Cardiac Intensive Care Units: What Should Be the Standard of Care?

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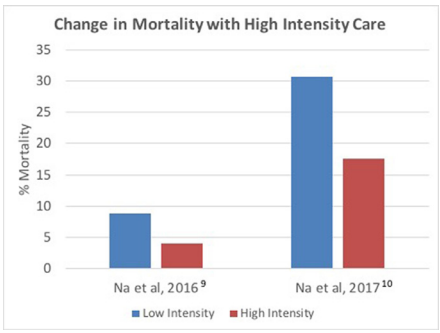
Since the creation of intensive care units (ICU) in the early 1960s, the central question of how to operate and staff them has continued to be an ongoing discussion. Early studies demonstrated decreased morality when staffing was altered from remote providers to full-time on-site providers. In addition to the shift towards full-time onsite providers, the structure of daily care has also undergone significant paradigm changes. Several studies have revealed the importance and benefit of multidisciplinary rounds with direct and open communication of daily goals. Particularly for cardiac patients in shock, two recent studies have provided hard data demonstrating a significant decrease in mortality in ICUs with full-time onsite providers. This benefit was even more pronounced for patients supported with extracorporeal membrane oxygenation. These data support the practice of intensive care with (1) full-time onsite provider staffing, (2) multidisciplinary rounds, and (3) a safe environment with open communication between team members.

Semin Thoracic Surg 31:7–10 © 2018 Elsevier Inc. All rights reserved.



Whether a med-surg unit in 1984 or a highly sophisticated CCU in 2012–2015, high-risk patients do better with full-time intensivist care.

Central Message

The standard of care for the cardiac patient should be by full time intensivists, including cardiac surgeons. Multidisciplinary rounds and a culture of collaboration are crucial to providing high-quality care.

Although ICUs came into being in the early 1960s, the concept of how to appropriately staff them started to take form in the early 1980s. One of the first studies addressing this issue in 1984,[1] examined a community Hospital in New York City. Without changing any intensive care unit (ICU) staffing other than physician coverage, the hospital invited full-time providers to care for their ICU patients during daylight hours, rather than continue with ICU management by physicians who were offsite the majority of the time. During the second year of the study, when a dedicated provider was in the ICU at all times, ICU patients had close to a 40% improvement in survival to hospital discharge. After stratification by mortality risk factors, the two groups with intermediate levels of critical illness were found to have significantly superior survival. The intensivists were found to utilize more tests and monitoring interventions such as pulmonary artery catheters and arterial lines, however the benefits were clear.

At roughly the same time, a Canadian study[2] examined ICU staffing and hospital mortality for patients in a large teaching hospital. In what would be an often repeated study model, they examined two consecutive time periods; the first during which ICU patients were managed by an offsite attending, and the second during which patients were managed by on site, critical care specialists in consultation with the patient's attending physician. The analysis showed ICU mortality virtually halved with full-time intensivists and overall hospital mortality decreasing by 30% even after normalization for admission Apache II scores. Importantly, a recurrent theme, not well addressed by this or subsequent studies, is the concurrent development of critical care pathways, protocols, and multidisciplinary rounding. Also not captured in this analysis is the benefit of comanagement, ie, continued input from the primary attending physician or surgeon while simultaneously using full time, ever present, ICU physician coverage.

During the last quarter of a century, virtually every study supports the notion that full-time intensivists provide more effective care than those who are in the unit only part time. In 2002, Pronovost et al[3] conducted a systematic review of the literature to evaluate the effect of ICU staffing on hospital and ICU mortality as well as length of stay. ICU physician staffing was grouped into high intensity (mandatory intensivist consultation or a closed ICU, wherein all care was delivered through ICU intensivists) or low intensity (no intensivist or elective intensivist consultation, rather than one required). Of the 17 studies that met criteria, 16 showed an improvement in ICU and hospital survival. The pooled estimate of the relative risk of mortality in the ICU with full-time intensivist care revealed a 29% benefit when compared to the low intensity model.

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1043-0679/$–see front matter

https://doi.org/10.1053/j.semtcvs.2018.05.006

It bears mentioning that along with restructuring ICU staffing to full time, with continual presence of physicians trained in critical care, ICU organization and rounding models have also evolved. Highlighting this was a study done in 1999[4] looking at outcomes in abdominal aortic surgery throughout the state of Maryland. Full-time intensivist staffing, a full time ICU medical director, the occurrence of daily rounds by an ICU physician, and more intense nurse to patient ratios (the elimination of 1:3 care), all played a significant role in improved outcomes. The 2010 study by Kim et al[5] stressed the importance of multidisciplinary care. Over 100 hospitals across the state of Pennsylvania between 2004 and 2006 encompassing over 100,000 patient admissions were examined. Overall hospital mortality was 18%, indicative of the severity of illness of the patients admitted during this time period. ICU and hospital survival were found to improve with multidisciplinary care, defined as routine daily care given by a physician, a nurse, and at least one other healthcare provider (social workers, respiratory therapists, or pharmacists). The study was designed to separate the effect of multidisciplinary care from "high intensity vs low intensity" ICU staffing. The authors showed that multidisciplinary care models resulted in close to a 15% improvement in survival, regardless of the physician staffing, high vs low intensity.

