



## Trainee physician turnover and 30-day mortality in Korean intensive care units

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### ABSTRACT

**Purpose:** Previous studies have found an increase in in-hospital mortality when trainee physicians rotate. Our retrospective cohort study investigated whether trainee physicians' turnover influenced 30-day mortality in Korean intensive care units (ICUs), which have high-intensity daytime intensivist coverage only on weekdays.

**Materials and methods:** Participants were adults over 19 years old admitted to ICUs in a Korean tertiary care academic hospital between 2012 and 2016. Demographic and clinical data were collected on admission, and dates of death recorded. The primary outcome was the association between ICU admission in the turnover periods (March and May) and 30-day mortality after admission to ICUs with high-intensity daytime intensivist coverage. **Results:** Overall, there was no significant correlation between ICU admission during turnover periods and 30-day mortality [hazard ratio (HR), 1.06; 95% confidence interval (CI), 0.83–1.35,  $P = 0.647$ ]; the same trend was found for ICU admissions when there was no intensivist coverage (HR: 1.24, 95% CI: 0.91–1.69,  $P = 0.177$ ).

**Conclusions:** We found no overall association between physician turnover and 30-day mortality of patients admitted to ICUs with high-intensity daytime intensivist coverage or with no intensivist coverage.

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### 1. Introduction

In an academic hospital, there are inevitable periods of staff turnover during the transition from medical school to hospital employment, or from internships to residencies [1]. This turnover period, known as the “July effect” in North America [2], has been implicated in potential adverse outcomes for inpatients [2,3]. However, some studies have found that physician turnover has no effect on patient outcomes in teaching hospitals [4–6]. Therefore, the influence of physician turnover on health-related outcomes still remains controversial.

Intensive care units (ICU), where the most seriously ill patients are hospitalized, are staffed by the most experienced medical professionals [7]. Therefore, it is possible that physician turnover could result in increased mortality of ICU patients; a recent study has reported that physician turnover can influence the outcome of in-hospital cardiopulmonary resuscitation (CPR) in the ICU, in contrast to the emergency department, and medical and surgical wards [8]. However,

another study reported that physician turnover did not influence mortality of high-risk patients hospitalized for septic shock in the United States [9]. The influence of physician turnover in the ICU setting therefore remains controversial and may differ according to staffing patterns. There has been no research on the influence of physician turnover on patient outcomes in ICUs with daytime-only intensivist coverage and, in particular, on the mortality of ICU patients in academic hospitals in Asia, which may differ from those of Western academic hospitals.

Therefore, our study aimed to investigate the relationship between physician turnover and 30-day mortality of ICU patients in Korea, where ICUs have only daytime intensivist cover. We also analyzed the correlation between physician turnover and 30-day mortality after weekend ICU admissions, when there was no intensivist coverage.

### 2. Methods

This was a retrospective observational study conducted with the approval of the Institutional Review Board of Seoul National University Bundang Hospital (SNUBH) (approval number: B-1706/402-106; approval date: 2017.05.25) The need for the informed consent was waived due to minimal risk to participants. The participants were adults aged over 19 years old who were admitted to the medical, neurology,

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emergency, or surgical ICUs of SNUBH between January 1, 2012 and December 31, 2016. Patients with inaccurate or missing medical records were excluded. In order to ensure that independent variables relating to the most seriously ill patients were included in the statistical analysis, only the last admission was included where individual patients had repeated ICU admissions.

Demographic and clinical information was collected at the time of ICU admission, and the exact date of death recorded. Accurate dates of death were collected with approval of the Ministry of Interior and Safety of South Korea. Other data were extracted from medical records by medical record technicians in the Medical Informatics Team of SNUBH, who were blinded for the purposes of this study. Patient data were anonymized during collection and analysis. SNUBH is a 1360-bed tertiary hospital and a large teaching center of the Medical College of Seoul National University.

### 2.1. Turnover periods for trainees in SNUBH

The Korean medical training system consists of a year of internship, four years of residencies, and one to two years of fellowships, followed by graduation; two-thirds of new medical trainees start on March 1. Additional positions start on May 1, when male students complete their military service [10]. March and May are therefore referred to as the “turnover periods” for trainees in most teaching hospitals in South Korea.

### 2.2. High-intensity staffing by daytime intensivists in SNUBH

Throughout the period of the study, the four ICUs in SNUBH were staffed by at least one certificated attending intensivist between 08:00–18:00 (daytime), who was assisted in patient care by residents. In a high-intensivist staffing model for ICU [11], certified intensivists (thoracic surgeon, neurologist, anesthesiologist, emergency physician, and pulmonologist) were often consulted about admission of inpatients to ICU and principal care regimens for ICU patients.

