QMJ
A peer reviewed journal
QATAR MEDICAL JOURNAL

4th Annual ELSO-SWAC Conference Proceedings

Can simulation improve ECMO care?

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http://dx.doi.org/10.5339/qmj.2017.swacelso.7

Cite this article as: Labib A, Alinier G. Can simulation improve ECMO care?, Qatar Medical Journal, 4th Annual ELSO-SWAC Conference Proceedings 2017:7 http://dx.doi.org/10.5339/qmj.2017.swacelso.7

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"Bringing ECMO simulation to life": The main theme of the 4th Annual Conference of the Extracorporeal Life Support Organisation – South and West Asia Chapter (ELSO-SWAC), "*Bringing ECMO Simulation to Life*", is meant to emphasise the growing role of simulation in healthcare and medical education at large and in the highly specialised and complex field of extracorporeal life support (ECLS), and in particular for extracorporeal membrane oxygenation (ECMO). Application of ECMO simulation to improve team response to ECMO emergencies was first described in 2006.[1] In the last decade, several authors have described the development, utility, and advantages of simulation-based training for ECMO. In this editorial, we will discuss the role of and evidence supporting the use of simulation-based education in ECMO.

ECMO is a complex intervention: The first point to consider when it comes to ECMO is the complexity, time critical, and inter-disciplinary nature of the intervention. Typically, ECMO is considered for the most sick and physiologically deranged patient, sometimes as a last resort rescue measure. Time pressure, the patient critical condition, the potential rapid deterioration, and the uncertainty interact within the critical care environment to make decision-making, planning, and execution quite challenging for the less experienced members of the clinical team. This relates to the domains of team and crisis resource management in which there is a complex interplay of human and environmental factors involved.[2] Appropriate training programmes of the required technical and non-technical skills for ECMO are lacking.[3,4] In addition, ECMO is relatively new to many centres and/or countries, and this novelty brings with it a general lack of experience regarding such therapy and the fear of the unknown. Simulation can help relieve staff anxiety and introduce ECMO in a safe, less intimidating learning environment.[3,4] Ideally, all aspects of ECMO patient care can be progressively introduced to the staff being trained through the use of various simulation modalities to promote better

understanding and deep learning regarding the initiation of an ECMO run and ongoing ECMO patient care.

Simulation can expedite preparedness for crisis: On 11 June 2009, the World Health Organisation (WHO) declared a global H1N1 pandemic only two months after the influenza outbreak in Mexico and USA. This allowed very little time for governments and organisations to prepare.[4] A 2010 European taskforce for the intensive care unit (ICU) triage of influenza epidemic or mass disaster recommended commencing training of clinicians as early as possible with demonstration followed by practice under supervision.[5] In line with these recommendations, a 3-day ECMO-based simulation training was established to provide a large number of clinicians with the technical, behavioural, and cognitive ECMO skills in anticipation of the H1N1 pandemic. The programme enabled some ICUs with no previous ECMO experience to care for patients on ECMO.[4] Although it was probably the product of an expedited process of rapidly setting up a custom simulation programme, as opposed to adopting a more structured approach involving step-by-step development and validation through piloting,[6] the anticipated outcome was still deemed beneficial to justify the rapid process. The European Taskforce's recommendation demonstrated the importance given to this educational approach in such a critical time as clinicians had to commit to 3 days of training to master life-saving skills and it was widely rolled out.

What can ECMO simulation provide? Traditional ECMO training and education focused on didactic lectures, water drills, and animal laboratory.[7] This mostly passive learning approach is suboptimum for adult learning as adults tend to prefer developing knowledge and understanding using problem-solving, as it encourages active leaning, sharing of knowledge, and acquisition of experience.[8] It calls upon "learners" to develop and use critical thinking skills, not only during the simulation-based experience, but also during the "review" phase, which corresponds to the debriefing of the simulation. This phase is usually in the form of a facilitated discussion, which helps learners further explore the event they partook in, clarify doubts, and develop their knowledge.[9] It is not always without difficulty, but it is a crucial learning phase to understand the thought process behind learners' actions and it allows to deepen their learning.[10]

