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.

Considerations for ventilator triage during the COVID-19 pandemic

The global pandemic of coronavirus disease 2019 (COVID-19) is placing significant strain on health-care resources worldwide.[1] Although most patients infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) do not require hospital admission,[1] severe illness commonly leads to acute respiratory distress syndrome necessitating invasive mechanical ventilation.[2] Unfortunately, ventilator scarcity has become a bottleneck in the provision of care to critically ill patients with COVID-19.[1]

The separation of clinical care from triage decision making is recommended in pandemic triage protocols.[3] This approach is important, because resource allocation and the ethics of face-to-face patient care have the potential to be at odds in individual cases. Furthermore, this separation might help to reduce the moral distress experienced by health-care providers in the event that patients are excluded from receiving scarce resources, including invasive mechanical ventilation, or if the decision is made to pursue palliative extubation.[4] Compared with clinical judgment, triage systems might be more likely to apply medical decision making consistently across large groups of patients.[3]

Existing ventilator triage guidelines facilitate ventilator allocation on the basis of illness severity, giving priority to the sickest patients with a reasonable chance of a desired outcome.[1] More controversially, priority might be given to certain patient populations, such as younger patients, with a higher likelihood of recovery and maximisation of life-years saved. Health-care providers with COVID-19 might also be prioritised on the basis of their role in treating patients affected by the pandemic.[1]

Determination of illness severity should occur during initial assessment and at regular time intervals. Serial assessments aim to estimate the trajectory of a patient's clinical course, which in turn informs ventilator triage decisions. Patients with improving clinical status should be considered for endotracheal extubation and transfer out of the intensive care unit, whereas patients with worsening clinical status and poor overall prognosis should be considered for palliative extubation and palliative care.[5] Illness severity should be determined using a combination of clinical and laboratory findings. A validated method to combine these findings is the sequential organ failure assessment (SOFA) tool, which reflects the function of six organ systems. An elevated SOFA score is one of several tools that have been used to triage scarce resources during the COVID-19 pandemic.[4] Further stratification on the basis of specific clinical phenotypes or biomarkers would enhance the specificity of triage; however, in the setting of COVID-19, more evidence is needed before such approaches can be implemented.

Ventilators are one part of the whole of critical care resources that require careful stewardship during a pandemic. Other resources that might be limited include endotracheal tubes, vasopressors, sedatives, extracorporeal membrane oxygenation, intensive care space, and critical care nurses and physicians. Allocation principles are meant to mitigate the worst outcomes that might result from a scarcity of resources during a crisis. A flexible approach to triage decision making should be taken to respond to emerging knowledge of the mechanisms and course of COVID-19. Hospitals should adopt policies for making transparent allocation decisions about ventilators and other critical resources that are based on an explicit ethical framework. The emerging gold standard is for triage teams to make decisions independently from, and in communication with, frontline clinical staff.[5] These teams should be multidisciplinary, be connected to a hospital ethics committee, and report to hospital leadership. It is also the role of governments to counter shortages through legislation, mobilisation of resources, and provision of supplies to communities hit hardest by the pandemic.

We thank Rosamond Rhodes for thoughtful discussion on the ethical principles of triage, and for providing resources on the topic. We declare no competing interests.

*Max M Feinstein, Joshua D Niforatos, Insoo Hyun, Thomas V Cunningham, Alexandra Reynolds, Daniel Brodie, Adam Levine

max.feinstein@mountsinai.org

Department of Anesthesiology, Perioperative and Pain Medicine, Icahn School of Medicine at Mount Sinai, New York, NY 10029, USA (MMF, AL); Department of Emergency Medicine, The Johns Hopkins Hospital, The Johns Hopkins School of Medicine, Baltimore, MD, USA (JDN); Department of Bioethics, Case Western Reserve University School of Medicine, Cleveland, OH, USA (IH); The Center for Bioethics, Harvard Medical School, Boston, MA, USA (IH); Kaiser Permanente Southern California Bioethics Program, Los Angeles, CA, USA (TVC); Loyola Marymount University Bioethics Institute, Los Angeles, CA, USA (TVC); Department of Neurosurgery, Icahn School of Medicine at Mount Sinai, New York, NY, USA (AR); Division of Pulmonary, Allergy and Critical Care Medicine, Department of Medicine, Columbia University Medical Center, New York, NY, USA (DB)

1 Emanuel EJ, Persad G, Upshur R, et al. Fair allocation of scarce medical resources in the time of Covid-19. *N Engl J Med* 2020; published online March 23. DOI:10.1056/NEJMsb2005114.

2 Arentz M, Yim E, Klaff L, et al. Characteristics and outcomes of 21 critically ill patients with COVID-19 in Washington State. *JAMA* 2020; published online March 19. DOI:10.1001/jama.2020.4326.

3 Biddison LD, Berkowitz KA, Courtney B, et al. Ethical considerations: care of the critically ill and injured during pandemics and disasters: CHEST consensus statement. *Chest* 2014; **146:** e145S–55S.

4 Truog RD, Mitchell C, Daley GQ. The toughest triage — allocating ventilators in a pandemic. *N Engl J Med* 2020; published online March 23. DOI:10.1056/NEJMp2005689.

5 White DB, Katz MH, Luce JM, Lo B. Who should receive life support during a public health emergency? Using ethical principles to improve allocation decisions. *Ann Intern Med* 2009; **150:** 132–38.

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Lancet Respir Med 2020

Published Online
April 28, 2020
https://doi.org/10.1016/S2213-2600(20)30192-2