

## LESS IS MORE IN INTENSIVE CARE



# ICU beds: less is more? Yes

Thomas S. Valley<sup>1,2,3\*</sup>  and Danilo T. Noritomi<sup>4,5</sup>

© 2020 Springer-Verlag GmbH Germany, part of Springer Nature

In these extraordinary times, when intensive care unit (ICU) capacity is being outpaced by the dangers of the COVID-19 pandemic, ICU beds are a precious resource. However, when this crisis subsides, we may be left with greatly expanded ICU capacity. We, as intensivists, must act as leaders for our health care systems as there will be an opportunity to reevaluate two core tenets of critical care: (1) the definition of an ICU bed, and (2) the ideal number of ICU beds.

ICUs have been historically defined by several key concepts [1]. First, ICUs have the capacity to provide immediate, lifesaving care to patients who might otherwise die without it. Second, over time, ICUs have become defined by the multidisciplinary team providing care within them—intensivists, critical care nurses, respiratory therapists, and many other valuable clinicians. Finally, ICUs have increasingly become geographically defined within a hospital—resulting in the isolation of the sickest patients to one central location.

In this time of unimaginable ICU strain, the COVID-19 pandemic provides a glimpse into what is truly essential about intensive care. ICU beds remain incredibly important, but mainly due to their ability to provide immediate, lifesaving care—through clinicians trained in critical care and equipment, such as mechanical ventilators. These challenging times highlight that the traditional concept of a geographically isolated ICU may be less important than strategies to target resources to critically ill patients, wherever critical illness occurs. This concept of an “ICU without walls” is not new [2], but it seeks to maximize opportunities to treat critically ill patients through ICU-convertible beds, flexible allocation of lifesaving

resources, and expansion of the critical care specialty outside of the ICU and throughout the hospital.

While the COVID-19 pandemic has strained global ICU capacity, we must also recognize that global pandemics are uncommon, and ICU clinicians must continue to act as stewards to intensive care—one of the most lifesaving, yet expensive treatments in medicine. This tension—saving lives at great expense—underscores the need to carefully consider the ideal number of beds within an ICU. The decision to reduce the number of beds within an intensive care unit (ICU) can have major implications for patients, clinicians, and hospitals. Therefore, this decision is ideally made from a societal perspective (i.e., maximizing benefits and minimizing harms for an entire health care system).

The focus on ICU care can, at times, misallocate valuable health care resources. In health care systems with relatively few ICU beds per hospital, expanding ICU care may misallocate spending that could be more useful in other areas of health care. In systems with more ICU beds, reducing the number of ICU beds may improve efficiency. Thus, reasons to limit the number of ICU beds differ by the underlying resources available to a health care system and are supported by two key lessons from personal finance.

*#1. Don't tell me what your priorities are. Show me where you spend your money, and I'll tell you what they are.—James W. Frick*

Many health care systems struggle to provide optimal care to the critically ill because they lack sufficient ICU beds. For instance, Bangladesh has less than one ICU bed per 100,000 citizens [3]. Insufficient ICU beds result in patients who might benefit from ICU care not receiving it [4]. In these constrained settings, it is difficult to suggest that less ICU beds are more. Instead, we might consider whether expansion of ICU care is the optimal investment for resource-limited health care systems.

\*Correspondence: valleyt@med.umich.edu

<sup>1</sup> Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine, University of Michigan, Ann Arbor, MI, USA  
Full author information is available at the end of the article

Rather than expanding ICU capacity, three alternative strategies may improve population health: enhancing primary care, regionalizing critical care, and improving advanced care planning. Each of these interventions may also indirectly reduce the number of ICU beds needed within a hospital.

In limited resource settings, shifting money toward ICU care may restrict efforts in other areas of health care. For instance, one day in a Vietnamese ICU costs 28 U.S. dollars, on average. Yet, annual per capita health care spending in Vietnam is only 48 U.S. dollars [5]. Increasing funding to support primary and preventative care may avert or at least reduce the need for critical care. For example, a substantial proportion of ICU admissions may have been avoidable with the use of primary care-based interventions [6].

