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The Ward or the Intensive Care Unit: Is It All Relative?

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As intensivists, decisions about whom *not* to admit to our care are often as challenging as decisions regarding patients already in the intensive care unit (ICU). For marginal patients—those with high acuity but no clear-cut ICU indications—admission to the general care ward typically means losing the reassurance and rapid ability to intervene provided by frequent vital signs, other advanced monitoring, and close geographic proximity to critical care nurses, physicians, and respiratory therapists. Not surprisingly, triage decisions are consequential; mortality is higher among critically ill patients initially triaged to the general care ward compared with those directly admitted to the ICU or among those with delays in accessing the ICU once ill (1, 2). Deteriorating ward patients may also have collateral effects on neighboring patients who share clinicians and clinical resources (3). On the other hand, overtriage of patients at low likelihood of benefit might expose patients to unnecessary risk and exacerbate limitations in ICU clinicians and beds (4, 5). Accurate, objective triage guidelines are essential, and central to this goal are studies that identify who benefits from ICU admission and why.

In an excellent series of papers, Anesi and colleagues have sought to provide strong observational evidence in support of these goals. The authors began with foundational work in 2020 when they identified hospital capacity strain as a determinant of ICU triage (6). Hospitals under strain—measured using markers of occupancy, acuity, and activity—admit fewer marginal patients to the ICU than they do when they are less strained. The authors leveraged this variability as a tool to study the potential benefits of ICU admission among patients not on mechanical ventilation or vasopressors (7). Specifically, they conducted an instrumental variable analysis in which capacity strain functioned akin to a coin flip in a randomized controlled trial by helping determine whether a marginal patient with sepsis or respiratory failure would go to the ICU or to the general care ward. Ultimately, they found that admission to the ICU among such patients was associated with shorter lengths of stay and improved survival in respiratory failure. The opposite was true among patients in the study with sepsis.

In this issue of *AnnalsATS*, Anesi and colleagues (pp. 406–413) ask two related questions about whether hospitals vary in their response to strain and in the benefits associated with ICU versus ward triage for respiratory failure (8). They begin with an established cohort of patients with acute respiratory failure presenting to emergency departments in each of 27 hospitals. They excluded people requiring mechanical ventilation or vasopressors and others with treatment limitation decisions that may have precluded ICU care. They then characterized strain temporally within each hospital and used regression to identify the relationship between strain and ICU versus ward triage. Models were adjusted for demographic characteristics, comorbidities, and severity of illness using laboratory and vital sign measurements.

Hospitals in the authors' study varied widely in the degree to which their triage decisions were influenced by strain; whereas some hospitals' practices were fairly static, others' predicted probability of ICU admission differed by up to 60% between times of high and low strain. That a potentially consequential decision varies so much depending on whether the hospital is strained is by itself a noteworthy finding. Workforce limitations, resource shortages, and high-strain events (e.g., periodic pandemic surges, natural disasters) are unlikely to abate in the near term and seem to cause tangible changes in how we care for patients with respiratory failure.

Next, the authors test whether the effects of ICU versus ward admission for marginal patients vary across hospitals. As in their earlier work, they use instrumental variable methods (Figure 1), with ICU capacity strain as an instrument (9). Within hospitals, they assume (with justifications where possible) that *1*) capacity strain is associated with ICU admission (there is a causal "arrow" between strain and ICU admission on the directed acyclic graph), *2*) capacity strain is associated with outcomes only via ICU admission (the only paths between strain and outcomes go through ICU admission), and *3*) there are no common causes of hospital strain and ICU admission (there are no other variables with arrows between both capacity strain and ICU admission). This method allows them to measure unbiased (e.g., unconfounded)

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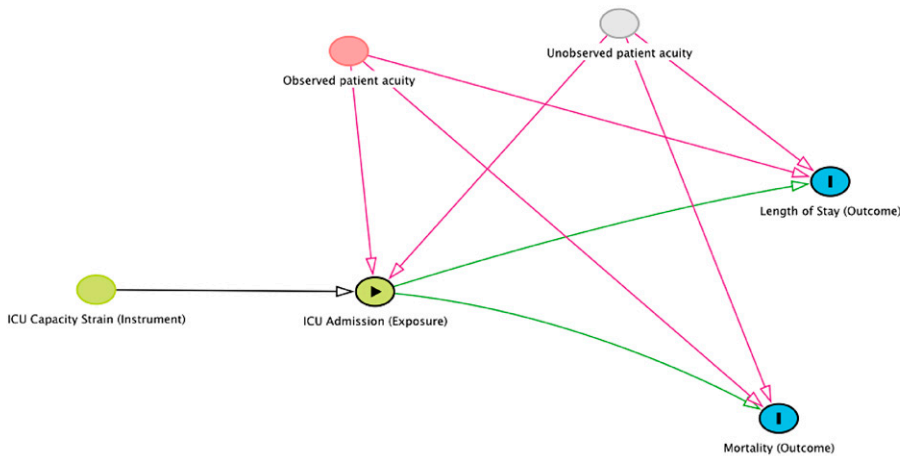

Figure 1. Directed acyclic graph describing the authors' instrumental variable analysis (created using DAGitty version 3.0; dagitty.net). ICU = intensive care unit.

benefits or harms associated with ICU admission among marginal patients (i.e., those without organ failure and whose emergency department triage destination is determined by whether the hospital is strained). In doing so, they find substantial hospital-level differences in both length of stay and mortality attributed to ICU versus ward triage. Put another way, an otherwise identical patient with moderate illness severity might be harmed by ICU admission at one hospital and saved by ICU over ward admission at another.

