



# Association Between Presence of a Cardiac Intensivist and Mortality in an Adult Cardiac Care Unit

Soo Jin Na, MD,<sup>a</sup> Chi Ryang Chung, MD, PhD,<sup>a</sup> Kyeongman Jeon, MD, PhD,<sup>a,b</sup> Chi-Min Park, MD, PhD,<sup>a,c</sup> Gee Young Suh, MD, PhD,<sup>a,b</sup> Joong Hyun Ahn, MS,<sup>d</sup> Keumhee C. Carriere, PhD,<sup>d,e</sup> Young Bin Song, MD, PhD,<sup>f</sup> Jin-Oh Choi, MD, PhD,<sup>f</sup> Joo-Yong Hahn, MD, PhD,<sup>f</sup> Jin-Ho Choi, MD, PhD,<sup>f</sup> Seung-Hyuk Choi, MD, PhD,<sup>f</sup> Young Keun On, MD, PhD,<sup>f</sup> Hyeon-Cheol Gwon, MD, PhD,<sup>f</sup> Eun-Seok Jeon, MD, PhD,<sup>f</sup> Duk-Kyung Kim, MD, PhD,<sup>f</sup> Jeong Hoon Yang, MD, PhD<sup>a,f</sup>

## ABSTRACT

**BACKGROUND** Dedicated intensive care unit (ICU) physician staffing is associated with a reduction in ICU mortality rates in general medical and surgical ICUs. However, limited data are available on the role of a cardiac intensivist in the cardiac intensive care unit (CICU).

**OBJECTIVES** This study investigated the association of cardiac intensivist-directed care with clinical outcomes in adult patients admitted to the CICU.

**METHODS** This study analyzed 2,431 patients admitted to the CICU at Samsung Medical Center in Seoul, South Korea, from January 2012 to December 2015. In January 2013 the CICU was changed from a low-intensity staffing model to a high-intensity staffing model managed by a dedicated cardiac intensivist. Eligible patients were divided into either a low-intensity management group (n = 616) or a high-intensity management group (n = 1,815). One-to-many (1:N) propensity score matching with variable matching ratios was also performed. The primary outcome was death in the CICU.

**RESULTS** Death in the CICU occurred in 55 patients (8.9%) in the low-intensity group versus 74 patients (4.1%) in the high-intensity group (p < 0.001). Of 135 patients who underwent extracorporeal membrane oxygenation, the CICU mortality rate in the high-intensity group was also lower than that in the low-intensity group (54.5% vs. 22.5%; p = 0.001). On propensity score matching, high-intensity staffing was found associated with a lower CICU mortality rate in the matched cohort of patients (7.5% vs. 3.7%; adjusted odds ratio: 0.53; 95% confidence interval: 0.32 to 0.86; p = 0.010). In overall and propensity-matched patients, there were no substantive differences in either median length of CICU stay or readmission rates between the 2 groups.

**CONCLUSIONS** The presence of a dedicated cardiac intensivist was associated with a reduction in CICU mortality rates in patients with cardiovascular disease who required critical care. (J Am Coll Cardiol 2016;68:2637-48)

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After the introduction of dedicated coronary care units for patients with acute myocardial infarction (AMI) in the early 1960s, the in-hospital mortality rate was reduced by about one-half in patients with AMI (1-3). However, since the 1980s, cardiac intensive care unit (CICU, an abbreviation derived from the earlier coronary care unit) and in-hospital mortality rates have not significantly



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From the <sup>a</sup>Department of Critical Care Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea; <sup>b</sup>Division of Pulmonary and Critical Care Medicine, Department of Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea; <sup>c</sup>Department of Surgery, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea; <sup>d</sup>Biostatistics and Clinical Epidemiology Center, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea; <sup>e</sup>Department of Mathematical and Statistical Sciences, University of Alberta, Edmonton, Alberta, Canada; and the <sup>f</sup>Division of Cardiology, Department of Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea. All authors have reported that they have no relationships relevant to the contents of this paper to disclose.

Manuscript received July 23, 2016; revised manuscript received September 13, 2016, accepted September 29, 2016.

