

Pediatric Extra Corporeal Membrane Oxygenation Practices and Challenges in Kingdom of Saudi Arabia and Gulf Cooperation Council Countries

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Abstract

Introduction: The Extracorporeal Membrane Oxygenation (ECMO) is a vital rescue therapy for patients experiencing refractory heart or respiratory failure after conventional intervention failure. Establishing a new ECMO program, particularly for neonates and children, has challenges in logistics or operation. Furthermore, maintaining a standardized ECMO program add more complexity.

Methods: A cross sectional survey was distributed to health care professional in Saudi Arabia and the GCC to describe the pediatric ECMO practices and challenges for potential expansion.

Results: A total of 254 responses were collected, 82% from Saudi Arabia. In these, 54% have ECMO service at their centers. Majority are working in Pediatric Intensive Care Units (PICUs), with >300 admissions per year, treating respiratory failure cases. ECMO experience and practice was variable among respondents as well as in ECMO deployment and management. Challenges include shortages in trained personnel, logistics and infrastructure.

Conclusion: Establishing and supporting a new pediatric ECMO program gas challenges. Findings of this survey support the need for enhanced ECMO training and systemic support for successful program development.

Keywords: Gulf Cooperation Council (GCC); Extracorporeal Life-Support (ECLS); Extracorporeal Membrane Oxygenation (ECMO); Extracorporeal Life Support Organization (ELSO); Intensive Care Unit (ICU); Kingdom of Saudi Arabia(KSA).

Introduction

Global Extracorporeal Membrane Oxygenation (ECMO) is an advanced extracorporeal support that provides circulatory and/or respiratory support until organ recovery. The first successful use of ECMO in a neonate was reported in 1975 and its application has expanded to include children and adults, particularly during the COVID-19 pandemic. According to the ELSO registry report in 2023, over 45,000 neonates and 29,000 children have received ECMO support, with overall survival rates exceeding 60% [1,2]. Despite the global growth, its implementation in the Southwest Asia and Africa (SWAAC) region, particularly for pediatrics, remain limited due to logistical and resource constraints [1]. To our knowledge, few pediatric ECMO centers exist in Saudi Arabia and the GCC countries. This study surveys the current state of pediatric ECMO in SA and GCC, highlighting variability in practice, challenges and the potential for expansion [3,4].

Materials and Methods

A cross-sectional survey was distributed to healthcare professionals across Saudi Arabia and GCC countries using survey monkey. Recruitment occurred *via* a scientific webinar and social media platforms. The survey included closed questions to minimize response bias and covered four main domains: Demographic information, ICU settings, ECMO practices and perceived challenges. No incentives for participation. The study received exemption approval from the King Fahad Medical

City (KFMC) Research Center Institutional Review Board (IRB No#24-399).

Results

We received 254 responses to the survey. In these respondents, 56% reported having ECMO services in their centers, with 64% working in government hospitals. A majority of units admitted over 300 patients annually, primarily for respiratory failure. 84% of respondents are working in Saudi Arabia and the rest are from GCC.

PICU setting

Most ICUs have more than 300 admissions per year with a patient-to-nurse ratio of 2:1. 163 (64%) respondents are working in governmental hospitals, 29 (11.4%) in specialized hospitals, 27 (10.6%) in private hospitals and 35 (14%) respondents in other sectors [5]. Among PICUs, 69 (30.8%) respondents have <10 beds, 71 (31.7%) have 11-20 beds, 55 (24.6%) have 21-30 beds and 29 (12.9%) have >30 beds. The most frequent diagnosis on admission was respiratory failure followed by septic shock then heart failure.

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Among units that have ECMO, one or more types of ECMO are offered. Survey results revealed that central VA-ECMO is offered in 69.6% of the responders' units, peripheral VA-ECMO in 36.3%, VV-ECMO in 55.3% and hybrid in 24.4%. 97 respondents answered that they do central ECMO access only, 62 respondents do percutaneous access and 30 they do cut down peripheral ECMO Cannulation.

Pediatric ECMO practices

As per this research 48% of respondents take care of pediatric patients in their ICU and 30% of neonates and the rest take care of all age groups or adults only. 76 (29.9%) of respondents have no experience on ECMO. 19 (7.5%) respondents have VA-ECMO experience, 17 (6.7%) respondents have respondents VV-ECMO experience, 62 (24.45%) have experience in both VV/VA-ECMO, while 79 (30%) respondents have exposure from training only. The available experience on ECMO was variable, with the majority having less than 2 years of experience in pediatrics (40%). When we asked how the decision was made to offer ECMO in ICU, we received one or more choices. ECMO decision was based on a different approach (Figure 1 and Table 1).

