

Is Coronary Intensive Care Unit Volume a Quality Metric?

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Practice, the master of all things

—Augustus Octavius

Faced with a serious medical condition, care at a high-volume center would be generally supported by research. Across the medical, surgical, and critical care literature, annual institutional and individual physician volumes have been associated with improved patient outcomes in observational studies.^{1–6} For surgical or invasive procedures where an operator's skills and judgment are related clinical outcomes, the evaluation and establishment of minimum annual volumes to maintain procedural competency are more straightforward.⁷ The task of benchmarking minimum annual institutional or care-unit volumes for the care of common medical conditions, however, is confounded by the interplay of regional, institutional, and individual care-provider differences layered over the patient population characteristics and the environment in which the medical services are located (Figure). Consequently, the evaluation and establishment of institutional or care-unit volume as a quality metric that is clearly evidence-based, reproducible, and defensible is a far more problematic endeavor.

Current Status of Volume Relationships in Cardiac Critical Care

In cardiovascular inpatient care, both physician volume and specialty have been associated with lower patient mortality in myocardial infarction (MI) and heart failure care.^{8–10} Although interesting, the findings are not necessarily compelling. These studies were not able to clearly account for the contributions

of regional care systems, hospital unit types, staffing models, other teams of health care professionals, or differences among individual physician providers. In the latter case, it is conceivable that the volume relationship may vary by physician experience. At an institutional level, the relationship between volumes and outcomes is less clear. A recent analysis from the US Premier Perspective database reported wide interhospital differences in the critical care unit (CCU) admission rates of patients with heart failure; no mortality differences were observed, but low-volume centers had substantially higher admission rates and lower use of critical care-specific therapies.¹¹ Subsequently, a Canadian study using a population health data set reported that low-volume centers were more likely to admit patients with heart failure and acute coronary syndrome to CCUs.¹² Patients at low-volume centers required fewer critical care-specific therapies; had lower resource-intensive weighting; and, paradoxically, had longer CCU and overall hospital admissions. Similarly, no differences in in-hospital mortality were observed, but low-volume centers had higher 30-day cardiovascular readmission rates. Taken together, these studies suggest that low-volume CCUs admit lower risk cardiac patients who could otherwise be managed safely in lower acuity environments. These studies also identified opportunities to potentially standardize CCU admission criteria. Although annual CCU volumes were not associated with in-hospital mortality, these analyses were unable to account for many of the aforementioned regional, hospital, and individual provider variables; herein are some of the complexities required to comprehensively evaluate and quantify how annual physician or institutional volumes are associated with outcomes in the care of common medical conditions.

The Study in Context

In this issue of *JAHA*,¹³ Stolker and colleagues used a remote data-monitoring CCU data set to retrospectively identify 22 752 patients with MI from 248 mixed CCUs between 2008 and 2010. The authors described the differences in evidence-based therapies and clinical outcomes between patients admitted to low-volume (≤ 50 th percentile, < 2 MI patients per month) versus high-volume (≥ 90 th percentile, ≥ 8 MI patients per month) CCUs. In low-volume units, patients had higher unadjusted in-hospital mortality rates and longer lengths of

