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individuals or clinicians will act on the test results, availability, and cost. Although trials of the use of rapid diagnostics are ideal to assess the potential net effect of all of these variables on important outcomes, doing such trials across the wide range of potential uses of rapid diagnostics, especially in the context of a global health emergency, is challenging. Modelling studies that incorporate these parameters and are informed by real-world data from field studies can and should inform the investments being made in the development and use of rapid diagnostics. In future years, we will probably continue to need to respond to annual cycles of respiratory infection, including variants of SARS-CoV-2 and seasonal strains of influenza. Routine use of rapid diagnostic tests in emergency rooms and inpatient areas could play an important part in reducing mortality associated with these infections.

I declare no competing interests.

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Should we ration extracorporeal membrane oxygenation during the COVID-19 pandemic?

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The COVID-19 pandemic has raised challenging questions about the rationing of intensive care unit (ICU) beds, mechanical ventilators, and extracorporeal membrane oxygenation (ECMO).¹ Experts have recommended that ECMO be curtailed or even halted when patient numbers surpass an ill defined threshold, wherein demand for critical care outstrips available resources.² It might seem counterintuitive to reduce the provision of ECMO at precisely the time when demand increases, yet it could be deemed necessary. In this Comment, we argue that a decision to curtail or continue ECMO should be deliberate and reasoned, such that alternatives are actively rejected.

According to a large German registry, approximately 17% of patients with COVID-19 treated in hospital during the first few months of the pandemic required mechanical

ventilation and 1% received ECMO.³ Both modalities are complex and can entail a prolonged ICU stay; however, the resource intensity of ECMO is typically higher, especially with respect to ICU staffing.⁴ Therefore, if ICU staff are the primary scarce resource, cessation of an ECMO programme might result in more patients being treated. However, if it is not staff that are scarce, but mechanical ventilators or ICU beds, the same might not hold true.

ECMO comes relatively late in the acute respiratory distress syndrome (ARDS) treatment algorithm, and is only considered in a subset of patients with the most severe forms of ARDS.⁵ The value of ECMO is not universally accepted as part of established critical care in the way that mechanical ventilation is; therefore, access to ECMO might not be regarded as a right equal to access to mechanical ventilation.

When the volume of patients increases and demand surpasses available resources, hospitals and health systems seriously affected by the COVID-19 pandemic or other crises must transition from conventional standards of care to contingency standards and, ultimately, to crisis standards of care, if mitigation efforts are not sufficiently successful (figure; appendix pp 1–2).⁶ It is particularly challenging to identify the specific point in time during a pandemic when crisis standards of care should be adopted. Unlike a single mass casualty event, the experience with COVID-19 suggests that the process will be dynamic during a pandemic, with a threshold that is crossed more than once in both directions, and that different resources will be constrained at different points in time.⁷ Furthermore, it has been clear that many governmental agencies will be reluctant to invoke crisis standards of care for political reasons, even when potentially lifesaving treatments, which under normal conditions are available in sufficient quantities to everyone who needs them, become scarce and must be rationed at individual hospitals to a much greater degree than under normal circumstances.⁸

Two basic elements should be considered for decision making and balancing of resources between treatment with mechanical ventilation and ECMO: consensus on the prioritisation of ethical principles, including outcome-oriented utilitarian principles and rights-oriented egalitarian principles, as the basis for rationing decisions, and incorporation of these principles into triage guidelines for use during crises.^{3,7} Ideally, this prioritisation exercise should occur before a crisis occurs. However, during the COVID-19 pandemic, such consensus had not been achieved in time to act. In this situation, experts, professional organisations, and governments must attempt to reach agreement on the principles to be applied to guide bedside clinicians who have no choice but to make such decisions, with or without the guidance of society at large.

Calls for a limitation of ECMO services under late contingency or crisis standards of care are aimed at assuring that the highest number of patients can be treated with mechanical ventilation or other ICU resources.² Before assuming that rationing of ECMO is the optimal approach, the validity of the argument and the underlying principles should be disclosed and discussed, and the alternatives explicitly rejected.

