ELSO 2025 Narrative Guideline on ECMO Training and Continuing Education

Elizabeth A. Moore,* Peggy Han,† Kiran Shekar,‡ Kollengode Ramanathan,§ Jordi Riera del Brio,¶‖ Mateusz Puslecki,# Rodrigo Diaz,** Huda Alfoudri,†† Raj Ramanan,‡‡ Simon W. C. Sin,§§ Leen Vercaemst,¶¶ Tammy Friedrich,‖‖ Peter Roeleveld,## Ahmed Said,*** Guillaume Alinier,††† and Bishoy Zakhary‡‡‡

Reviewers: René D. Gómez Gutiérrez, Cara Agerstrand, Michael Kotwas, Peter Chi Kueng Lai, Jayne Sheldrake

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Key Words: ECMO, education, simulation, certification, competency-based education, training, curriculum

Since the publication of the Position Paper on Global ECMO Education in 2019,[1] there has been a four-fold increase in publications related to extracorporeal membrane oxygenation (ECMO) education, with many studies describing original curricula and educational interventions delivered using simulation, traditional didactics, online modules, and other multimedia.[2] Although this growth in ECMO educational scholarship mirrors the growing utilization of ECMO worldwide, particularly for adult and pediatric populations, there remains significant variability in educational practices across Extracorporeal Life Support Organization (ELSO) centers.[3] Although survival rates in the ELSO registry have remained relatively unchanged, and complication rates remain high,[4] this may, in part, reflect the increasing complexity of cases being treated. Nonetheless, the opportunity and need for consensus-driven, standard curriculum and competency assessment remain clear.

Multiple gaps inherent to ECMO education have historically made the worldwide adoption of a competency-based education framework challenging. First, ECMO practitioners are healthcare professionals with specialized training who demonstrate competencies in patient selection, circuit management, patient management, troubleshooting, and emergency response.[1] These practitioners come from diverse disciplines and have varying core skills and roles. As a result, creating a uniform assessment is challenging for both ECMO specialists (*eg*, nurses, respiratory therapists, perfusionists, or other ECMO-trained providers managing the circuit and bedside care) and ECMO physicians (*eg*,

From the *University of Iowa Heart and Vascular Center, University of Iowa Healthcare, Iowa City, Iowa; †Division of Critical Care Medicine, Department of Pediatrics, Stanford University School of Medicine, Palo Alto, California; ‡The Prince Charles Hospital, Metro North Health Service, Brisbane, Queensland, Australia; §National University Hospital, Singapore, Singapore; ¶Critical Care Department, Vall d'Hebron University Hospital, Barcelona, Spain; ‖Vall d'Hebron Research Institute, Barcelona, Spain; #Department of Medical Rescue, Poznan University of Medical Sciences, Poznan, Poland; **Programa de Oxigenación Por Membrana Extracorpórea, Clinica Red Salud, Santiago, Chile; ††Department of Anesthesia, Critical Care, and Pain Management, Al-Adan Hospital, Ministry of Health, Kuwait, Kuwait; ‡‡Department of Critical Care Medicine, University of Pittsburgh, Pittsburgh, Pennsylvania; §§Critical Care Unit, Queen Mary Hospital, Hong Kong, Hong Kong SAR (China); ¶¶Department of Perfusion, University Hospital, Leuven, Belgium; ‖‖Mayo Clinic, Rochester, Minnesota; ##Department of Pediatric Intensive Care, Leiden University Medical Center, Leiden, the Netherlands; ***Department of Pediatrics, Center for Applied Health Informatics, Institute of Informatics, Data Science and Biostatistics, Washington University, St. Louis, Missouri; †††Weill Cornell Medicine-Qatar, Doha, Qatar, Hamad Medical Corporation, Doha, Qatar; and ‡‡‡Division of Pulmonary and Critical Care, Oregon Health and Science University, Portland, Oregon.

Submitted for consideration January 2026; accepted for publication in revised form February 2026.

Disclosure: The authors have no conflicts of interest to report.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text, and links to the digital files are provided in the HTML and PDF versions of this article on the journal's Web site (www.asaiojournal.com).

Correspondence: Elizabeth A. Moore, University of Iowa Heart and Vascular Center, University of Iowa Healthcare, Iowa City, IA. Email: elizabeth-a-moore@uiowa.edu. Twitter: @elsoorg

DOI: 10.1097/MAT.0000000000002686

intensivists, cardiologists, surgeons, neonatologists, or anesthesiologists overseeing patient care and decision-making). Second, ECMO instructor development lacks a formalized process and defined milestones for transmitting high-quality information and valuable expertise. Third, competency-based assessment and certification processes are inconsistent across ECMO training centers.[5] Lastly, with a growing recognition that time-based training may not yield competent ECMO practitioners, educators are primed to clearly define desired programmatic outcomes, design curricula that facilitate the attainment of those outcomes, and establish programs of assessment to measure the extent to which those outcomes have been achieved.

