Staffing, Equipment, Monitoring Considerations for Extracorporeal Membrane Oxygenation

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KEYWORDS

• Extracorporeal membrane oxygenation • Monitoring • Educational models

KEY POINTS

- Training for extracorporeal clinicians should consist of a structured and evidenced-based educational format that incorporates both didactic and applied simulation components.
- Technological advancements in current pump, oxygenator, and cannula design have not only expanded the indications of extracorporeal support, but have also been associated with an improved delivery of care.
- Continuous clinical monitoring that measures the quality and safety parameters of extracorporeal support has demonstrated significant benefits in optimizing patient care and outcome.

INTRODUCTION

Despite several early reports of the successful use of extracorporeal membrane oxygenation (ECMO) in the 1970s,[1,2] adult ECMO failed to establish itself as a conventional therapy for cardiopulmonary resuscitation. Unable to demonstrate a significant clinical benefit in randomized controlled trials, the widespread interest for adult ECMO was nonexistent for nearly 30 years while its emergence in both neonatal and pediatric applications continued.[3,4] Within the last decade, this complex, life-sustaining treatment modality has experienced exponential growth in the United States,[5] with the

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observation of similar trends occurring in adult intensive care settings across the world.[6] Not only have international, critical care teams been able to increase the use of adult ECMO but also the duration of support has been safely and significantly prolonged, maximizing any potential and realized recovery for the native heart and lungs.[7]

Although the reasons for the recent growth in adult ECMO are multifactorial, much of the success may be attributed to the development of well-trained staff and the technological innovations in equipment and monitoring devices used during extracorporeal support. In this article, the authors discuss general educational formats for the ECMO bedside provider, staffing support models, and devices designed to best meet the needs of the patient while simultaneously ensuring the proper delivery of ECMO-related care.

Educational Models for Extracorporeal Membrane Oxygenation Specialists

Historically within the world of ECMO, training models for new employees have been heavily concentrated in didactical frameworks with competency assessment through written examinations and practical application stations to facilitate demonstration of required skills. As a professional multidisciplinary organization of ECMO, the Extracorporeal Life Support Organization (ELSO) recommends a didactic training course ranging from 24 to 36 hours.[7] Specifically, ELSO guidelines recommend these didactic hours be broken down as follows: 6 to 8 hours for disease inclusion and pathophysiology, 6 to 8 hours of ECMO physiology, 4 to 8 hours for review of extracorporeal life support (ECLS) equipment/basic procedures, 4 to 8 hours of emergency management training, and a minimum of 12 hours of bedside skill review.[7] This standard educational model facilitates a very concentrated indoctrination of core ECMO principles, with minimal time allotment granted toward practical application apart from the actual patient care environment.

Although this traditional education model has proven to be successful for many programs, research has demonstrated that this specific method of instruction can become static, whereas a more “hands-on” approach is far more sustainable for the end learner.[6] The direct utilization of technology in high-fidelity simulation training fosters an educational model that is both challenging and invigorating for the learner. With the incorporation of high-fidelity simulation into ECMO education, a training model can be created that is demonstrative of an environment that is both extremely realistic and directly elicits responsiveness from participants for scenarios that are introduced.[7] The result is a valuable, true-to-life educational opportunity that can be directly translatable to performance within the actual patient care setting.[8]

The provision of an in situ setting in which ECMO clinicians can have practical application sessions is an invaluable asset to any training model.[9] The emergence of commercial hydraulic extracorporeal simulators, such as the Califia (Biomed Simulation Inc, San Diego, CA, USA) and the Eigenflow (Curtis Life Research LLC, Indianapolis, IN, USA), facilitates specific manipulations that will produce variable patient-simulated responses. Because these simulators are compatible with all types of ECMO circuits, the fidelity of the learning environment is enhanced by managing the same components that clinicians are accustomed to using in the clinical setting. The development of a training model inclusive of a realistic practice environment for clinicians enhances learning through multiple factors, such as the provision of immediate performance feedback and repetitive skill practice by the identified learner.[7] Through the purposeful placement of learners into an artificial, patient care environment, the process of simulation acts to immerse the learner and therefore is able to