Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Hospital characteristics and COVID-19: Hidden figures in COVID-19 risk models

Both clinicians and the general public are motivated to understand factors associated with death in critically ill patients with COVID-19. Age, sex, comorbidities, and organ failure are traditional factors in risk models, and the data collated for multivariate-adjusted risk models in recent reports have contributed valuable insights.[1,2] These data are largely from referral centers (tertiary and quaternary care), likely due to infrastructure that enables rapid dissemination of patient outcomes research.

In current reports of patient characteristics and predictors of critical illness and death in COVID-19, some analyses have incorporated structural measures such as ICU beds per hospital. For example, in one report, ICU bed risk models use hospitals with >100 ICU beds as the reference to compare adjusted risk models for hospitals with 50-99 ICU beds and <50 ICU beds.[1] But classification of hospitals with <50 ICU beds as "small" is inconsistent with most definitions. Using a 10% rule of thumb, hospitals with 40 ICU beds often have >400 hospital beds and are classified as large hospitals by the AHA and health services researchers.[3] Thus risk models based on number of ICU beds severely underrepresent small and medium hospitals, since the comparators are large hospitals (<50 ICU beds), larger hospitals (50-99 ICU beds), and still larger hospitals (>100 ICU beds). Assessments of hospital-level characteristics, however, should be interpreted with caution. Although empirical evidence is established for demographic and physiologic parameters, risk models for death tied to the structural measure of ICU beds per hospital without other attributes (i.e., intensivist availability) is insufficiently clear and may contribute to public perceptions of excess risk for COVID-19 death based on hospital bed counts.

Furthermore, although variation in outcomes has informed decisions about interhospital transfer of critically ill patients who require surgical intervention, less is known about the risk-benefit ratio for interhospital transfers to referral centers for patients who require complex medical care, including those with COVID-19–related critical illness. Measures of structure and process (hospital size, trauma center designation, ICU bed capacity) have been evaluated in the context of surgical interventions, but the evidence of a mortality benefit related to hospital services specific to complex (nonsurgical) medical care is weak. Recent linked analyses suggest that critically ill patients with sepsis (non-COVID-19) may not experience improved outcomes from interhospital transfer to referral centers,[4] and evidence-based practice in non-COVID-19 sepsis care is guiding COVID-19-related sepsis care. Given that only a minority of critically ill patients with COVID-19 are receiving highly specialized ICU interventions (<3% receiving ECMO),[1,5] access for most patients to hospital ICUs with care capabilities spans both referral and nonreferral centers. More than 50% of hospital ICUs in the U.S. are staffed with credentialed intensivists[3] for critical care intervention (e.g., mechanical ventilation, renal replacement therapy). However, risk-adjusted outcomes from nonreferral centers are less prominent or available for interpretation in comparison with the data contributed by larger centers. Further study of structure and process factors associated with mortality in critically ill patients with COVID-19 is warranted.

Selection bias, given the relative homogeneity of referral center data, presents a threat to internal validity for existing risk models of critical illness due to COVID-19. Balanced data to represent the diversity of US care delivery is needed. At present, it is unclear whether risk factors for death vary according to center size and whether or not interhospital transfer between nonreferral center ICUs and referral center ICUs is warranted when organ support (e.g., ventilators, renal replacement) and intensivist staffing (on-site or e-ICU) are accessible. Furthermore, in addition to unknown impact, the availability of investigational treatments for COVID-19 does not follow historical trends of access to new drugs or treatment modalities. For example, participation in convalescent plasma programs is relatively widespread with more than 2,800 hospitals participating in the US and territories.[6]

Small (<100 hospital beds) and medium (100-399 hospital beds) hospitals represent more than 80% of the hospitals with ICU beds in the US.[3] Detailed data pooled from medium and small hospitals is needed to advance our understanding of factors associated with death in critically ill patients with COVID-19. Ongoing analyses of the risk-benefit profiles for interhospital transfers for access to interventions that are traditionally accessible in larger centers, including investigational drugs and ECMO, are needed. Data representative of care delivered in large, medium, and small hospitals is needed to improve the generalizability of risk factors and risk-benefit profiles to reflect the demographics of hospital characteristics during the ongoing pandemic.

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