The ELSO has introduced several guidelines to predefine educational objectives, including training guidelines for ECMO centers, ECMO Specialists, and certification programs, such as the ELSO-Adult ECMO Certification (E-AEC) and ELSO-Neonatal Pediatric ECMO Certification (E-NPEC).[6,7] These are early steps toward standardization and require further refinement to align with best practices in medical education. Reflecting efforts to reduce variability in ECMO training worldwide, where educational preparation and prior professional experience differ substantially across regions and disciplines, ELSO has developed an international, consensus-driven ECMO education curriculum, identified essential technical skills for troubleshooting ECMO emergencies, and created a standardized assessment of minimum competency. Extracorporeal Life Support Organization is updating its guidelines for ECMO education to establish a globally recognized, competency-based framework.

Purpose

The revised Guideline for Training and Continuing Education aims to:

- Align ECMO education with evidence-based instructional methodologies.
- Define minimum standards for initial and ongoing ECMO training and instructor development.
- Define standardized processes for assessment and certification of ECMO practitioners.

The guideline integrates best practices in simulation, debriefing, and adult learning principles to create a standardized and scalable ECMO education model. The goal is to promote a consistently high standard of ECMO care that reduces variability in ECMO training, provides centers with an essential, competency-based ECMO education framework, and ultimately leads to improvements in patient outcomes worldwide.

ECMO Education and Instructional Methodologies

An effective ECMO education program must integrate evidence-based instructional methodologies 1) to ensure providers develop the cognitive knowledge and technical skills necessary for safe and effective patient management and 2) to promote evaluation of the educational activity. All aspects of ECMO education should be grounded in conceptual frameworks and learning theory, ensuring that learning objectives align seamlessly with the teaching structure, design, and evaluation of effectiveness.[8–10] For instance, Miller's Pyramid of Clinical Competence serves as a valuable framework for assessing ECMO competency (Figure 1).

For cognitive skills such as knowledge of patient selection, ECMO modalities, physiology, complications, treatment strategies, and outcome prediction, traditional didactic teaching can be complemented by evidence-based instructional methods. These may include simulation-based learning, case-based discussions, interactive e-learning modules, flipped classroom models, and formative assessments. Together, these approaches create a more effective and engaging learning experience (Table 1).

Online modules and lectures meet the need for efficient information delivery to introduce foundational knowledge and essential information on a large scale. They also provide context for the subject material and motivate learners by highlighting the importance of what is to be learned. Knowledge can be augmented by integrating evidence-based practices, such as active learning (case-based discussions, hands-on activities), promoting reflection, appropriate modeling, and timely and directive feedback. Importantly, scaffolding and spaced repetition help to set a solid foundation of knowledge.

Simulation-based medical education (SBME) applies cognitive skills to real-life scenarios while enabling refinement of psychomotor skills. In ECMO, SBME may be used in two consecutive ways. First, drills for practicing and improving technical skills, such as de-airing a circuit, may be performed in a repetitive manner with directive feedback and reflection. This instructional methodology, best described as deliberate practice, is designed to move learners from novice to expert. Once adequate comprehension and grasp of foundational ECMO knowledge is achieved, the focus of SBME may shift toward the second goal of increasing cognitive load[12] by adding complexity, increasing time pressure, or adding distractions. This is an evidence-based approach[13] to enhance learning and potentially improve retention and transfer of knowledge in real-world scenarios. Critical to the application of these instructional methodologies for psychomotor skills are achievable learning objectives and alignment with the learner's level.

Lastly, simulation with a high degree of realism, otherwise known as high-fidelity simulation, has proven to be an essential educational tool to enhance team communication, improve crisis resource management skills, and bolster the collective ability to handle ECMO emergencies. Studies have demonstrated that this approach not only reduces errors but also leads to more effective clinical decision-making[8–10] and improves leadership and communication skills among clinicians.[12,13] Specifically, in ECMO, simulation studies have demonstrated improvement and retention in cannulation skills and nontechnical skills characterized by effective communication, teamwork, and leadership skills.[14] Additionally, a high-fidelity, ECPR simulation training program has shown significantly reduced "time to ECMO flow" in real events of ECPR.[15] The use of high-fidelity ECMO simulation for the purposes of enhancing team training and ultimately affecting patient outcomes is reflective of an evidence-based instructional methodology rooted in experiential learning theory. Simulation-based training thus fosters the development of critical competencies essential for handling complex and high-risk scenarios.[16] These elements are crucial for closing care disparities by ensuring