Decision to offer ECMO

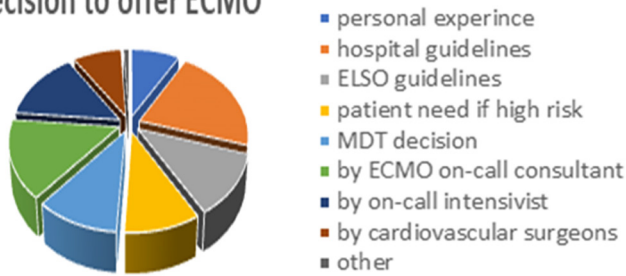


Figure 1. ECMO management approach selection (multi-choice question).

Table 1: Demographics distribution of responders.

General Demographics	n (%)
Age	
25-34 years	77 (30)
35-44 years	111 (44)
45-54 years	51 (20)
Above 54 years	15 (6)
Gender	
Female	135 (53)
Male	119 (47)
Profession	
ICU Consultants	41 (16)
ICU Assistant/Fellows	35 (14)
Pediatric Intensivists	76 (30)
Cardiologists	8 (3)
ICU Nurses	35 (14)

Respiratory therapists	41 (16)
Others (neonatologists, etc.)	18 (7)

ECMO service at their centers

Yes	142 (56)
No	112 (44)

Region of work

KSA-Eastern	25 (10)
KSA-Central	127 (50)
KSA-Northern	18 (7)
KSA-Western	28 (11)
KSA-Southern	15 (6)
UAE	13 (5)
Kuwait	8 (3)
Oman	2 (1)
Other	18 (7)

Perceived ECMO challenges

Most respondents believe the challenges are the lack of skilled human resources, logistical support and the high costs associated with running ECMO programs (Table 2). Despite challenges, there is strong support among responders for expanding pediatric ECMO services. They believe that ECMO is important for managing severe respiratory and heart failure in children, in cases where conventional therapies have failed.

Table 2: The respondents' perspectives and perceived challenges.

Description of pediatric ECMO service	N (%)
Life-saving	170 (67)
Demanding	61 (24)
Underestimated	46 (18)
Overrated	8 (3)
Neutral	38 (15)
Challenges limiting ECMO centers	Respondents' belief (%)
Lack of human resources	109 (43)

Discussion

The ECMO is recognized as life-saving, its implementation in the region is limited by a shortage of specialized personnel, particularly perfusionists. Comparisons to established programs in Europe and North America highlight the need for regional adaptation and resource allocation. The development of an ECMO/ECLS program is far more complex than organizing a small group of interested providers and acquiring the hardware necessary for support, program development involves the engagement of key stakeholders including physicians, nursing and administrative leadership [6]. Internationally, many institutions are facing significant challenges in setting up or maintaining ECMO programs. ECMO is costly and fewer centers

exist in the SWAAC region than in Europe and the United States, as noted by Ponaam and Tiwari. Support is required from the institution infrastructure and the system to facilitate the ECMO program and address any challenges [7,8]. A great example was Saudi Arabia when the Saudi Ministry of Health in 2021 laid the groundwork for expanding services across the country for adult ECMO and successfully implemented a national ECMO program with standard policy and process [9]. This initiative included a hotline for ECMO consultations and retrievals and has the potential to bridge gaps in care by facilitating the transfer of critically ill patients after ECMO deployment to an equipped ECMO center. Also, the National ECMO program in KSA have established new ECMO centers during the pandemic that was later supported by ELSO. However, ongoing efforts are still needed to ensure that the necessary training and resources are available for long-term sustainability. Similar challenges could be seen in the region for pediatric ECMO and far more complex in cannulation and ECMO management. We observed a wide variability in cannulation techniques in pediatrics could be related to patient's age or the available manpower experience (surgeons vs. intensivists) and variable ECMO management approaches as well. The variability in ECMO management and cannulation techniques indicates a need for standardization. In this survey, we found that one of the most significant challenges to expand ECMO services is the lack of human resources and having ECMO specialized personnel, particularly perfusionists. This survey reveals that the key barriers to expanding ECMO services human resources, logistical challenges and available training require immediate attention from both healthcare institutions and policymakers.

Conclusion

To improve pediatric ECMO services, targeted training programs, better resource allocation and system support are essential. Furthermore, standardizing ECMO protocols and guidelines across the region could enhance outcomes.

Limitations

The limitations of this survey include potential selection bias, as clinicians with a strong interest in ECMO were more likely to participate, possibly skewing results. The online format and distribution *via* social media may have restricted access

to certain professional groups, limiting the survey's reach. Additionally, the sample size represents only a small portion of healthcare providers in the region. Finally, the cross-sectional design prevents analysis of trends over time, suggesting future research should consider longitudinal studies to track changes in ECMO practices and resources.

Author contributions

Dr. Nada aljassim, Dr. Nooralhuda; IRB development

Dr. Nada aljassim, Dr. Nabeel Almashraqi; survey questionnaire development.

Dr. Nada Aljassim, Dr. Nooralhuda; literature review and writing the manuscript.

Dr. Mohamed Kabbani; manuscript revision.

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