# Utilization and Outcomes of Extracorporeal Membrane Oxygenation in China and Scandinavia:

## **A Systemic Literature Review**

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#### **BACKGROUND & OBJECTIVES**

- Extracorporeal membrane oxygenation (ECMO) has emerged as a critical life-support intervention for patients with severe cardiac and respiratory failure.
- China and the Scandinavian countries Denmark, Finland, Norway, and Sweden represent two distinct healthcare landscapes with differing approaches to the implementation and management of ECMO.
- A comprehensive comparison of the utilization and outcomes of ECMO in China and Scandinavia could potentially provide valuable insights into its effectiveness across regions and assist in guiding future healthcare policies and practices.

## **METHODS**

#### **ECMO for pulmonary indications**

- Chinese patients were significantly older (54.7 years vs. 45.5 years, p=0.019) and with lower BMI than Scandinavian patients (24.9 vs. 28.5 kg/m<sup>2</sup>, p<0.001).
- Chinese patients had a significantly higher prevalence of diabetes (21.4% vs. 10.1%, p=0.003) but a significantly lower prevalence of chronic pulmonary disease than Scandinavian patients (2.5% vs. 26.5%, p<0.001).
- The clinical outcomes and health resource utilization associated with ECMO are presented in Figure 2.



Data sources	<ul> <li>Bibliographic databases: MEDLINE, Embase, and Web of Science.</li> <li>Search period: from January 1, 2013, to December 31, 2023.</li> </ul>	0.0%China (T=9, Scandinavia N=384)China (T=11, Scandinavia N=1228)China (T=11, Scandinavia (T=3, N=429)China (T=12, Scandinavia 								
Search strategies	<ul> <li>Combined ECMO-related keywords with country-specific terms (e.g., China, Denmark, Finland, Norway, Sweden, and Scandinavia).</li> </ul>	T: number of studies; N: total sample size Figure 2. Clinical outcomes and health resource utilization for pulmonary indications in China and Scandinavia. ECMO for cardiac indications								
Inclusion criteria	<ul> <li>Original observational studies reporting health resource utilization and/or clinical outcomes related to ECMO in China and four Scandinavian countries.</li> </ul>	<ul> <li>Cardiac arrest</li> <li>The differences in the pooled age (55.7 years vs. 53.1 years, p=0.017) and male proportion between Chinese patients and Scandinavian patients were significant or approaching significance (75.9% vs. 80.2%, p=0.075).</li> </ul>								
Exclusion criteria	<ul> <li>Clinical trials, non-human studies, case studies, case reports, clinical guidelines, reviews, and studies lacking relevant information on specific clinical conditions.</li> </ul>	<ul> <li>The pooled BMI from the Chinese patients was 3.2 lower than that from Scandinavia patients (23.8 vs. 27.0, p&lt;0.001).</li> <li>Prevalence of comorbidities are presented in Figure 3.</li> </ul>								
Quality ssessment	<ul> <li>The quality of included studies was assessed using the Newcastle–Ottawa Scale (NOS), categorizing them as high quality (NOS score 7-9), moderate quality (4-6), and low quality (0-3).</li> </ul>	$\begin{bmatrix} 50.0\% \\ 40.0\% \\ 38.5\% \\ 24.7\% \\ 10.0\% \\ 10.0\% \\ \end{bmatrix} = \begin{bmatrix} P = 0.009 \\ 24.7\% \\ 13.4\% \\ 7.6\% \\ \end{bmatrix} = \begin{bmatrix} P = 0.056 \\ 16.5\% \\ 11.9\% \\ 9.7\% \\ \end{bmatrix} = \begin{bmatrix} P = 0.001 \\ 19.4\% \\ 9.7\% \\ 9.7\% \\ \end{bmatrix}$								
Evidence synthesis	<ul> <li>A single-arm meta-analysis with a random-effects model was employed for data synthesis.</li> <li>Pooled evidence for the same outcome measure from the two</li> </ul>	0.0% China (T=1, N=351) Scandinavia (T=3, N=586) Hypertension China (T=1, N=351) Scandinavia (T=2, N=447) Heart failure Ischaemic heart disease Diabetes								

T: number of studies; N: total sample size

Figure 3. Comorbidities in patients receiving ECMO for cardiac arrest from China and Scandinavia.

regions were compared using student t test or chi-square test.

## RESULTS

#### **Study selection**

synthesis

• After the screening of titles and abstracts, full publication review, a total of 25 references for China and 16 for Scandinavia were included for data extraction and evidence synthesis. The literature search process are illustrated in Figure 1.