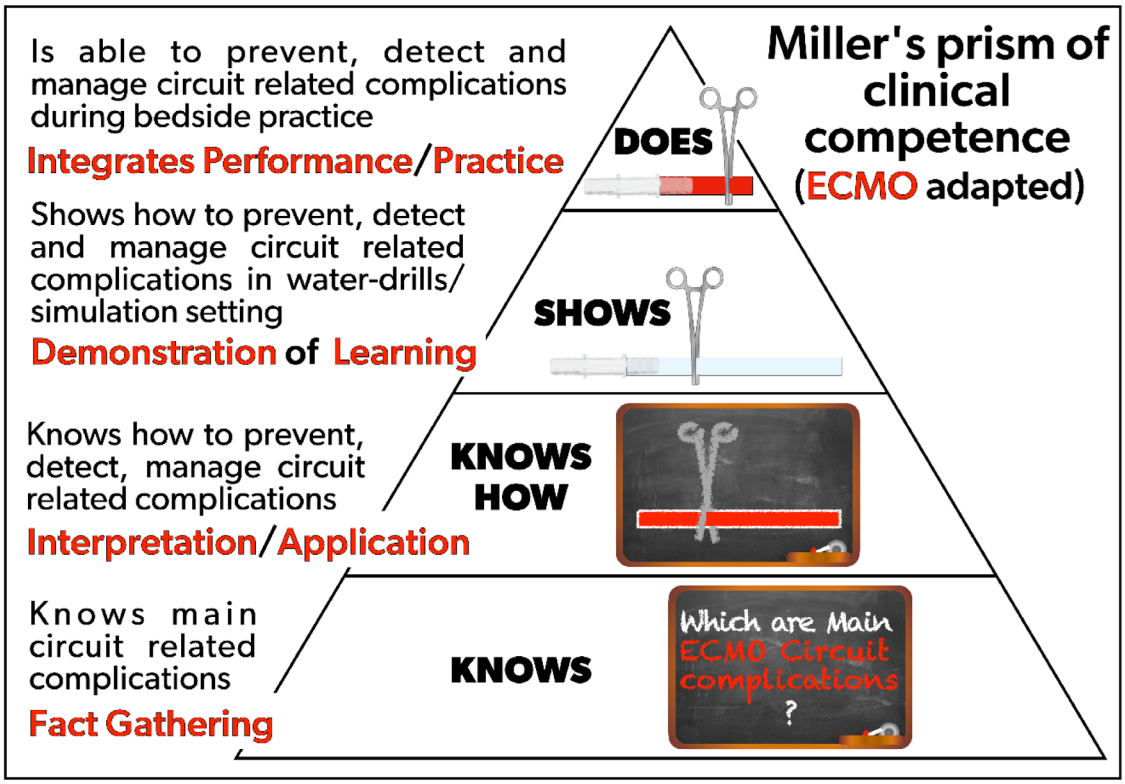

Figure 1. Adaptation of Miller's Pyramid of Clinical Competency for ECMO training illustrates the progression from foundational knowledge acquisition to higher levels of competence, including interpretation and application, demonstration of skills, and ultimately, integration into clinical practice. This structured approach aims to enhance patient care by ensuring that practitioners develop the necessary competencies at each stage.[11] ECMO, extracorporeal membrane oxygenation.

Table 1. Instructional Methods to Support Cognitive Skill Development in ECMO Education

Instructional Method	Description/Purpose
Didactic lectures	Foundational knowledge delivery
Simulation-based learning	Practice clinical scenarios and decision-making
Case-based discussions	Apply knowledge to real or hypothetical patient cases
E-learning modules	Flexible, self-paced learning with interactive elements
Flipped classroom	Pre-class study with in-class application and discussion
Formative assessment	Ongoing quizzes or tests to reinforce and assess learning

Didactic lectures provide foundational knowledge, whereas simulation, case-based discussions, e-learning modules, flipped classrooms, and formative assessments complement traditional teaching by enhancing application, interactivity, and learner engagement.

ECMO, extracorporeal membrane oxygenation.

that ECMO practitioners meet a standardized level of proficiency (Table 2).

Minimum Standards for Initial ECMO Training

Key components of effective ECMO training include didactic learning, hands-on simulation, competency-based assessments, team training with emphasis on human factors, ongoing continuing education, and affordability.[17] Using Delphi methodology to obtain international consensus, we present below the development of an initial standardized ECMO curriculum.

Knowledge Content

Badulak *et al*.[18] published the first consensus among international experts for essential learning objectives reflecting minimum requirements for knowledge of ECMO. This led to the creation of the ELSO adult ECMO curriculum (Appendix I, Supplemental Digital Content, https://links.lww.com/ASAIO/B882). A similar process was applied to learning objectives for the neonatal and pediatric ECMO curriculum (Appendix II, Supplemental Digital Content, https://links.lww.com/ASAIO/B883), ensuring alignment with evidence-based practices. Both curricula address all learning objectives with expert-created digital modules that incorporate visual aids, videos, and interactive elements, rendering an engaging and accessible curriculum for a diverse group of learners. By using a structured, consensus-driven approach to curriculum development, both the adult and neonatal-pediatric ECMO curricula establish clear educational standards, promote competency-based training, and support high-quality ECMO care worldwide. The application of these curricula should be integrated into the development of institutional training programs.

Table 2. Summary of Recommendations—ECMO Education and Instructional Methodologies

Domain	Recommendations
Educational framework	Ground ECMO education in conceptual models such as *Miller's Pyramid of Clinical Competence*.
Cognitive knowledge	Incorporate didactic lectures, e-learning modules, case-based discussions, flipped classrooms, and formative assessments.
Psychomotor skills	Apply deliberate practice with directive feedback, progressing to increasingly complex scenarios with higher cognitive load.
Team skills	Use high-fidelity simulation to strengthen communication, crisis resource management, leadership, and teamwork.
Simulation outcomes	Simulation supports standardization, skill retention, and preparedness for ECMO emergencies.

