



# Extracorporeal Membrane Oxygenation for Children

Last Updated: May 31, 2022

## Recommendation

- The COVID-19 Treatment Guidelines Panel (the Panel) recommends that the use of extracorporeal membrane oxygenation (ECMO) should be considered for children with acute COVID-19 or multisystem inflammatory syndrome in children (MIS-C) who have refractory hypoxemia or shock when hemodynamic parameters cannot be maintained or lung-protective strategies result in inadequate gas exchange (**CIII**). Candidacy for ECMO should be determined on a case-by-case basis by the multidisciplinary team.

## Rationale

ECMO is used as a rescue therapy for children with refractory hypoxemia or shock. Similar to outcomes for adults, outcomes for children managed with venovenous ECMO are variable and are influenced by the etiology and duration of respiratory failure and by underlying comorbid medical conditions.<sup>1,2</sup> In addition, studies have shown that pediatric centers that treat fewer patients with ECMO have worse outcomes than facilities that treat a high volume of patients with ECMO.<sup>3,4</sup> No randomized trials evaluate the efficacy or benefit of ECMO for hypoxemic respiratory failure in children without COVID-19 beyond the neonatal period. In an observational study of 122 children with severe pediatric acute respiratory distress syndrome (PARDS), 90-day mortality for children treated with ECMO and for those supported without ECMO was similar (25% vs. 30%).<sup>5</sup>

The Pediatric Acute Lung Injury Consensus Conference recommends considering ECMO for patients with severe PARDS from reversible causes or for children who are candidates for lung transplantation.<sup>6</sup> The *Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children* issued a weak recommendation, based on very low quality of evidence, to use venovenous ECMO for children with PARDS and refractory hypoxemia.<sup>7</sup>

Venoarterial ECMO has been used successfully for the treatment of refractory shock in children, although no trials evaluate this approach, and the potential benefits must be weighed against risks of bleeding or thromboembolic events.<sup>8-10</sup> The Surviving Sepsis Campaign guidelines for children issued a weak recommendation, based on very low quality of evidence, for use of venoarterial ECMO in children with shock that is refractory to all other treatments; however, a standardized definition of refractory shock in children is not available.<sup>7</sup>

Studies evaluating data on the use of ECMO in children with COVID-19 and MIS-C are limited to case reports and case series.<sup>11-13</sup> A publicly available [registry for pediatric patients with COVID-19 on ECMO](#) is maintained by the multinational Extracorporeal Life Support Organization (ELSO). In-hospital mortality at 90 days was about 30%, which is similar to reports from non-COVID-19 ECMO cohorts.<sup>14,15</sup> ELSO has published guidelines for use of ECMO in COVID-19.<sup>16</sup> In general, ECMO candidacy for children with COVID-19 or MIS-C should be assessed using criteria similar to those used for other causes of severe respiratory failure or shock. Cannulation approaches and management principles should follow published [international guidelines](#) and local protocols for non-COVID-19 patients.

Pediatric clinicians should consider entering patients into clinical trials or registries to inform future

recommendations regarding use of ECMO in children with COVID-19. The following resources provide more information on an international ECMO registry and on clinical trials evaluating ECMO in children with COVID-19:

- [The ELSO registry for ECMO in COVID-19](#)
- [ClinicalTrials.gov](#)