Literature search of ECMO-related observational studies published from 2013 to 2023

ECMO-related studies in Chinese Population	ECMO-related studies in Scandinavian populations					
<ul> <li>Initial search references after the removal of duplicated hits: 229</li> <li>Embase: 159; Medline: 96; Cochrane: 7; Web of Science: 140</li> </ul>	<ul> <li>Initial search references after the removal of duplicated hits: 111</li> <li>Embase: 86; Medline: 34; Cochrane: 4; Web of Science: 64</li> </ul>					
Initial title and abstract screening results: 99	Initial title and abstract screening results: 57					
Final inclusion in the analysis • Full publications: 22; Abstracts: 3	Final inclusion in the analysis • Full publications: 13; Abstracts: 3					
NOS assessment results <ul> <li>Six points: 3; seven points: 6; eight points:13</li> </ul>	NOS assessment results <ul> <li>Six points: 3; seven points: 9; eight points:1</li> </ul>					

### • Cardiogenic shock

- Chinese patients receiving ECMO for cardiogenic shock had a significantly lower prevalence of arrhythmia than Scandinavian patients (16.9% vs. 44.0%, p<0.001).
- The length of ECMO use for cardiogenic shock in Chinese patients was significantly shorter than that in Scandinavian patients (5.6 days vs. 8.0 days, p=0.008).
- The meta-analysed in-hospital mortality in Chinese patients and in Scandinavian patients were comparable for cardiogenic shock (36.0% vs. 25.0%, p=0.421) but significantly different for cardiac arrest (66.3% vs. 75.3%, p<0.001).

## **Complications associated with ECMO**

The meta-analyzed distributions of ECMO-related complications from the nineteen included studies involving patients receiving ECMO for pulmonary or cardiac indications are shown in Figure 4.

	China				Scandinavia countries						Z-test			
Complications	Number	Sample		Point estimation (95% CI)	Heterogeneity test		Number	Sample		Point estimation	Heterogeneity test		7	Dyalua
	of studies	size			P value	<b>1</b> <sup>2</sup>	of studies	; size		(95% CI)	P value	<b>I</b> <sup>2</sup>	<sup>-</sup> Z value	r value
Bleeding	12	962	-	50.2% (36.0%, 64.4%)	<0.001	97.4%	5	652		44.8% (23.4%, 66.2%)	<0.001	97.9%	0.41	0.682
Infection	9	623	-	40.6% (26.3%, 54.9%)	<0.001	95.3%	3	292	-	14.9% (3.3%, 26.5%)	<0.001	87.4%	2.74	0.006
Thrombosis	7	290	•	7.5% (2.9%, 12.1%)	0.051	52.1%	1	68	-	2.9% (0.7%, 11.0%)			1.288	0.198
Mechanical complication	s 6	562	-	16.0% (4.6%, 27.3%)	<0.001	92.1%	3	292	•	1.5% (0.1%, 2.8%)	0.686	0%	2,481	0.013
Liver injury	4	455		29.9% (11.7%, 48.2%)	<0.001	93.7%	1	124	•	3.2% (1.2%, 8.3%)			2.814	0.005
Cerebral dysfunction	3	296	•	5.5% (2.7%, 8.3%)	0.451	0%	1	68	-	10.3% (5.0%, 20.1%)			-1.169	0.242
Pneumothorax	3	163	-	5.2% (0%, 11.2%)	0.047	63.7%	1	68	-	23.5% (14.9%, 35.0%)			-3.073	0.002
Pulmonary embolism	1	38	-	7.9% (2.6%, 21.8%)			1	68	-	23.5% (14.9%, 35.0%)			-2.205	0.027
			0.020406						0 02 04 06					

Figure 1. The flowchart of literature search.

## **Clinical indications for ECMO**

- In the group with pulmonary indications, the most common diagnoses in China and Scandinavia included viral pneumonia (78.5% vs. 25.9%, p<0.001) and bacterial pneumonia (10.3% vs. 44.4%, p<0.001).
- In the group with cardiac indications, the most common diagnoses included acute fulminant myocarditis (47.6% vs. 10.0%, p<0.001), cardiomyopathy (12.8% vs. 32.0%, p<0.001), and coronary heart disease (12.4% vs. 27.0%, p=0.002).

Figure 4. The meta-analyzed proportions of ECMO-related complications in patients receiving ECMO for pulmonary or cardiac indications in China and Scandinavia.

#### CONCLUSIONS

- In conclusion, this study reveals significant regional differences in the clinical indications, utilization, and outcomes of ECMO between China and Scandinavia.
- These findings likely underscore the importance of considering regional variations in patient characteristics and healthcare practices when developing and implementing ECMO protocols.

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