This table outlines key domains and strategies for structuring ECMO education. Recommendations emphasize grounding training within established educational frameworks, using diverse methods to build cognitive knowledge, deliberate practice for psychomotor skills, and high-fidelity simulation for team-based competencies. Simulation is highlighted as a critical tool for standardization, skill retention, and preparedness for ECMO emergencies.

ECMO, extracorporeal membrane oxygenation.

Psychomotor Content

Building psychomotor skills in ECMO requires a structured approach that combines cognitive understanding with hands-on practice to develop proficiency in technical procedures. Rooted in Miller's Pyramid of Competency,[19,11] where psychomotor skills progression follows a hierarchical model (knowledge, application of knowledge, demonstration of skills, performing independently), a standardized psychomotor curriculum was developed via a modified Delphi process with an international panel of ECMO experts. The group defined essential simulations that ECMO practitioners must be able to manage to achieve minimal competency. These simulations emphasize key technical procedures and behavioral aspects, such as performing critical actions and communicating during a crisis. The ELSO Essential Simulations (Appendices III and IV, Supplemental Digital Content, https://links.lww.com/ASAIO/B890) are recommended to be integrated into institutional training and are required for courses seeking ELSO Endorsement, like the Adult and Neonatal/Pediatric curricula.[20]

Behavioral Content

Integrating teamwork and communication into ECMO simulation training is vital for optimizing patient care in high-pressure environments. Effective coordination between ECMO team members—such as physicians, nurses, perfusionists, and respiratory therapists—ensures efficient management of complex cases and quick responses to critical situations.[16,21] High-fidelity SBME provides ample opportunities for teams to practice these skills in a controlled setting and within the pre-defined period, enhancing collaboration and decision-making, hence positively impacting patient safety.[22] Although the frequency of training needed is likely institution and team-specific, monthly one-hour sessions focused on teamwork and decision-making during ECMO initiation were associated with sustained and consistently improved communication and teamwork.[23] Offering a controlled setting for ECMO practitioners to practice their response to an ECMO event not only enhances team behavior and communication but may also define and refine institution-specific ECMO team culture.

Overall Structure for High-Fidelity Extracorporeal Membrane Oxygenation Simulation

To ensure effective skill acquisition and team performance, ECMO simulation training should follow a structured approach that includes four vital stages: briefing, simulation, debriefing, and assessment. Sufficient time should be allocated for each scenario to allow progression through all stages.[24] Each simulation scenario should begin with a briefing, where learners are introduced to the scenario, learning objectives, equipment, and expected roles while establishing a psychologically safe learning environment (safety contract). The simulation stage involves active participation in a realistic ECMO scenario, where practitioners apply their knowledge and skills to manage a critically ill patient on ECMO. Trained facilitators allow learners to independently navigate challenges that assess their decision-making and technical skills.

Following the scenario, debriefing is conducted as a critical learning phase, where participants are guided to reflect on their performance, analyze key actions, and receive structured feedback. This stage enhances critical thinking, communication, and crisis management skills.[25] Finally, the post-simulation phase focuses on evaluation, where learners assess their competency, integrate lessons learned into clinical practice, and potentially undergo formal assessments for certification. This structured approach, shown in Figure 2, ensures that ECMO practitioners develop proficiency in both technical and nontechnical skills.

Recent literature reinforces the effectiveness of this approach: a systematic scoping review by Ling *et al*.[26] evaluating 28 studies on simulation-based education (SBE) for ECMO found consistent improvements in both quantitative metrics (*eg*, competency scores) and qualitative outcomes such as team communication, confidence in ECMO management, and troubleshooting. Importantly, SBE was associated with improved clinical outcomes, including reduced time to critical actions and cannulation. These findings validate the value of structured ECMO simulation training and underscore its role in preparing teams for high-stakes, time-sensitive interventions. However, the authors noted considerable heterogeneity in reporting methods and outcomes, highlighting the need for more standardized, high-quality studies to further substantiate these benefits.[26]

The goals of ECMO training, as previously mentioned, are to ensure that 1) ECMO is initiated appropriately and managed efficiently, 2) unnecessary resource expenditure is minimized, and 3) evaluations of standardized training may lead to improved patient-centered outcomes, such as reduced intensive care unit (ICU) length of stay.[27] Additionally, as well-trained teams are better equipped to handle ECMO circuit emergencies, prevent complications, and minimize costly interventions, standardized