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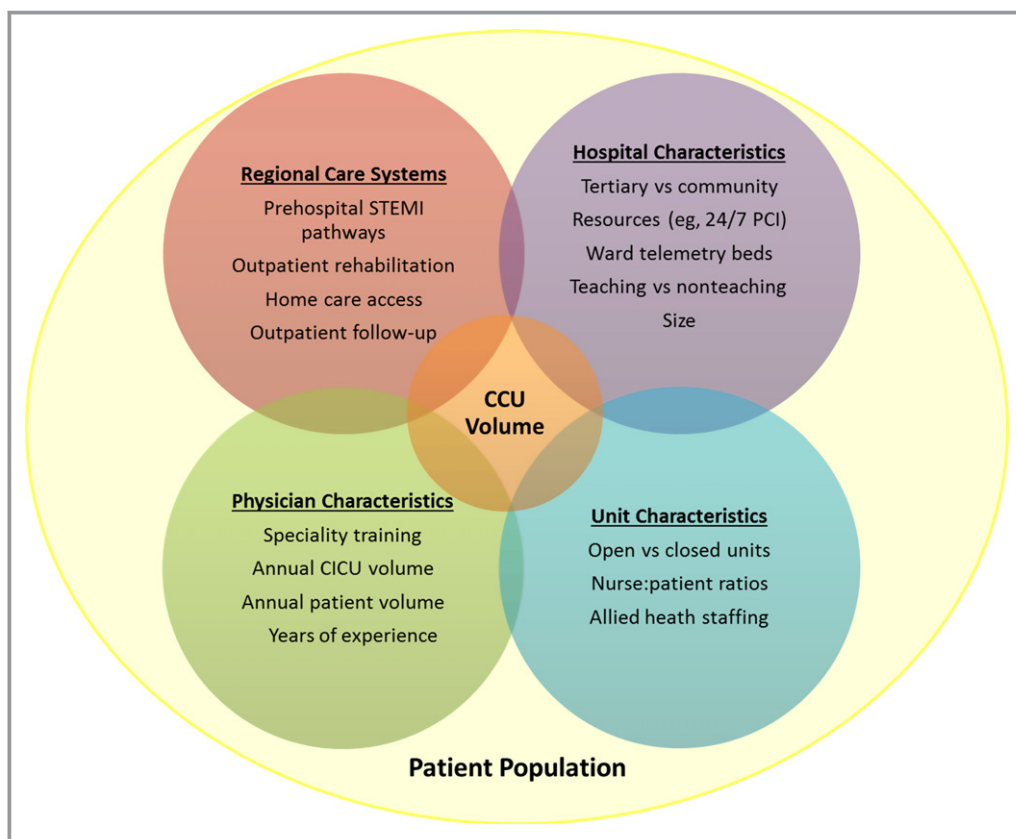


Figure. Interaction between regional care system, institution, care unit, individual physician, and patient characteristics in the CCU volume–outcome relationship. CCU indicates critical care unit; CICU, cardiac intensive care unit; PCI, percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction.

stay, and patients with ST-segment elevation myocardial infarction were less likely to receive reperfusion therapy. After multivariable adjustment, however, the associations between CCU volume and mortality and length of stay was no longer significant. These results were similar in a sensitivity analysis limited to cardiac units.

The authors should be commended for undertaking this analysis, which adds to the limited body of published research in this field. From a health services research perspective, the findings of this study suggest that in-hospital outcomes for MI are similar regardless of the monthly volume of CCU patients. The strengths of this analysis rest in the size of the study population, the number of CCUs, and the ability to include patients with MI admitted to a variety of CCU environments (medical, surgical, mixed, and cardiac units); this approach mirrors international clinical practices. The results, however, should be considered in light of the multiple limitations, which were appropriately acknowledged by the authors. First, the analysis cannot account for regional systems of care, individual medical provider specialty or volume, unit staffing, or each patient's triage or transfer pathway to the CCU from the point of hospital admission. Second, recognizing that postdischarge

outcomes may also reflect on institutional care quality, the lack of end points beyond hospital discharge in this analysis should also be acknowledged as a limitation. Finally, medical oversight by remote monitoring in this cohort cannot be extrapolated to other CCU care systems. It is particularly noteworthy that the study found a mean of 1 electronic intervention per day by a physician in low-volume units; this frequency was higher than in high-volume units. Consequently, the limitations of the study preclude drawing a definitive conclusion about a volume–quality relationship, but the findings provide additional perspective in this nascent field of study.

Future Direction for Research

The identification of minimal institutional or CCU patient volumes for common cardiac diagnoses could lead to improved outcomes through improved adherence to evidence-based care standards. At the present time, the limited body of observational research in this area does not support the implementation of a volume-based quality metric. Future studies should be directed along 4 central themes. First, studies should clearly

elucidate how annual volume and clinical outcomes are modified by regional care systems, institutional and CCU variables, and individual provider differences. Second, volume-related outcomes should be evaluated in high-acuity cardiac patients. In theory, patients with cardiogenic shock, advanced heart failure, cardiac arrest, or cardiogenic multisystem organ failure may be the most likely to benefit from care teams that are both familiar and facile with these less common conditions with high mortality rates. This approach was proposed by the American Heart Association's scientific statement advocating for the transformation of cardiac intensive care unit care and staffing and recommending centralization of care for the most critically ill and complex patients in level I tertiary cardiac intensive care units.¹⁴ Third, there is a need to derive and validate outcome-based point-of-care decision-support tools to support standardized CCU admission criteria for common cardiac conditions. Fourth, the aforementioned decision tools could underpin health services research aimed at reducing unnecessary cardiac intensive care unit admissions, hospital costs, and critical care bed capacity strain. Most clinicians intuitively believe that good clinical care is tied to maintaining a minimum practice volume, but delineating how much is enough remains an important question.

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None.

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