## References

1. Zabrocki LA, Brogan TV, Statler KD, et al. Extracorporeal membrane oxygenation for pediatric respiratory failure: survival and predictors of mortality. *Crit Care Med*. 2011;39(2):364-370. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/20959787>.
2. Gow KW, Heiss KF, Wulkan ML, et al. Extracorporeal life support for support of children with malignancy and respiratory or cardiac failure: the extracorporeal life support experience. *Crit Care Med*. 2009;37(4):1308-1316. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/19242331>.
3. Freeman CL, Bennett TD, Casper TC, et al. Pediatric and neonatal extracorporeal membrane oxygenation: does center volume impact mortality? *Crit Care Med*. 2014;42(3):512-519. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/24164955>.
4. Gonzalez DO, Sebastiao YV, Cooper JN, Minneci PC, Deans KJ. Pediatric extracorporeal membrane oxygenation mortality is related to extracorporeal membrane oxygenation volume in US hospitals. *J Surg Res*. 2019;236:159-165. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/30694751>.
5. Barbaro RP, Xu Y, Borasino S, et al. Does extracorporeal membrane oxygenation improve survival in pediatric acute respiratory failure? *Am J Respir Crit Care Med*. 2018;197(9):1177-1186. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/29373797>.
6. Dalton HJ, Macrae DJ, Pediatric Acute Lung Injury Consensus Conference Group. Extracorporeal support in children with pediatric acute respiratory distress syndrome: proceedings from the Pediatric Acute Lung Injury Consensus Conference. *Pediatr Crit Care Med*. 2015;16(5 Suppl 1):S111-S117. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/26035361>.
7. Weiss SL, Peters MJ, Alhazzani W, et al. Surviving Sepsis Campaign international guidelines for the management of septic shock and sepsis-associated organ dysfunction in children. *Pediatr Crit Care Med*. 2020;21(2):e52-e106. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/32032273>.
8. Schlapbach LJ, Chiletto R, Straney L, et al. Defining benefit threshold for extracorporeal membrane oxygenation in children with sepsis—a binational multicenter cohort study. *Crit Care*. 2019;23(1):429. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/31888705>.
9. Ramanathan K, Yeo N, Alexander P, et al. Role of extracorporeal membrane oxygenation in children with sepsis: a systematic review and meta-analysis. *Crit Care*. 2020;24(1):684. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33287861>.
10. Oberender F, Ganeshalingham A, Fortenberry JD, et al. Venoarterial extracorporeal membrane oxygenation versus conventional therapy in severe pediatric septic shock. *Pediatr Crit Care Med*. 2018;19(10):965-972. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/30048365>.
11. Di Nardo M, Hoskote A, Thiruchelvam T, et al. Extracorporeal membrane oxygenation in children with coronavirus disease 2019: preliminary report from the collaborative european chapter of the extracorporeal life support organization prospective survey. *ASAIO J*. 2021;67(2):121-124. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33009172>.
12. Alfoudri H, Shamsah M, Yousuf B, AlQuraini N. Extracorporeal membrane oxygenation and extracorporeal cardiopulmonary resuscitation for a COVID-19 pediatric patient: a successful outcome. *ASAIO J*. 2021;67(3):250-253. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33627597>.
13. Feldstein LR, Tenforde MW, Friedman KG, et al. Characteristics and outcomes of US children and adolescents

with multisystem inflammatory syndrome in children (MIS-C) compared with severe acute COVID-19. *JAMA*. 2021;325(11):1074-1087. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33625505>.

14. Extracorporeal Life Support Organization. Registry dashboard of ECMO-supported COVID-19 patient data. 2022. Available at: <https://www.elseo.org/Registry/FullCOVID-19RegistryDashboard.aspx?goHash=1&sO=1&all=true&NA=false&Eur=false&Asia=false&La=false&Africa=false&AA=false&Neo=true&Ped=true&Adlt=false&AllDts=true&YTD=false#TheFilter>. Accessed May 18, 2022.
15. Extracorporeal Life Support Organization. ELSO live registry dashboard of ECMO patient data. 2022. Available at: <https://www.elseo.org/Registry/ELSOLiveRegistryDashboard.aspx>. Accessed May 20, 2022.
16. Badulak J, Antonini MV, Stead CM, et al. Extracorporeal membrane oxygenation for COVID-19: updated 2021 guidelines from the extracorporeal life support organization. *ASAIO J*. 2021;67(5):485-495. Available at: <https://www.ncbi.nlm.nih.gov/pubmed/33657573>.