Regionalizing critical care (i.e., using a hierarchical system where designated high-volume hospitals routinely accept critically ill patients from lower-volume hospitals) may improve efficiency and outcomes [7]. Transferring a patient can be burdensome for patients, families, and clinicians. It may also be of less utility in densely populated areas with multiple hospitals. However, encouraging transfer of the most critically ill patients out of low-volume hospitals may improve outcomes via the volume-outcome effect, permit allocation of ICU resources to other patients likely to benefit from ICU care, and reduce the need for smaller hospitals to expand critical care services.

Despite recent increases in survival after critical illness, a large proportion of survivors die within 6 months [8]. Many of these patients may have benefited from advanced care planning. Having fewer ICU beds would force health care systems to emphasize, implement, and optimize advanced care planning for the elderly and the chronically ill. Improved advanced care planning would permit ICU beds to be reserved for patients who would clearly benefit from ICU care or promote time-limited trials for those in whom benefit is less clear [9–11].

*#2. “Many people take no care of their money till they come nearly to the end of it.”—Johann Wolfgang von Goethe*

Compared to Bangladesh, the U.S., Canada, and many Western European countries have 10 to 30 times the number of ICU beds [12]. In these health care systems, the onus is placed on clinicians to carefully “budget” the use of these beds. In other words, clinicians must thoughtfully consider whether an individual patient might benefit from ICU care. Ideally, clinicians would have clear, consistent, and established standards for which types of patients should receive ICU care. As a result, patients who would benefit from ICU care would receive it, while others would not.

Yet, the preponderance of evidence suggests that ICU clinicians allocate intensive care services inefficiently as increased ICU bed availability leads to ICU care for those who may not need it. Several studies demonstrate a clear association between the number of available ICU beds and the likelihood that a patient will be admitted to an ICU [13, 14]. For example, one study revealed that ICU’s with high bed availability were much more likely to admit patients who were either too sick or too healthy to benefit from ICU care than ICU’s with limited bed availability [13]. The abundance of ICU beds has led to indiscriminate use of ICU care—where critically ill and non-critically ill patients are granted ICU access in a first-come, first-served model until ICU beds become limited. Reducing the number of ICU beds should promote the use of ICU care for the sickest patients.

Several studies also suggest that less ICU use would not worsen patient outcomes and would increase health care efficiency. For example, one study from the U.S. Veterans Affairs health care system demonstrated that the majority of their ICU patients had a predicted mortality of less than 2% [15]. Other studies among patients with pulmonary embolism and diabetic ketoacidosis have also suggested that many hospitals overuse ICU care for these traditionally low-mortality conditions [16, 17]. Reducing the number of available ICU beds should constrain ICU use and lessen the urge to expand the critical care workforce, without negatively impacting clinical outcomes.

Limiting the number of ICU beds is not always beneficial. Indeed, in these uncertain times, it may even seem

**Table 1 Interventions that might limit ICU use and their potential benefit to health care systems based on their resources**

Interventions that might limit ICU use	Benefit to a low-resource system	Benefit to a high-resource system
Promoting primary care and prevention	+++	++
Regionalizing critical care	+++	++
Maximizing advanced care planning	++	+++
Improving ICU triage practices	++	+++
Reducing the number of available ICU beds	–	+

outlandish. However, in the current critical care landscape, where some health care systems are seeking to improve ICU efficiency while other health care systems are contemplating whether to finance the expansion of intensive care over other needs, less ICU beds may be more in improving population health (Table 1).

