

Initial ELSO Guidance Document: ECMO for COVID-19 Patients with Severe Cardiopulmonary Failure

ROBERT H. BARTLETT,* MARK T. OGINO,†‡ DANIEL BRODIE,§¶ DAVID M. McMULLAN,|| ROBERTO LORUSSO,#
GRAEME MACLAREN,**††‡‡ CHRISTINE M. STEAD,* PETER RYCUS,* JOHN F. FRASER,§§¶¶ JAN BELOHLAVEK,|||
LEONARDO SALAZAR,## YATIN MEHTA,*** LAKSHMI RAMAN,††† AND MATTHEW L. PADEN†††

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The Extracorporeal Life Support Organization (ELSO) and all of the ELSO worldwide chapters have prepared this document to describe when and how to use extracorporeal membrane oxygenation (ECMO) in COVID-19 patients during this pandemic. It is a consensus guideline intended for experienced ECMO centers.

COVID-19 is a disease caused by the novel SARS-CoV-2 virus which appeared in December 2019 and is now a worldwide pandemic. Because it is a new viral disease, this guidance document is based on limited experience and written with the intention to be updated frequently as new information becomes available. A link to the latest version of this document will be found at <http://covid19.else.org>.

AQ3 From the *Extracorporeal Life Support Organization, Ann Arbor, Michigan; †Department of Paediatrics, Division of Neonatology, Nemours Alfred I duPont Hospital for Children, Wilmington, Delaware; ‡Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, Pennsylvania; §Columbia University College of Physicians and Surgeons, New York, New York; ¶Centre for Acute Respiratory Failure, New York-Presbyterian Hospital, New York, New York; ||Division of Cardiothoracic Surgery, Seattle Children's Hospital, Seattle, Washington; #Department of Cardiothoracic Surgery, Maastricht University Medical Centre, Cardiovascular Research Institute Maastricht, Maastricht, The Netherlands; **Cardiothoracic Intensive Care Unit, National University Hospital, National University of Singapore, Singapore; ††Yong Loo Lin School of Medicine, National University of Singapore, Singapore; †††Paediatric Intensive Care Unit, The Royal Children's Hospital, University of Melbourne, Melbourne, VIC, Australia; §§Critical Care Research Group, The Prince Charles Hospital, Brisbane, QLD, Australia; ¶¶Faculty of Medicine, University of Queensland, Brisbane, Australia; |||Department of Medicine-Department of Cardiovascular Medicine, General University Hospital in Prague and First Faculty of Medicine, Charles University in Prague, Prague, Czech Republic; ##Department of ECMO and VAD, Fundación Cardiovascular de Colombia, Bucaramanga, Colombia; ***Institute of Critical Care and Anaesthesiology, Medanta Hospital, New Delhi, India; ††††Division of Paediatric Critical Care, University of Texas, Southwestern Medical Center, Dallas, Texas; and †††††Division of Paediatric Critical Care, Emory University, Atlanta, Georgia.

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ECMO has, and will certainly continue, to play a role in the management of COVID-19 patients. It should be emphasized that this initial guidance is based on the current best evidence for ECMO use during this pandemic. Guidance documents addressing additional portions of ECMO care are currently being assembled for rapid publication and distribution to ECMO centers worldwide.

Correspondence: Matthew L. Paden, Department of Pediatrics, Emory University, 1405 Clifton Road, Atlanta, GA 30322. E-mail: matthew.paden@choa.org.

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Although most COVID-19 patients have moderate symptoms and recover quickly, some patients develop severe respiratory failure and acute respiratory distress syndrome (ARDS) requiring intensive care admission. The mortality in COVID-19 patients who require mechanical ventilation is high. Extracorporeal membrane oxygenation can be lifesaving in patients with severe forms of ARDS, or refractory cardio-circulatory compromise. Initial experience in Japan and South Korea with ECMO in >50 COVID-19 cases has had survivors, with many still receiving treatment.

An overview article in *Lancet Respiratory Medicine* examines the role of ECMO and ECMO centers during the COVID-19 pandemic.¹ Additionally, guides detailing the requirements for an ECMO program are available in both the medical literature² and the ELSO website.³ The Society of Critical Care Medicine also has promulgated guidelines for the management of COVID-19 patients and recommends the use of ECMO when conventional management fails.⁴ Due to the intensive hospital resource utilization, substantial staff training, and multidisciplinary needs associated with starting an ECMO program, ELSO recommends against starting new ECMO centers for the sole purpose of treating patients with COVID-19. As mentioned in a recent article by ELSO leaders in *JAMA*,⁵ for inexperienced centers, "ECMO is not a therapy to be rushed to the front lines when all resources are stretched during a pandemic." A list of experienced ECMO centers is provided on the ELSO website.⁶ During the COVID-19 surge, it is reasonable to concentrate those patients with the greatest chance of benefit from receiving ECMO in a hospital where an experienced ECMO team is available.