## ABBREVIATIONS AND ACRONYMS

**AMI** = acute myocardial infarction

**CICU** = cardiac intensive care unit

**CRRT** = continuous renal replacement therapy

**ECMO** = extracorporeal membrane oxygenation

**IABP** = intra-aortic balloon pump

**ICU** = intensive care unit

changed (4). Recently, CICUs have evolved from coronary care units that focus exclusively on patients with AMI to units that provide comprehensive critical care to patients with all kinds of cardiovascular diseases and complex comorbidities and that use advanced hemodynamic monitoring and therapeutic devices. High-intensity intensive care unit (ICU) physician staffing, which is defined as the presence of a dedicated ICU and mandatory intensivist consultation, was evaluated in several general medical and surgical ICUs as a means of improving clinical outcomes in

patients with critical illnesses; it was associated with a significant decrease in ICU mortality rates (5,6). However, no data are available on the role of high-intensity ICU staffing by a cardiac intensivist in CICUs (7). We investigated the association between high-intensity staffing with a dedicated cardiac intensivist and clinical outcomes in adult patients admitted to the CICU.

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## METHODS

**STUDY POPULATION.** We enrolled 2,923 consecutive patients admitted to a CICU at Samsung Medical Center, which is a tertiary care center in Seoul, Korea, from January 2012 to December 2015. Of these patients, 492 who did not have cardiovascular disease were excluded, leaving 2,431 patients for analysis in this study. Patients were divided into a low-intensity management group (n = 616) and a high-intensity management group (n = 1,815) by their admission date to the CICU: patients who were admitted to the CICU before January of 2013 were assigned to the low-intensity management group, and those who were admitted to the CICU after January 2013 were assigned to the high-intensity management group (Figure 1). Clinical, laboratory, and outcome data were collected by a trained study coordinator using a review of hospital records. When necessary, additional information was gathered by contacting the principal investigators. APACHE (Acute Physiology and Chronic Health Evaluation) II scores on the admission day to the CICU were calculated by 12 physiological variables and 2 disease-related variables collected retrospectively to compare the severity of patients' conditions between the 2 groups. The Institutional Review Board of Samsung Medical Center approved the study protocol and waived the requirement for informed consent.

**CARDIAC INTENSIVE CARE UNIT SETTING.** In our hospital, patients with cardiovascular disease who

require acute cardiac care are admitted to the CICU or the cardiac surgical ICU, depending on the need for surgical management. Our CICU is a 12-bed ICU where patients with various kinds of cardiovascular diseases requiring nonsurgical care are treated. It is equipped with invasive and noninvasive devices that can monitor the hemodynamic status of the patients and provide advanced therapeutic technologies to support the cardiovascular system, such as intra-aortic balloon pump (IABP), extracorporeal membrane oxygenation (ECMO), and ventricular assist devices, as well as mechanical ventilators and machines for continuous renal replacement therapy (CRRT). Experienced cardiac surgeons are readily available 24 h per day, 7 days per week when surgical treatment is needed. The nurse-to-patient ratio is maintained at approximately 1:2. Multidisciplinary care is provided through consultation with a dietitian, a pharmacist, and a respiratory care practitioner.

Before 2013, 3 senior residents in internal medicine provided in-unit coverage as primary decision makers under the supervision of general cardiologists. Intensivist consultation was not available. Instead, each patient's cardiology faculty physicians made rounds regularly on weekdays, and routinely once or twice per day, but were not present for 24 h per day, 7 days per week in the CICU. Residents had the responsibility for the in-house calls every third night, and they were backed up by 1 of the in-house general cardiologists at night. Starting in January of 2013, the CICU adopted a high-intensity staffing model, which was managed by a dedicated cardiac intensivist for the first time. ICU-based physicians routinely assess all patients admitted to the CICU and are responsible for all aspects of patient care. The cardiac intensivist is a cardiologist who is board certified in interventional cardiology and critical care medicine. During the daytime, the cardiac intensivist is present in the CICU along with a general cardiologist, a general intensivist, and 3 senior residents in internal medicine; as circumstances dictate, the team administers interventional cardiology procedures such as urgent right-sided cardiac catheterization, placement of temporary pacemakers, IABP, ECMO, coronary catheterization, and angioplasty. Overnight coverage in the CICU consists of in-house senior residents and a general cardiologist, and the cardiac intensivist can be contacted by telephone calls or text messages. A general cardiologist and a general intensivist provide backup when the cardiac intensivist cannot cover for these patients, given that patients can be admitted to the CICU 24 h per day, 7 days per week. During the study period, there were no major changes in treatment guidelines, equipment advancement, or

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