Further data suggest that perhaps the most important multidisciplinary team member, other than the physician and the nurse, is a pharmacist who rounds with the team and oversees drug orders. In 1999, Leape et al[6] evaluated the effect of pharmacists participating on rounds in an ICU, specifically examining the effect on the rate of preventable adverse drug events (ADE). In fact, they decreased the ADE rate by 66%. Furthermore, of the close to 400 recommendations by the pharmacists related to drug ordering over the 4-month course of the study, 99% of the recommendations were accepted, including clarifications, prevention of duplicate or incomplete drug orders, incorrect dosages and frequency of administration, as well as inappropriate choices of drugs.

In 2003, in the *Journal of Critical Care*, the importance of structured communication during rounds was evaluated at Johns Hopkins in a medical ICU.[7] Not only did that study assess ICU length of stay, resident and nurse understanding of the goals of care for patients was evaluated in written form at the close of rounds. By implementing a daily goals form with active read back by the nurse prior to moving on to the next patient, the authors achieved a 50% reduction in ICU length of stay. Virtually 100% of the residents and nurses successfully demonstrated understanding the goals of care. Those of us who use this model on a day-to-day basis recognize that the added time required for rounding is significant, but the assurance of effective communication pays dividends on multiple fronts. Clearly defined goals improves the coordination of procedures, determination of appropriate testing, fulfillment of requirements for transfer, and presentation of a unified approach to the patient to family and loved ones.

Despite the plethora of evidence, some believe that full-time intensive care coverage is not routinely required for cardiac ICUs secondary to the relatively low mortality commonly cited (5% compared to 20−30% in medical and surgical ICU's across the country).

As determined by the Society of Thoracic surgery (STS) database report of 2016,[8] the mortality rate seen in the seven "major" STS operations for which there are observed and expected mortalities (isolated coronary artery bypass grafting, aortic valve replacement, mitral valve replacement, mitral valve repair, as well as each valve procedure combined with a coronary bypass) runs close to 3%. However, that same population experiences a major complication rate of 10−15%, as defined by the incidence of stroke, renal failure, prolonged ventilation, unplanned reoperations, and deep sternal wound infections. With regard to all "major" cases for the 3 years ending December 31, 2016, the average ICU stay was close to 3 days, the average ventilation time was 18 hours, and the incidence of any complication, major or minor, was roughly 40%, with major complications occurring 12% of the time. In coronary bypass patients, the group that constitutes roughly 70% of all open heart surgery, pulmonary complications were the most common, with ventilation duration over 24 hours (the definition of "prolonged ventilation") occurring in roughly 8% of patients. Red blood cell transfusions occurred in 30% of patients, with 44% receiving a transfusion of one type or another. All of this data suggest that the postop course of the cardiac surgery patient is characterized by early, acute, physiologic disequilibrium, with a frequently unpredictable outcome and potentially devastating complications.

However, if this were not justification enough for a full-time intensivist in the cardiac ICU, it is worth examining the 20% of all cardiac surgery patients who undergo a procedure not classified as a "major". The mortality in these procedures runs between 3% and 20%, and the overall mortality and major complication rate are as high as 24−50%.[8] Over a quarter suffer from prolonged ventilation, 5−10% develop renal failure. One could argue when seen in this light, that cardiac surgery patients require every bit as much intensive care as those dealt with in studies supporting the need for full-time intensive care.

Remarkably, just this past year, there is now hard data to support the notion that cardiac patients, though not necessarily cardiac surgery patients, benefit from full-time intensivists. Na et al[9, 10] retrospectively looked at two consecutive time periods in a cardiac ICU without and then with full-time intensivist care. These two studies examined the outcomes of cardiology, assist device, and ECMO patients cared for in a dedicated cardiac ICU. In the first article,[9] they analyzed 2400 cardiac admissions between 2012 and 2015. During the study period, a transition was made to employing full time, dedicated cardiac intensivists after 2013. Unlike prior studies where patients were grossly normalized by APACHE or SOFA scores on ICU admission, this study used sophisticated propensity matching to help assure validity of their results. In doing so, they showed a drop in mortality rate for these patients from 8.9% to 4.1%, and a 50% reduction in ICU mortality for those patients supported with extracorporeal membrane oxygenation after transition to full-time intensive care (Fig. 1). Their second publication[10] looking

specifically at patients who were inotrope or vasopressor dependent and exhibited circulatory shock similarly showed a mortality rate decrease of more than 30%, from 31% to 18%. Given the evidence, it would appear difficult to argue that cardiac patients should receive anything less than full-time, intensive care.