Extracorporeal membrane oxygenation indications, access, and management are described in the ELSO Guidance for Adult Respiratory and Cardiac failure on the ELSO web site (<https://else.org>). Extracorporeal membrane oxygenation is indicated in patients who have a high risk of mortality. There are several ways to measure mortality risk in ARDS. All include PaO₂/FiO₂ below 100, despite and after optimal care. For adult respiratory failure, the recently published EOLIA trial contains three indications that define severe ARDS where ECMO may be useful.⁷ Many standardized algorithms for ARDS therapies, such as **Figure 1** below, have been published and may be of aid to clinicians.⁸ When patients meet indications, ECMO should be initiated immediately in an experienced center, and not days later.

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Because the use of ECMO for COVID-19 is occurring during a pandemic which can overwhelm hospital resources, unique considerations for ECMO in COVID-19 patients are:

Should ECMO be Considered for COVID-19 Patients?

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This decision is a local (hospital and regional) responsibility. It is a case by case decision that should be reassessed

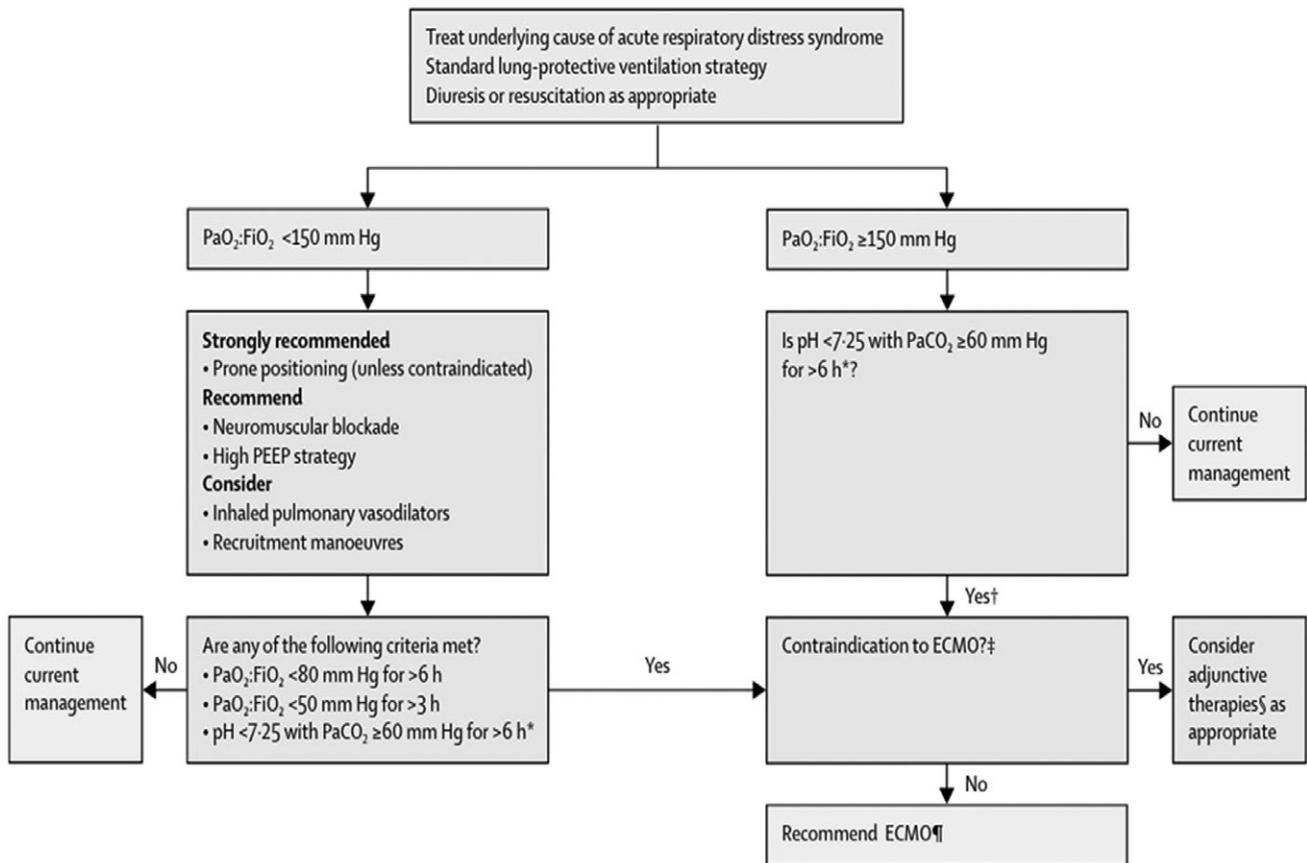


Figure 1. Algorithm for management of acute respiratory distress syndrome. *With respiratory rate increased to 35 breaths per minute and mechanical ventilation settings adjusted to keep a plateau airway pressure of ≤ 32 cm of water. †Consider neuromuscular blockade. ‡There are no absolute contraindications that are agreed upon except end-stage respiratory failure when lung transplantation will not be considered; exclusion used in the EOLIA trial¹ can be taken as a conservative approach to contraindications to ECMO. §Eg neuromuscular blockade, high PEEP strategy, inhaled pulmonary vasodilators, recruitment maneuvers, high-frequency oscillatory ventilation. ¶Recommend early ECMO as per EOLIA trial criteria; salvage ECMO, which involves deferral of ECMO initiation until further decompensation (as in the crossovers to ECMO in the EOLIA control group), is not supported by the evidence but might be preferable to not initiating ECMO at all in such patients. PEEP, positive end-expiratory pressure; $PaO_2:HO_2$, ratio of partial pressure of oxygen in arterial blood to the fractional concentration of oxygen in inspired air; ECMO, extracorporeal membrane oxygenation; $PaCO_2$, partial pressure of carbon dioxide in arterial blood.

regularly based on overall patient load, staffing, and other resource constraints, as well as local governmental, regulatory or hospital policies. If the hospital must commit all resources to other patients, then ECMO should not be considered until the resources stabilize. If the hospital feels that ECMO can be safely provided, then it should be offered to patients with a good prognosis with the use of ECMO, and perhaps to other patients who qualify for ECMO support (see below). Use of ECMO in patients with a combination of advanced age, multiple co-morbidities, or multiple organ failure should be rare.

Based on current medical evidence and outcomes, it is not appropriate to state “ECMO will never be considered for COVID-19 patients.”

Should ECMO During CPR Be Considered for COVID-19 Patients?

Due to the complexity and extensive team training associated with doing ECMO During CPR (E-CPR), centers who do not currently provide these services, should not initiate programs during times of limited resources. Inexperienced ECMO centers should consider whether to continue these programs

during resource-limited times. At experienced centers, E-CPR may be considered for in-hospital cardiac arrest depending on resource availability. However, in patients with COVID-19, the potential for cross-contamination of staff and the use of personal protective equipment by multiple practitioners when in short supply, should be considered in the risk-to-benefit ratio of performing E-CPR. Initiating E-CPR in patients with multiple co-morbidities or multiple organ failure should be rare.

