICUs (EDICU, medical, cardiac, alimentary, and neurological units) between January 2007 and July 2011 were retrospectively reviewed. The respective number of admissions, bed turnover rate, and length of stay were compared. Cox regression models were also applied to compare in-hospital mortality risks among these patients.

**Results:** With only 13% (14/108) of all ICU beds, EDICU admitted 36% (3711/10449) of patients. Emergency department ICU patients had an unfavorable adjusted hazard ratio for in-hospital mortality compared with medical ICU and cardiac ICU patients, but after excluding patients with an ICU length of stay of 2 days or less, the difference in hazard ratio became nonsignificant.

**Conclusions:** Emergency department ICU has admitted a disproportionately higher proportion of patients without sacrificing quality of care. Specialty care could be secured through direct communication between EDICU and specialty physicians and forming close collaboration between departments and ICUs.

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## 1. Introduction

The boarding of critically ill patients in the emergency department (ED) could lead to reduced timeliness and quality of care [1] and even an increase in mortality [2,3]. As most EDs are designed for initial resuscitation but not the care beyond [4], from the ED perspective, critically ill patients should be admitted to the intensive care unit (ICU) without delay [1]. For mechanically ventilated ED patients, an ED waiting time of more than 4 hours has been associated with increased mortality and resource expenditure [2]. However, nowadays, the number of critically ill patients continues to increase in the ED, and their stay in the ED has become even longer [5]. These have indeed posed particular challenges for many EDs.

Chang Gung Memorial Hospital, Linkou (LCGMH) is a 3715-bed tertiary medical center located in northern Taiwan. Its ED receives around 110000 adult nontrauma patients per year, of which approximately 2400 were subsequently admitted to nonsurgical ICUs. An emergency

department intensive care unit (EDICU) has been set up in 1997 and aims to (1) facilitate timely delivery of critical care, (2) decrease the ED waiting time for critically ill patients, and (3) reduce workload of ED staff. Here, we report the outcomes of EDICU (including number of admissions, bed turnover rate, patient's length of stay [LOS], and in-hospital mortality rate) in comparison with specialty ICUs.

## 2. Methods

## 2.1. Setting

Approximately 20% of the adult nontrauma ED patients in LCGMH were stratified into triage levels 1 and 2, using the 5-level Taiwan triage and acuity scale [6]. Nonsurgical ICUs in LCGMH are EDICU and specialty ICUs, which include medical (MICU, cared by pulmonologists), cardiac (CCU), alimentary (ACU, caring patients with acute liver failure, severe acute pancreatitis, massive gastrointestinal bleeding, and biliary tract infection or liver abscess complicated with severe sepsis), and neurological (NMICU) ICUs. While EDICU only admits patients from ED, specialty ICUs also admit patients from floor. Emergency department ICU admits patients only when specialist physicians deem intensive care indicated but the respective ICU has no vacant bed. Emergency department ICU provides invasive hemodynamic monitoring and

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advanced life-supporting modalities, including continuous renal replacement therapy, therapeutic hypothermia, and extracorporeal membrane oxygenation.

Specialty ICUs have priority over EDICU in admitting ED patients, but when specialty ICUs vacate a bed, they will first admit a patient from ED or floor. Emergency department ICU patients will be taken over by specialty ICUs only when no more patients are waiting at ED or floor or when the attending physicians of both units deemed specialty ICU transfer necessary. Emergency department ICU patients were treated by an assigned group of attending emergency physicians, all of which are critical care medicine board certified. The EDICU attending physicians take full charges and responsibilities of patient care, whereas specialists are consulted as needed for treatment recommendation and procedures such as cardiac catheterization, endoscopy, and extracorporeal membrane oxygenation institution. Certain treatment modalities are only provided by specialty ICUs, for example, high-frequency oscillatory ventilation by MICU and Molecular Adsorbent Recirculating System by ACU.