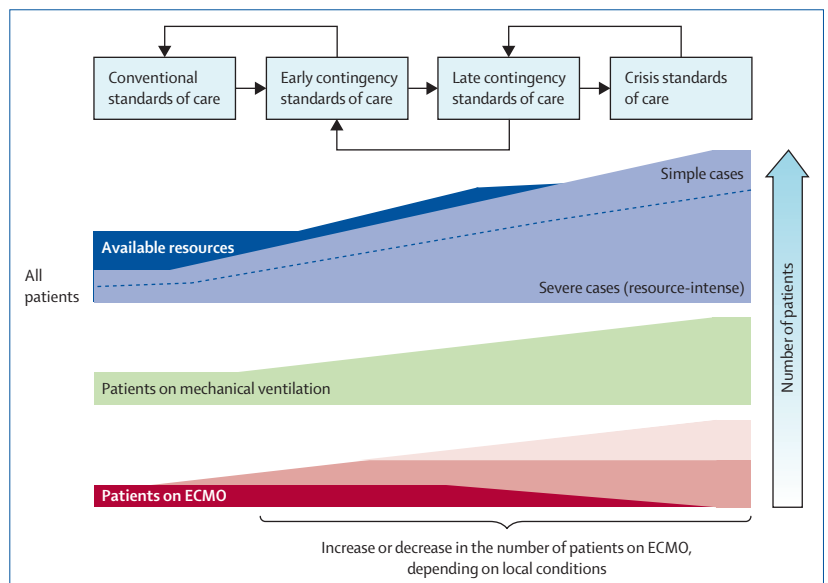


Figure: Transitioning between standards of care during an acute crisis
 Before life-saving treatments are rationed, efforts should be taken to extend available resources and to use them most efficiently and effectively. These efforts have to be continued, even after entering crisis standards of care, to return to a previous step as soon as possible. Depending on the ethical principles adopted and patient characteristics, levels of ECMO offered could be the same as those provided during normal circumstances, reduced, or even increased during the transition from normal to crisis standards of care. ECMO=extracorporeal membrane oxygenation.

When rationing is required, a standard therapeutic measure such as ECMO should not be reduced or withheld simply because it is resource intense. Such a decision must follow individual patient-centred considerations. If utilitarian reasoning is adopted as a guiding principle, outcome prediction with suitable and validated scores should be applied. Precise scores of this nature do not exist at present.⁹ Limited resources should then be distributed in a way that allows health systems to achieve the highest number of lives saved. This approach could result in reduced, unchanged, or even increased numbers of patients being treated with ECMO, depending on the specific resources in scarcity and the purported effectiveness of ECMO use in the patients in question. If an approach more focused on individual rights is favoured instead, emphasis will be on guaranteeing a fair process for the distribution of scarce resources. Again, although this choice might result in reducing the number of patients treated with ECMO, there are circumstances in which this will not be the case.

See Online for appendix

Under crisis standards of care, with an overwhelming number of patients competing for a scarce resource (eg, mechanical ventilation or ECMO), a thorough comparative assessment of individual risks and prognosis will be challenging. Therefore, final allocation

decisions and commitment to the degree to which ECMO services can be provided require careful assessment of the specific resources that are scarce, the (additional) resources required for ECMO at a given centre, and the effect on other patients of choosing to offer ECMO to a specific patient in this environment. Further changes in ECMO technology, the human resources needed, or the evidence base supporting ECMO could alter the balance of whether or not to provide ECMO during late contingency or crisis standards of care during a pandemic.

Offering ECMO to a patient during a crisis also depends on the capabilities of the individual centre, including the actual effectiveness of this intervention at the respective centre under the current circumstances. Effectiveness of critical care can decrease when systems are under stress.¹⁰ If a centre has had no survivors among their patients treated with ECMO during a crisis, this should be factored into decision making. However, if many patients are believed to have survived because of ECMO, this should prompt greater consideration of the intervention, even in the context of waning resource availability.

There is neither an ethical nor an operational imperative requiring the cessation of ECMO services during a public health crisis, such as the COVID-19 pandemic. Ethical principles and triage guidelines based on these principles might or might not result in the cessation of ECMO services when demand outstrips available resources, depending on the circumstances and the choices made. Importantly, we believe that cessation of ECMO is an ethical option that should be explicitly considered during late contingency and crisis standards of care.

AS reports research grants and lecture fees from CytoSorbents and lecture fees from Abiomed, outside of the submitted work. DB reports grants from ALung Technologies; personal fees from Baxter, Xenios, and Abiomed; and

unpaid consultancy for Hemovent, outside of the submitted work. JRC reports grants from the National Institutes of Health and the National Palliative Care Research Center, and grants and personal fees from Cambia Health Foundation, outside of the submitted work. All other authors declare no competing interests.

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Ethics and evidence: learning lessons from pandemic triage

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As the northern hemisphere winter comes to a close, and many are looking forward to what is hopefully the end of the COVID-19 pandemic, there is a need to look back at the lessons to be learned.

One crucial ethical question has been how to allocate limited resources.¹ Alexander Supady and colleagues

criticise two elements of the triage or rationing guidance offered in the first wave.² The authors suggest that practical experience should lead to rejection of the use of triage committees for allocation decisions and rejection of allocation based purely on the so-called utilitarian principles—they focus on preference for