Should ECMO Be Considered for Traditional Indications During the COVID-19 Pandemic?

Understanding hospital resource limitations as above, standard ECMO should continue when that is possibly related to overall hospital resources.

When ECMO Is Used

What Patients Are The Highest Priority?

Younger patients with minor or no co-morbidities are the highest priority while resources are limited. Health care workers are a high priority. It should be acknowledged that

this is a dynamic prioritization. As resources change, priorities should shift based on what can be safely done in the hospital-specific setting.

What Patients Should Be Excluded?

Standard contraindications apply terminal disease, severe central nervous system damage, Do Not Resuscitate status, or advanced directives refusing such therapy.

1. Exclusions for COVID-19 during limited resources are hospital or region-specific.
2. Because prognosis is worse with comorbidity, patients with significant co-morbidities should be excluded.
3. Because prognosis is worse with age, older age should be considered when balancing resource availability with the potential to improve outcomes.
4. Because prognosis is worse with time on invasive mechanical ventilation, patients on mechanical ventilation greater than 7 days (these are general guidelines which may not apply to specific COVID-19 patients depending on local circumstances) should be excluded.
5. Renal failure is not an exclusion.
6. Use of ECMO in patients with a combination of advanced age, multiple co-morbidities, or multiple organ failure should be rare.

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What Protective Measures for the Team Should Be Used?

Standard COVID-19 precautions as recommended by WHO and national health organizations should be used. There are currently no special precautions recommended for blood contact.

What is the Definition of Futility for Termination?

Not all patients will improve with ECMO support. As is standard with usual ECMO care, clinicians should be continuously evaluating when ECMO no longer provides a positive benefit:risk ratio and should at that point return to conventional management regardless of how long the patient has been on ECMO. During times of limited resources, this becomes especially important and while the definition will be hospital or region-specific, observing no lung or cardiac recovery after approximately 21 days (these are general guidelines which may not apply to specific COVID-19 patients depending on local circumstances) on ECMO can be considered futile, and the patient can be returned to conventional management (note: for situations where withdrawal of life-sustaining therapies is

not an option, this change of management does not constitute withdrawal.).

What is the Incidence of Cardiac Failure and How Is it Managed?

As in any patient, cardiac failure is defined as sustained hypotension despite other management. Failure is confirmed and measured by physiologic parameters and echocardiography. VA access is indicated, perhaps in the form of V-VA. Therefore, timely echocardiographic assessment in the presence of any clinical suspicion of cardiac dysfunction or sign of circulatory compromise should be undertaken.

For ELSO member centers, when you use ECMO for COVID-19, please enter your patient in the Registry at the time they go on (and later when discharged). Early registry entry allows ELSO to be able to provide member centers with real-time and up to date outcome and complication data. Centers that are using ECMO and are not ELSO members are encouraged to join ELSO and enter COVID-19 cases. Membership fee is waived during this pandemic.

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