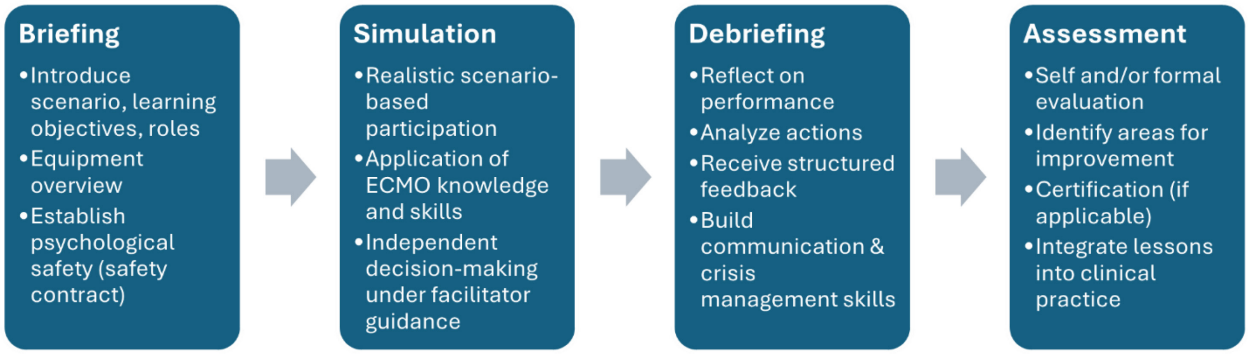

Figure 2. A structured four-stage approach to ECMO simulation training—briefing, simulation, debriefing, and assessment—designed to develop both technical and non-technical competencies. This cycle promotes effective learning, team performance, and integration of skills into clinical practice. ECMO, extracorporeal membrane oxygenation.

ECMO training would undoubtedly lead to improved cost-effectiveness of ECMO programs.[28] By investing in education and adopting global standardized training, centers can ensure that ECMO is delivered in a manner that is both clinically effective and financially sustainable (Table 3).

Minimum Standards for Ongoing Training, Simulation, and Case Volume

Maintaining competency in ECMO is critical for ensuring that practitioners continue to provide safe and effective care throughout their careers. Ongoing education and simulation training are essential for sustaining proficiency in both technical and non-technical ECMO skills. Regular participation in high-fidelity simulations helps reinforce these skills and keeps ECMO teams updated on the latest techniques and best practices. Competency assessments, including regular evaluations and feedback, are also necessary to confirm that practitioners meet established standards of care. By tailoring training frequency to individual practitioner exposure to ECMO, centers can better prepare their teams to manage complex clinical scenarios and consistently deliver high-quality patient care.

When determining competency training intervals, institutions should account for each team member's level of involvement in ECMO management. Although no universally accepted standard exists for defining center volume, programs have long adapted educational strategies to meet practitioner needs based on clinical volume—often reflected in the frequency of individual exposure to ECMO. Although the impact of overall center volume remains debated, practitioners who manage relatively few ECMO cases each year may benefit from more frequent, hands-on training to reinforce critical technical skills (*eg*, de-airing, power failure or hand-crank procedures) and to remain current with educational updates necessary to maintain proficiency. By contrast, ECMO practitioners who see several cases annually may benefit from simulation primarily for team training or quality improvement.[29] An ELSO registry analysis found that higher ECMO volumes at hospitals were associated with lower mortality rates for both neonates and adults, with high-volume centers defined as those performing more than 30 ECMO cases annually.[30] Retention of skills learned in simulation is an area of active research. Research from Advanced Cardiac Life Support (ACLS) training indicates that skill retention declines after 6 months, highlighting the need for ECMO team members to regularly practice infrequently used skills.[31]

Although there is no evidence to ascertain the minimum number of hours or competencies and no consensus thresholds for center volume, we suggest the following simulation frequency per ECMO practitioner focusing on the area of learning (Tables 4 and 5).

Minimum Standards for Developing Effective ECMO Instructors

Effective ECMO instructor development is pivotal in ensuring the delivery of high-quality, standardized education

Table 3. Summary of Recommendations—Minimum Standards for Initial ECMO Training

Domain	Recommendations
Knowledge content	Adopt consensus-driven learning objectives through the ELSO Adult and Neonatal/Pediatric curricula.
Psychomotor content	Implement structured *ELSO Essential Simulations* to achieve minimum competency in technical skills.
Behavioral content	Integrate *team training and communication* using high-fidelity simulation to improve collaboration and crisis management.
Simulation structure	Apply a four-phase model: *briefing, simulation, debriefing, and assessment* to maximize educational impact.
Overall goal	Ensure safe initiation and management of ECMO, reduce complications, optimize patient outcomes, and improve cost-effectiveness.

This table summarizes the essential components of initial ECMO training, emphasizing consensus-based knowledge objectives, structured simulation for psychomotor skill development, and team-based behavioral training. A four-phase simulation model is recommended to optimize learning, with the overarching goal of ensuring safe practice, reducing complications, improving patient outcomes, and enhancing cost-effectiveness.

ECMO, extracorporeal membrane oxygenation.

Table 4. Minimum Suggested Simulation Frequency for ECMO Practitioners According to Area of Focus for Learning

Focus Areas	Simulation Frequency
Psychomotor skills, cognition—recognition of emergencies	Quarterly
Psychomotor skills and team training	Twice per year
Multidisciplinary team training	Annually

Multidisciplinary team training that emphasizes behavioral skills, communication, and systems testing is recommended annually.

ECMO, extracorporeal membrane oxygenation.

across institutions as well as accurate assessment of learners and ongoing evaluation and improvement of curricular delivery. An effective ECMO instructor combines strong foundational knowledge with extensive hands-on experience, fosters cross-disciplinary collaboration, and is skilled in simulation-based training. They are committed to advancing ECMO education while staying current with published data, ELSO standards, innovations, and evolving best practices (Table 6). These criteria are detailed and reinforced in the ELSO Instructor Development Workshop—Train the Trainer, establishing the minimum global standard for preparing ECMO instructors.