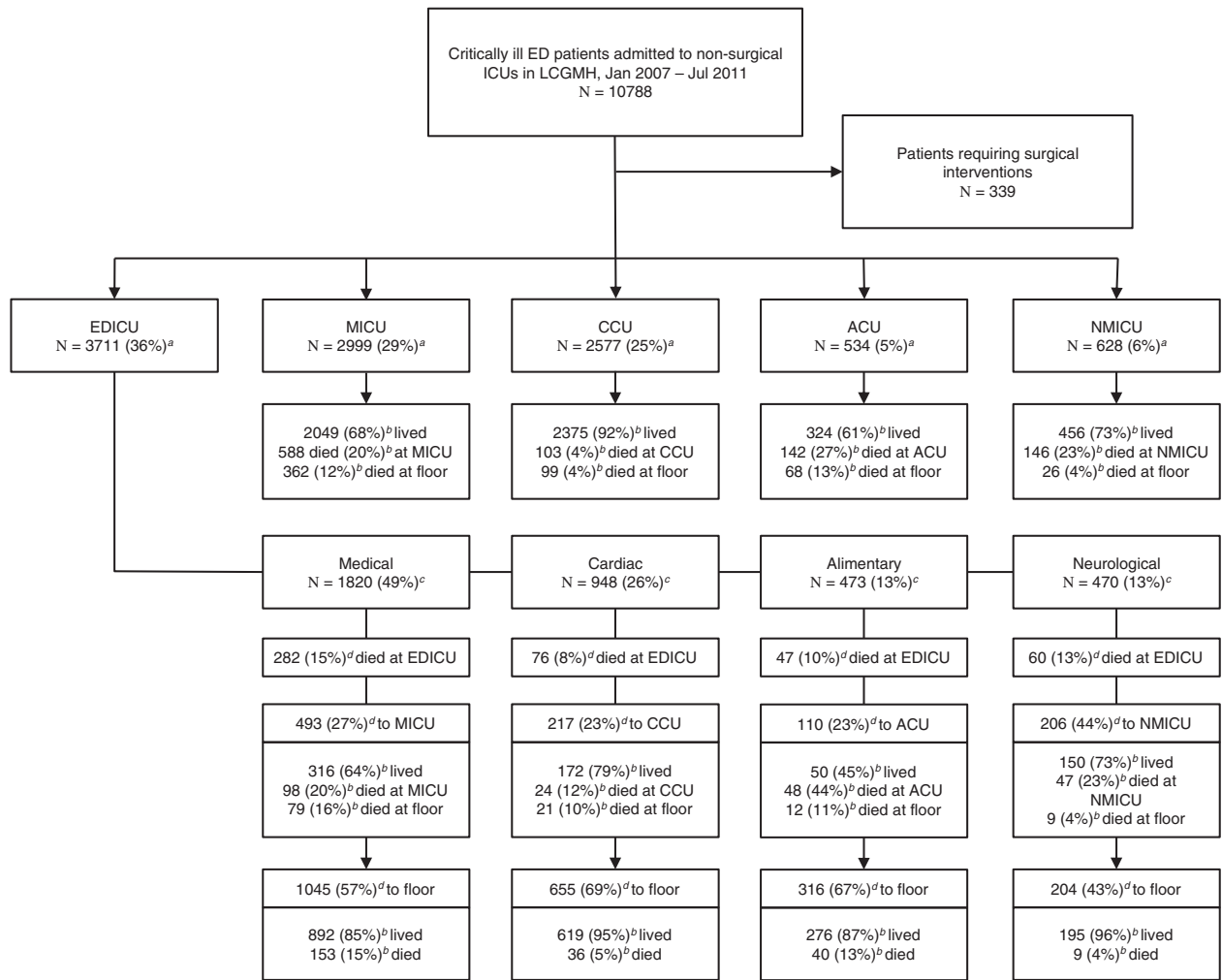
2.2. Study population and data collection

Medical records of adult nontrauma ED patients who were later admitted to nonsurgical ICUs at an index ED visit between January 2007 and July 2011 were retrospectively identified and reviewed. Patients who were subsequently transferred to surgical departments for surgical

interventions were excluded from the current analysis. Basic demographic data, the ED triage level, primary ED diagnoses, ED waiting time for an ICU bed, the Acute Physiology and Chronic Health Evaluation (APACHE) II score [7], dispositions from the ICU and from the hospital, the LOS in ICU and floor, and the inhospital survival status were collected and analyzed. When calculating the inhospital mortality rates, patients taken over from EDICU to specialty ICUs were excluded from calculation. *Emergency department waiting time* was defined as the interval in hours between ED triage and ICU admission. The number of vacant beds of EDICU each day during the study period was also calculated. This study protocol was approved by Chang Gung Memorial Hospital Institutional Review Board, and the requirement for an informed consent was waived.

2.3. Statistical analysis

Non-Gaussian distributed variables were compared using Mann-Whitney *U* test. The bed turnover rates for individual ICUs were compared with Kruskal-Wallis test with Dunn post hoc comparisons. The crude inhospital mortality rates were compared using  $\chi^2$  test. Kaplan-Meier curves were used to depict 28-day inhospital survival rate since ICU admission and compared using the log-rank test. Risks of inhospital mortality with respect to the ICU admitted were compared among patients admitted to the EDICU and those to specialty ICUs using Cox regression models with adjustment for age, sex, ED triage level, ED



**Fig. 1.** Number and subsequent disposition of ED patients admitted to nonsurgical ICUs of LCGMH, 2007–2011. Patients were categorized into medical, cardiac, alimentary, and neurological groups according to their primary ED diagnoses. <sup>a</sup>Percentages among the 10,449 patients included. <sup>b</sup>Percentages among patients admitted to/taken over by the specialty ICU or transferred to the floor. <sup>c</sup>Percentages among patients admitted to EDICU. <sup>d</sup>Percentages among EDICU patients separated into individual specialty groups.

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