Outside daytime hours, intensivists were on call and were sometimes called from home for certain patients or procedures. However, after 18:00 from Monday to Friday and on Saturdays and Sundays, duty residents in the second or third year of their 4 years of training in internal medicine and each surgical department were in charge of patient management in the ICUs.

### 2.3. Outcomes

The primary outcome of this study was the influence of physician turnover on 30-day mortality after ICU admission; the secondary outcome was the influence of lack of ICU intensivist cover on 30-day mortality after ICU admission, which was defined as death within 30 days after ICU admission.

### 2.4. Statistical methods

Student's *t*-test was used to compare patient characteristics in the turnover and non-turnover periods for continuous variables and the chi-square test for categorical variables. Univariate Cox regression analysis was used to identify individual variables that correlated to 30-day mortality after ICU admission. Variables with a *P*-value < 0.05 in the univariate analysis were selected for multivariate Cox regression analysis. Additional multivariate Cox regression analysis was conducted on patients admitted to the ICUs when there was no intensivist coverage. Kaplan-Meier analysis was conducted to compare survival of patients admitted during turnover and non-turnover periods, and the log-rank test was used for verification. All statistical analysis was conducted using R software (The R Foundation, Vienna, Austria) and a *P*-value < 0.05 was considered to be significant.

## 3. Results

There was a total of 9143 adult ICU admissions during the study period. Of these, we excluded 238 ICU admissions due to incomplete or

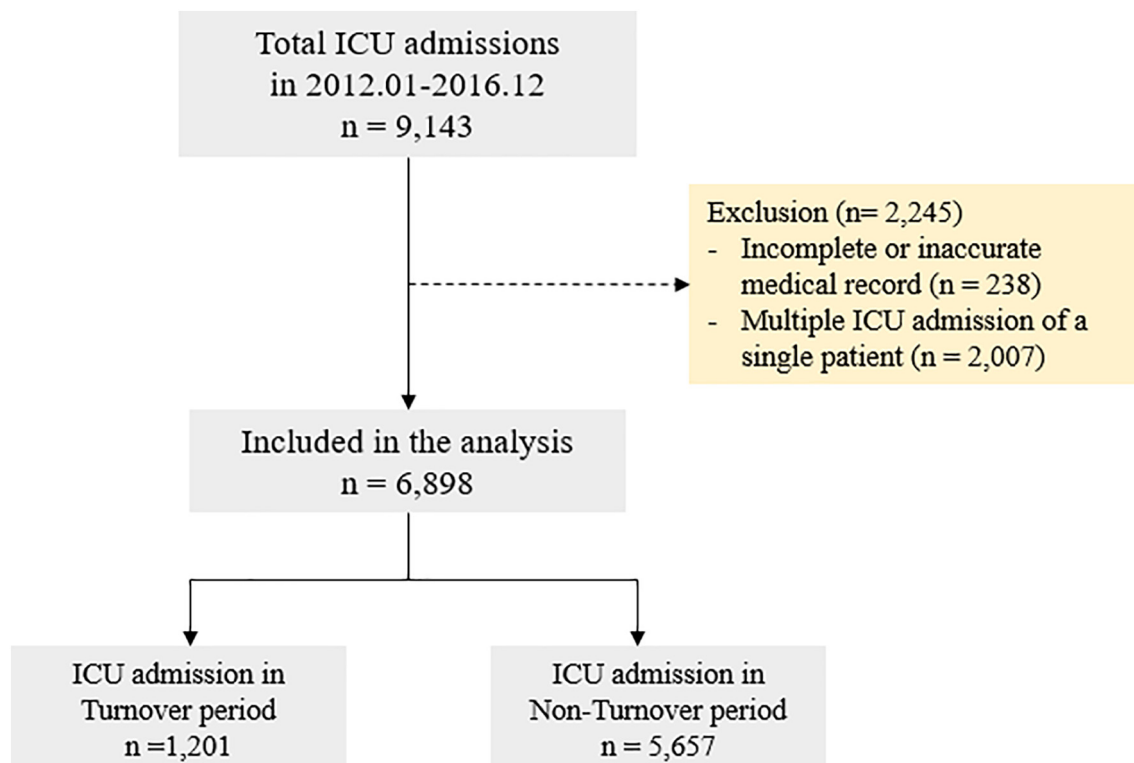


Fig. 1. Flow chart of patient selection process. ICU, Intensive Care Unit.

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