In high-fidelity SBME, there are three key roles (facilitator, technician, and debriefer) that are integral to promoting learning, reflection, and ultimately, application to successful clinical practice. Facilitators guide the simulation learning process by creating a supportive environment, engaging participants, and ensuring that learning objectives are met through active participation and reflection. Technicians manage the technical aspects of high-fidelity simulations, ensuring that all equipment (software, manikin, monitors, and other technology) functions properly to ensure realistic scenario execution. Debriefers lead post-simulation discussions, encouraging participants to reflect on their performance, analyze their actions, and integrate lessons learned to enhance future clinical practice.

In SBME, these three roles each represent distinct skill sets.[32,33] Facilitators and debriefers often overlap, as both require close observation of learner behaviors, real-time scenario adaptation, and the ability to guide reflection for deeper learning. These demands make it difficult to also manage the technical aspects, which are best handled separately. Ensuring the technician role is distinct—whether staffed or automated—reflects best practice and allows educators to focus fully on supporting learner growth and maintaining simulation quality. Ideally, the technician is also an experienced ECMO practitioner with a deep understanding of the physiological interactions between the patient and the pump, enabling them to accurately replicate clinical responses during simulated scenarios.

As SBME is an important and necessary tool for teaching ECMO to individuals and teams, ECMO instructors must, at a minimum, become proficient facilitators and debriefers. To seamlessly guide learners through critical learning points and procedures on ECMO, a facilitator must have clinical expertise and a deep foundation of knowledge for critical care and ECMO concepts. Additionally, the role of the simulation debriefer is considered *the most critical determinant* of whether a simulation leads to meaningful learning. A strong debriefer is not merely a feedback provider but a learning architect: they create a safe environment through upholding psychological safety, illuminate underlying thought processes, link behaviors to clinical outcomes, and guide learners in transforming experience into lasting practice change. By blending structured frameworks with adaptive questioning, they transform simulation experiences into meaningful insights that improve clinical practice and teamwork.[34]

Extracorporeal membrane oxygenation instructors should possess both deep expertise in ECMO knowledge and skills as well as proficiency in SBE. Their ability to function as skilled facilitators and debriefers while designing and running high-fidelity ECMO simulations is essential not only for developing individual and team competencies but also for advancing program quality and ultimately improving patient outcomes.

Standardized Assessment and Certification of ECMO Practitioners

The objective evaluation and assessment of ECMO practitioners following educational activities is essential to ensure that critical competencies are consistently met. Historically, training and assessment have varied across institutions, with no universally accepted standard for knowledge, technical skills, or clinical decision-making. Competency-based assessments provide a structured approach to evaluate cognitive and technical abilities, including scenario-based decision-making, circuit management, and team-based behaviors, while also facilitating benchmarking and targeted improvement.

Organizations such as ELSO, which track international ECMO outcomes and promote best practices, are working to define minimum competency standards and certification

Table 5. Summary of Recommendations—Minimum Standards for Ongoing Training, Simulation, and Case Volume

Domain	Recommendations
Training importance	Regular training is essential to maintain ECMO competency.
Low-volume centers	Schedule more frequent hands-on simulation to refresh psychomotor skills.
High-volume centers	Focus simulation on team training and quality improvement.
Evidence base	Higher ECMO case volumes are associated with improved survival outcomes.
Skill retention	Skills deteriorate within 6 months without reinforcement → ongoing practice is required.

This table highlights the importance of ongoing ECMO training to sustain competency, with recommendations tailored to center volume. Low-volume centers (or low individual practitioner ECMO exposure) benefit from more frequent hands-on simulation to reinforce psychomotor skills, whereas high-volume centers (or high individual practitioner ECMO exposure) should emphasize team training and quality improvement. Evidence links higher case volumes with improved survival, and data show skills decline within 6 months without reinforcement, underscoring the need for regular practice.

ECMO, extracorporeal membrane oxygenation.

Table 6. The Essential Criteria for Defining an Effective ECMO Instructor, Grounded in the Principles of Andragogy, or Adult Learning Theory, and the Unique Needs of Adult Learners

Criteria	Description
Foundational knowledge	Demonstrates a strong foundational knowledge of ECMO principles and physiology.
Hands-on experience	Has extensive hands-on ECMO management and troubleshooting experience.
Team collaboration	Cultivates successful interdisciplinary team collaboration to optimize patient care.
Simulation proficiency	Proficient in simulation-based training methods to enhance learning and practice.
Educational commitment	Displays a genuine interest in advancing ECMO education and mentoring others.
Current knowledge	Maintains up-to-date knowledge of ECMO outcomes, ELSO standards, innovations, and quality improvement processes.

By focusing on practical application, self-directed learning, and the integration of real-world experiences, these criteria ensure that instructors effectively engage and empower adult learners in the ECMO field.

ECMO, extracorporeal membrane oxygenation.

pathways. By unifying education and assessment, ELSO enhances practitioner competence, supports continuous program improvement, and ultimately advances patient safety and clinical outcomes. Standardization also creates a foundation for educational scholarship, research, and quality initiatives, enabling a deeper understanding of how to optimize ECMO care.