This finding suggests that the optimal location for an otherwise similar patient with moderate illness severity—for whom triage decisions are likely variable—is a hospital-specific characteristic, probably driven by features local to the ICU and ward environments. So, universal ICU triage guidelines that are valid across hospitals might not be plausible. Instead, future work might focus on identifying and implementing the features of wards or ICUs that make them more effective. The authors evaluated a broad range of protocols, staffing models, and capabilities across degrees of care at study hospitals. None of the surveyed practices, however, influenced the relative benefits of ICU versus ward admission. Beyond a deeper dive into the characteristics evaluated by the authors, several areas are ripe for further work leveraging modern advances in data availability, analytical techniques, and computational power.

First, we ought to continue leveraging electronic health record data to understand why the ICU does or does not improve outcomes for certain patients. What elements do high-functioning wards and ICUs share in common? Similarly, which complications do or do not occur that might explain the observed variation in benefit? In answering these questions, we will be better positioned to improve care across degrees of care while reducing reliance on overburdened ICUs for patients who can safely receive care elsewhere.

Second, locally developed clinical prediction models that apply rich electronic health record data may provide better identification of patients' potential for benefit from ICU transfer compared with more general guidelines. Modern machine learning techniques have the ability to incorporate patient diagnoses, vital signs, laboratory results, imaging data, and other characteristics into their predictions; clinical prediction models on the basis of these techniques can take advantage of this added nuance to identify patients who are most likely to deteriorate without higher degrees of care (10, 11). Triage rules applying such models warrant further evaluation.

Finally, we might reimagine ICU triage as matching specific patient needs to staff and resource availability in real time. It goes without saying that a patient hospitalized with respiratory failure requiring frequent nebulized medications or chest physiotherapy might do better in a location in which respiratory therapists and trained nurses are more available to care for them. At a given time, this might be in a specific ward, or it might be in an ICU. Real-time analytical tools that take into account the characteristics and needs of patients undergoing triage, the acuity and needs of other patients in the potential destination areas, and the specific resources currently available in those areas may be more effective than static triage guidelines. Such models might be able to deliver more effective care that responds to dynamic changes in staffing and workload.

This paper by Anesi and colleagues (8) and their related work represent important steps toward understanding relationships between ICU triage and subsequent outcomes for patients with respiratory failure and other critical illness syndromes. It should prompt further work on understanding how and why specific degrees of care matter for patients with respiratory failure, and efforts to increase access to the beneficial components of that care to all patients. ■

Author disclosures are available with the text of this article at www.atsjournals.org.

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Shortening the Journey from Evidence to Practice: The Benefits and Complexities of Hybrid Implementation-effectiveness Trials

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Translating evidence into practice is a long and arduous journey: 17 years, as the refrain goes (1). A traditional view sees this journey as linear; first, efficacy studies prove benefit, then effectiveness research creates knowledge in real-world settings, and finally, implementation science focuses on understanding and promoting uptake. With any one study in any phase potentially taking years to complete, the long period between the start of this journey and its end is unsurprising but, unfortunately, infeasible in the modern clinical care environment that needs treatment answers today. To address this evidence-to-implementation gap, hybrid effectiveness–implementation study designs have emerged (2), blending elements of effectiveness and implementation design to improve research efficiency and speed up knowledge translation. In this issue of *AnnalsATS*, Peltan and colleagues (pp. 424–432) give us an opportunity to consider the value and challenges of implementation research and hybrid implementation–effectiveness study designs. They report the results of a pilot hybrid trial of a complex and multifaceted program of several implementation strategies that, together, aimed to increase the use of lung protective ventilation directly (through audit and feedback, education, and championing of lung protective ventilation) and indirectly (by promoting increased use of clinical decision support tools in place to facilitate clinical decision-making) (3). Not only was the implementation itself multimodal, but the intended mechanism of practice change was also multipronged. They found that adherence to low tidal volume ventilation and other implementation outcomes indeed improved after intervention; however, no improvement was noted in several effectiveness outcomes, including mortality and ventilator-free days.

The study's strengths reveal the promise of implementation studies to shorten that journey from evidence generation to improved healthcare delivery. The investigators increased the efficiency of a complex, costly study by leveraging a hybrid trial design to create knowledge about implementation outcomes and clinical outcomes in tandem. Furthermore, this design acknowledges that the phases from proving efficacy to clinical practice change need not be entirely sequential. Intentionally combining elements of effectiveness and implementation recognizes that these parts cannot, and indeed should not, be separated and that evaluating one without the other would be a missed opportunity. For example, capturing data on implementation factors could and perhaps should be standard for an effectiveness study to enable the exportation of successful strategies to other settings. Another strength of this study is the investigators' approach to incorporating the possibility of secular trends in the analyses. By adding a secondary analysis using segmented regression, the investigators uncover that the findings of their primary analysis (that the period after intervention was associated with higher rates of adherence to lung protective ventilation) may have an alternative explanation and thereby potentially avoid incorrect conclusions about the impact of the specified implementation strategies. That finding also prompted them to recognize the silent or spillover implementation strategies that crept into the study, such as training local implementation teams before the study started.

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