There are 3 more aspects to cardiac care that we would like to address.

Who belongs in the cardiac ICU: The literature has rarely addressed the relationship between the specialty training of the intensivist and outcomes in a cardiac ICU. In 2010, a comparison between pulmonary critical care and care provided by cardiac surgeons was studied in an academic cardiac ICU.[11] In that study Whitman et al, retrospectively, looked at two time periods, the first wherein postoperative cardiac care was given by pulmonary critically care-trained intensivists followed, and a second period during which care was given by cardiac surgeons. There was no difference in mortality between periods, but efficiency of care as measured by hospital length of stay and cost of drugs was reduced in those patients cared for during the time period staffed by cardiac surgeons. That paper did not question the need for full-time intensivists, but rather simply documented an apparent benefit to patient care as a function of the intensivist's area of specialty training. In fact, hospitals need to acknowledge that cardiac surgeons are trained in critical care and can adequately fill the role of the cardiac surgical intensivist. The American Board of Thoracic Surgery emphasizes "critical care" as one of the 4 legs of thoracic surgical training.

> "... documented experience in critical care will now be required to be eligible for initial certification. In addition, specific questions relating to critical care are now included in the initial certification and in the maintenance of certification examinations. The goal of these efforts is to ensure that ABTS Diplomates are prepared to care for their patients across the continuum of a hospital stay, including the intensive care unit, and have the necessary documentation to support doing so."[12]

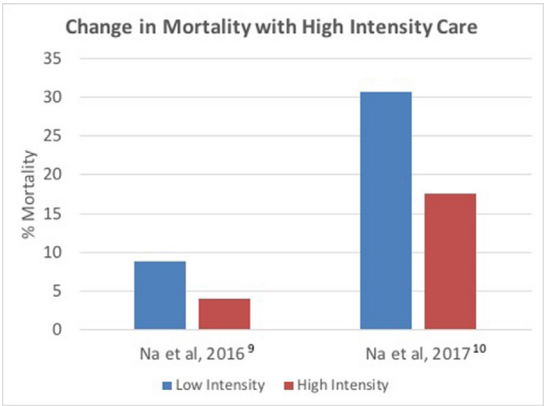

Figure 1. High intensity critical care in a Korean CICU significantly decreases cardiovascular mortality in overall patients,[9] and even more dramatically in patients supported with extracorporeal membrane oxygenation (ECMO).[10]

Closed vs co-managed units: The presence of full-time intensivists caring for our patients has the potential to be a double-edged sword. In a provocative paper, Olson et al[13] explored the well described conflict between the primary surgical team and the intensive care team that has frequently been reported by ICU clinicians.[14] Surveying neurosurgeons, vascular Surgeons, and cardiac surgeons, they documented that more than 50% of surgeons experienced conflicts with the intensivists caring for their patients, most notably regarding (1) clinical decision making for patients who had experienced a poor outcome or (2) communication with the families of those patients. Along with a variety of notably significant factors predicting conflict, surgeons practicing in a closed ICU reported conflict close to 70% more frequently than those practicing in an ICU, in which patients were comanaged. This study rings true to many of us, and emphasizes the importance of open communication and strong, mature leadership within the cardiac ICU.

The importance of the intensivist's specialty: We have at times felt that a cardiac surgeon may be the most appropriate director of a cardiac ICU, specifically to address this issue of conflict. Our thinking has been that a surgeon will have an easier time of expressing frustration and dissatisfaction and get more successful resolutions when talking to a physician who has trained and practiced as a cardiac surgeon. Cardiac surgeons understand firsthand the unique nature of our covenant with our patients and our personal investment in their well-being, one that may not be as profound in ICUs where the physician-patient relationship begins at the time of ICU admission, not before. On the other hand, we have learned that this is not at all essential. Much more integral to providing optimal care is the maturity of the ICU director and his or her team and the use of systems for conflict resolution and performance improvement. Essential is that care is characterized by open communication, a blame-free environment, and the development and maintenance of a common goal for each patient, for the unit, and for the service, as a whole.[15] In the highly performing cardiac ICU, the importance of specialty backgrounds is dwarfed by the effect of cooperation, respect, and team unity.

In conclusion, there should be no doubt that full-time intensivists should be the standard of care in the cardiac ICU, with the sickest benefitting the most from this level of service. Our patients deserve nothing less. All evidence suggests that cardiac patients benefit from high intensity care. Secondly, ICU care should be multidisciplinary, hopefully including a pharmacist. Finally, two important issues should be acknowledged:

(1) By virtue of our training, a cardiac surgeon has the knowledge to play the intensivist role.
(2) More important than the intensivist's specialty is the role that teamwork, open communication, and collaboration play in quality of patient care.

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