ELSO Adult ECMO Certification and ELSO Neonatal-Pediatric ECMO Certification: Standardizing ECMO Practitioner Certification

The E-AEC and E-NPEC are three-step certification programs developed by ELSO to ensure ECMO practitioners meet standardized competencies and deliver high-quality care across a range of patient populations (Figure 3). These certifications assess the knowledge and technical skills fundamental to safely initiate, manage, and wean patients from ECMO, with a focus on cognitive assessment.

The E-AEC certification is designed for professionals working with adult patients, focusing on the complexities of ECMO for respiratory and cardiac failure. It includes assessing expertise in areas such as patient selection, circuit management, and troubleshooting. Similarly, the E-NPEC certification targets professionals who care for neonatal and pediatric patients requiring ECMO support. This certification focuses on the unique physiological considerations of younger patients and includes competencies for neonatal and pediatric ECMO initiation, management, and complications.

Both certifications involve competency-based assessments, including knowledge tests, practical evaluations, and evidence of hands-on experience. These programs are essential for maintaining a consistent, high standard of ECMO care, ensuring that practitioners have the necessary skills to manage complex ECMO patients. E-AEC and E-NPEC certifications help to promote interdisciplinary collaboration, encourage continuous learning, and meet global ECMO education standards (Table 7).

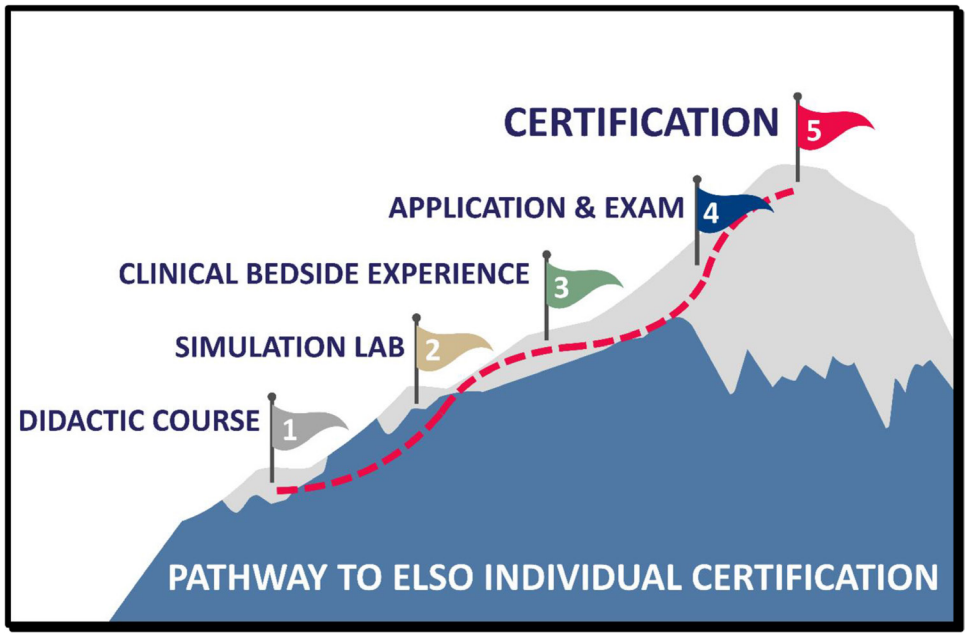

Figure 3. Each component of the certification process is grounded in methodologies that reflect expert consensus (Delphi), hands-on learning and deliberate practice (informed by adult learning theory and Ericsson's principles), experiential learning (Kolb), and practical application in clinical settings. This multifaceted approach ensures that learners engage in active construction of knowledge, observe and model best practices, and reflect critically on their experiences.

Table 7. Summary of Recommendations—Minimum Standards for Developing Effective ECMO Instructors

Domain	Recommendations
Core competencies	Instructors must demonstrate clinical expertise, ECMO knowledge, and simulation-based teaching skills.
Key roles in SBME	Facilitator: Guides learning, creates supportive environment, ensures objectives are met. Technician: Manages equipment and realism of the simulation. Debriefer: Leads structured reflection, critical to achieving meaningful learning outcomes.
Instructor excellence	Instructors should excel as facilitators and debriefers, maintaining psychological safety and guiding transformative learning.
Faculty development	Programs such as the *ELSO Train-the-Trainer Workshop* establish global standards for preparing ECMO instructors.

This table outlines essential competencies for ECMO instructors, including clinical expertise, ECMO knowledge, and simulation-based teaching skills. Three critical roles in simulation-based medical education are identified: facilitator, technician, and debriefer, with particular emphasis on facilitation and debriefing to ensure psychological safety and meaningful learning. Faculty development programs, such as the ELSO Train-the-Trainer Workshop, establish global standards for preparing and maintaining effective ECMO educators.

ECMO, extracorporeal membrane oxygenation; SBME, simulation-based medical education.