#### Author details

<sup>1</sup> Division of Pulmonary and Critical Care Medicine, Department of Internal Medicine, University of Michigan, Ann Arbor, MI, USA. <sup>2</sup> Institute for Healthcare Policy and Innovation, University of Michigan, Ann Arbor, MI, USA. <sup>3</sup> Center for Bioethics and Social Sciences in Medicine, University of Michigan, Ann Arbor, MI, USA. <sup>4</sup> Department of Critical Care Medicine, Hospital Israelita Albert Einstein, São Paulo, SP, Brazil. <sup>5</sup> Quality and Patient Safety Department, Rede Ímpar, São Paulo, SP, Brazil.

#### Funding

Dr. Valley acknowledges funding from the National Institutes of Health (NHLBI K23 HL140165).

#### Compliance with ethical standards

#### Conflicts of interest

The authors have no conflicts of interest to disclose.

#### Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Received: 26 February 2020 Accepted: 6 April 2020

Published online: 25 April 2020

#### References

1. Marshall JC, Bosco L, Adhikari NK et al (2017) What is an intensive care unit? A report of the task force of the World Federation of Societies of Intensive and Critical Care Medicine. *J Crit Care* 37:270–276
2. Hillman K (2002) Critical care without walls. *Curr Opin Crit Care* 8:594–599
3. Phua J, Faruq MO, Kulkarni AP et al (2020) Critical care bed capacity in Asian countries and regions. *Crit Care Med* 48(5):654–662
4. Robert R, Reigner J, Tournoux-Facon C et al (2012) Refusal of intensive care unit admission due to a full unit: impact on mortality. *Am J Respir Crit Care Med* 185:1081–1087
5. Turner HC, Hao NV, Yacoub S et al (2019) Achieving affordable critical care in low-income and middle-income countries. *BMJ Global Health* 4:e001675
6. Weissman GE, Kerlin MP, Yuan Y et al (2020) Potentially preventable intensive care unit admissions in the United States, 2006–2015. *Ann Am Thorac Soc* 17:81–88
7. Kahn JM, Branas CC, Schwab CW, Asch DA (2008) Regionalization of medical critical care: what can we learn from the trauma experience? *Crit Care Med* 36:3085–3088
8. Wunsch H, Guerra C, Barnato AE, Angus DC, Li G, Linde-Zwirble WT (2010) Three-year outcomes for Medicare beneficiaries who survive intensive care. *JAMA* 303:849–856
9. Detering KM, Hancock AD, Reade MC, Silvester W (2010) The impact of advance care planning on end of life care in elderly patients: randomised controlled trial. *BMJ* 340:c1345
10. Quill TE (2011) Time-limited trials near the end of life. *JAMA* 306:1483
11. Ramos JGR, Ranzani OT, Perondi B et al (2019) A decision-aid tool for ICU admission triage is associated with a reduction in potentially inappropriate intensive care unit admissions. *J Crit Care* 51:77–83
12. Prin M, Wunsch H (2012) International comparisons of intensive care: informing outcomes and improving standards. *Curr Opin Crit Care* 18:700–706
13. Robert R, Coudroy R, Ragot S et al (2015) Influence of ICU-bed availability on ICU admission decisions. *Annals of Intensive Care* 5:1–7
14. Stelfox HT, Hemmelgarn BR, Bagshaw SM et al (2012) Intensive care unit bed availability and outcomes for hospitalized patients with sudden clinical deterioration. *Arch Intern Med* 172:467–474
15. Chen LM, Render M, Sales A, Kennedy EH, Wiitala W, Hofer TP (2012) Intensive care unit admitting patterns in the veterans affairs health care system. *Arch Intern Med* 172:1220–1226
16. Admon AJ, Seymour CW, Gershengorn HB, Wunsch H, Cooke CR (2014) Hospital-level variation in ICU admission and critical care procedures for patients hospitalized for pulmonary embolism. *Chest* 146:1452–1461
17. Gershengorn HB, Iwashyna TJ, Cooke CR, Scales DC, Kahn JM, Wunsch H (2012) Variation in use of intensive care for adults with diabetic ketoacidosis\*. *Crit Care Med* 40:2009–2015