ECMO is a unique patient management and therapeutic strategy that requires a diverse set of technical, practical, cognitive, as well as behavioural and other non-technical skills. Initiation and maintenance of ECMO requires ongoing interprofessional interactions, which may sometimes occur in high-intensity situations such as a circuit emergency, which usually requires a coordinated and synchronised response from the various team members. Akin to high-risk industries, poor communication, inadequate leadership, and a dysfunctional team can cause significant harm.[11] The remedy adopted by high-risk industries, such as aviation, military, and the nuclear power plants, is regular simulation-based training for the employees, even if incidents are relatively rare, to ensure adequate readiness in the event of a potential crisis.[12]

The work by Brum *et al.*[3] shows that a one-day multiprofessional ECMO simulation course significantly improved staff confidence of ECMO management and enhanced behavioural skills. In another report, ECMO simulation improved thoracic surgery residents' skills in the management of post-cardiotomy ECMO crisis.[13] Management of patients on ECMO mandates high level of communication skills and team work, and rapid decision-making and actions. Simulation-based ECMO training provides an ideal platform to develop and maintain such skills. It enhances team response to crisis and permits rehearsal of less common and atypical life-threatening emergencies.[3,11] Simulation allows practice and acquisition of procedural skills in a safe environment,[11] and these can be initially practised in isolation and individually, prior to being embedded into more complex scenarios tackled as part of a multiprofessional team. In addition, team building, decision sharing, and execution are improved via simulation-based ECMO training, which enhances patient safety and minimises errors in response to an ECMO crisis.[3,11] The level of complexity and fidelity or realism adopted needs to match the intended types of learning objective and the level of experience of the participants.[14]

Beyond learners' educational and experiential benefits, simulation presents great opportunities with regard to systems' testing, environment orientation, as well as protocols and guidelines development. An application of particular interest is "in-situ" simulation, which engages the clinical team in their actual work environment,[15] and hence with their own equipment with which they should already be familiar.

Running *in-situ* simulations in particular is very useful to test the implementation of new services and identify potential risks and actual omissions of critical safety components.[16,17] Putting clinical teams in various simulated normal and emergency situations within their own context allows for observation of their actions and challenges they face in relation to the procedure, equipment availability or familiarity, or physical environment configuration. The immediate next phase is to engage them in a debriefing that will help identify potential as well as actual system or environmental issues, and assist in developing appropriate solutions. Organising *in-situ* simulation can however be challenging, especially in an operational clinical environment where real patients who might be critically ill are also present.[18] In the case of ECMO patient care-related *in-situ* simulation, it is the ideal setting to train a team to respond to a patient or circuit emergency, as it will test their ability to act appropriately and test the availability of the resources required to deal with an emergency circuit change or pump failure for example. A facility that has limited regular exposure to ECMO patients should be recommended to impose more regular *in-situ* simulations to ensure the clinical team and equipment are always ready to deal with any aspect of ECMO, right from the cannulation phase (wherever it may take place) and ability to bring together all required resources, performing an emergency circuit change, right through to weaning off a patient from ECMO.

Conclusion: There is a universal growing interest in various aspects and applications of simulation-based training. Simulation for the initiation and maintenance of ECMO provides several advantages over traditional passive learning approaches. ECMO simulation improves technical skills such as cannulation as well as non-technical skills that include, among others, effective communication, team working, decision making, and leadership skills. Appropriately designed simulation-based and educational ECMO interventions can alleviate staff anxiety with regard to new technology and equipment, and boost confidence in relation to crisis management. In future, advances in simulation technology will allow for increased realism and higher fidelity, and subsequently further enhance the clinical team learning experience.