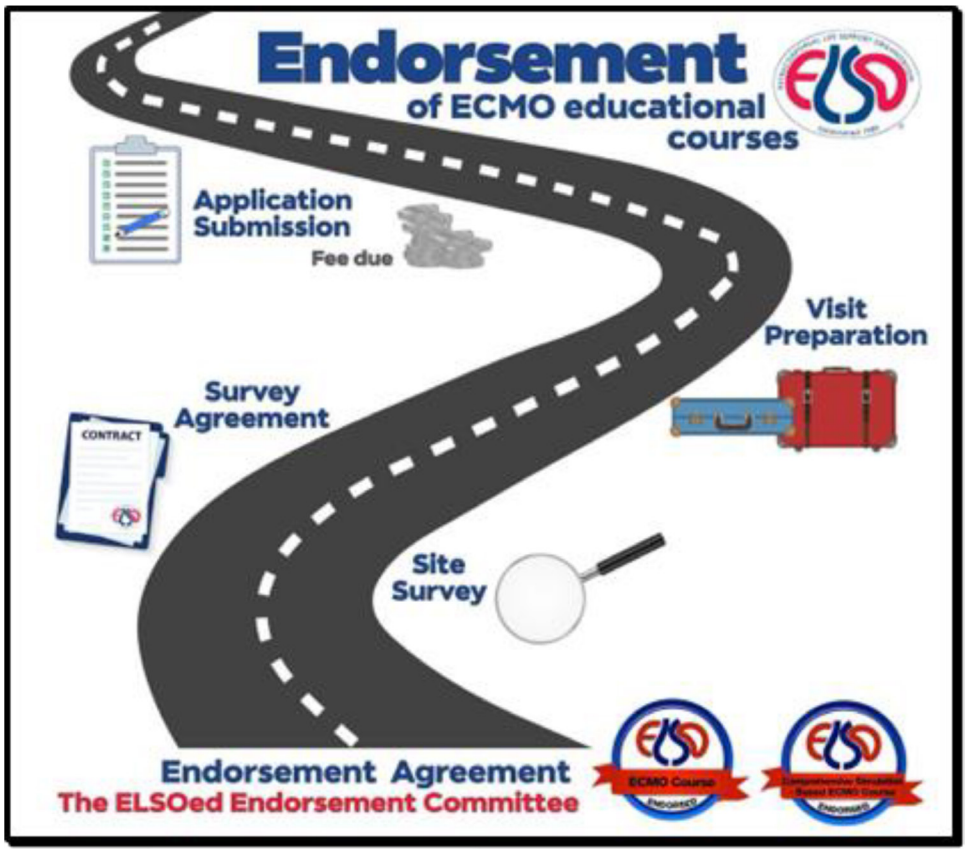

Figure 4. The pathway to achieving ELSO Endorsed Center status follows a structured process that ensures ECMO training programs meet ELSO's global standards of excellence. The steps outlined in this roadmap confirm that a center's training program is aligned with ELSO guidelines, emphasizing a standardized, competency-based curriculum that integrates cognitive and psychomotor skills. Simulation-based learning and debriefing are also central components, with programmatic evaluation guided by the New World Kirkpatrick Model.[35,36] ECMO, extracorporeal membrane oxygenation; ELSO, Extracorporeal Life Support Organization.

Becoming an ELSO Endorsed Training Center: Advancing Global ECMO Education

Becoming an ELSO Endorsed Training Center requires going through a rigorous process that ensures ECMO training programs meet ELSO's global standards of excellence and consistency (Figure 4). The process involves ensuring the center's training program aligns with ELSO guidelines, specifically, offering the standardized competency-based curriculum that covers essential cognitive and psychomotor skills. Training must also incorporate simulation-based learning and debriefing to ensure practitioners are equipped to handle both routine circuit interventions and emergency ECMO scenarios.[35] More information about active endorsed centers worldwide, along with a detailed overview of the endorsement process, is available on the ELSO website under the Education section.

A critical requirement for endorsement is the use of highly skilled ECMO instructors as described in Minimum standards for developing effective ECMO instructors. Additionally, centers must demonstrate ongoing assessment of training efficacy,

incorporating feedback mechanisms for both educator growth and program process improvement, and long-term competency tracking of ECMO practitioners. These measures would ensure sustained success in ECMO education.

Developing ELSO-endorsed centers globally is a critical step in increasing access to high-quality ECMO education, particularly in regions where ECMO resources and expertise are limited. By standardizing education and training across centers, ELSO endorsement ensures that ECMO practitioners worldwide have access to the same evidence-based practices and structured learning environments. We believe that such a network may foster consistency in ECMO management while reducing variability in clinical outcomes and complications.

Conclusions

The ELSO Guideline for Training and Continuing Education of ECMO Practitioners provides a vital reference for centers developing effective ECMO training programs and cultivating skilled instructors. Anchored in well-established principles of SBME, this guideline defines minimum standards for knowledge, psychomotor, and behavioral competencies, as well as for ECMO simulation, instructor preparation, and standardized certification. By establishing these standards, it creates a foundation for a universal, effective approach to training that equips practitioners with the skills necessary to manage ECMO patients safely and effectively.

As ECMO technology evolves and global demand for trained practitioners grows, competency-based assessments, structured simulation, and continuous instructor development are critical to maintaining high-quality patient care. By addressing gaps in training and fostering structured debriefing and program improvement, the guideline promotes a culture of continuous learning and collaboration. Through these efforts, ELSO aims to advance educational scholarship, elevate ECMO team performance, and strengthen the link between high-quality training and improved patient outcomes worldwide.

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