Keywords: ECMO, simulation, simulator, experiential learning, patient safety, human factors

REFERENCES

1. Anderson JM, Boyle KB, Murphy AA, Yeager KA, Le Flore J, Halamek LP. Simulating extracorporeal membrane oxygenation emergencies to improve human performance. *Simul Healthc*. 2006;1:220 – 227.
2. Musson DM, Helmreich RL. Team training and resource management in health care: Current issues and future directions. *Harvard Health Policy Rev*. 2004;5(1):25 – 35.
3. Brum R, Rajani R, Gelandt E, Morgan L, Raguseelan N, Butt S, Nelmes D, Auzinger G, Broughton S. Simulation training for extracorporeal membrane oxygenation. *Ann Card Anaesth*. 2015;18(2):185 – 190.
4. Brazzi L, Lissoni A, Panigada M, Bottino N, Patroniti N, Pappalardo F, Gattinoni L. Simulation-based training of extracorporeal membrane oxygenation during H1N1 influenza pandemic: The Italian experience. *Simul Healthc*. 2012;7(1):32 – 34.
5. Sprung CL, Zimmermann JL, Christian MD, Joynt GM, Hick JL, Taylor B, Richards GA, Sandrock C, Cohen R, Adini B. European Society of Intensive Care Medicine Task Force for Intensive Care Unit Triage during an Influenza Epidemic or Mass Disaster. Recommendations for intensive care unit and hospital preparations for an influenza epidemic or mass disaster: Summary report of the European Society of Intensive Care Medicine's Task force for intensive care unit triage during an influenza epidemic or mass disaster. *Intensive Care Med*. 2010;36:428 – 443.
6. Lioce L, Meakim CH, Fey MK, Chmil JV, Mariani B, Alinier G. Standards of best practice: Simulation standard IX: Simulation design. *Clin Simul Nurs*. 2015;11(6):309 – 315.
7. ELSO guidelines, Available from: www.elso.org/Portals/0/IGD/Archive/FileManager/97000963d6cusersshyerdocumentselsoguidelinesfortrainingandcontinuingeducationofecmospecialists.pdf [Accessed Jan 2017].
8. Merriam SB, Caffarella RS, Baumgartner LM. *Learning in Adulthood: A Comprehensive Guide*. 3rd edn. San Francisco: Jossey-Bass; 2007.
9. Sawyer T, Eppich W, Brett-Fleegler M, Grant V, Cheng A. More than One Way to Debrief: A Critical Review of Healthcare Simulation Debriefing Methods. *Simul Healthc*. 2016;11(3):209 – 217.

10. Der Sahakian G, Alinier G, Savoldelli G, Oriot D, Jaffrelot M, Lecomte F. Setting conditions for productive debriefing. *Simul Gaming*. 2015;46(2):197 – 208.

11. Johnston L, Oldenburg G. Simulation for neonatal extracorporeal membrane oxygenation teams. *Sem Perinatol*. 2016;40(7):421 – 429.

12. Breckwoldt J, Gruber H, Wittmann A. *Simulation Learning*. Chapter 25. International Handbook of Research in Professional and Practice-based Learning. Netherlands: Springer, 2014:673 – 698.

13. Burkhart HM, Riley JB, Lynch JJ, Suri RM, Greason KL, Joyce LD, Nuttall GA, Stulak J, Schaff HV, Dearani JA. Simulation-based post-cardiotomy extracorporeal membrane oxygenation crisis training for thoracic surgery residents. *Ann Thorac Surg*. 2013;95:901 – 906.

14. Tun JK, Alinier G, Tang J, Kneebone RL. Redefining simulation fidelity for healthcare education. *Simul Gaming*. 2015;46(2):159 – 174.

15. Rosen MA, Hunt EA, Pronovost PJ, Federowicz MA, Weaver SJ. In situ simulation in continuing education for the health care professions: a systematic review. *J ContinEdu Health Prof*. 2012;32(4):243 – 254.

16. Bender GJ. In situ simulation for systems testing in newly constructed perinatal facilities. *Semin Perinatol*. 2011;35(2):80 – 83.

17. Geis GL, Pio B, Pendergrass TL, Moyer MR, Patterson MD. Simulation to assess the safety of new healthcare teams and new facilities. *Simul Healthc*. 2011;6(3):125 – 133.

18. Hssain I, Alinier G, Souaiby N. In-situ simulation: A different approach to patient safety through immersive training. *Mediterranean J Emerg Med*. 2013;15:17 – 28.