


ECMO: Yesterday, Today, & Tomorrow

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Brief History of Critical Care

1953: First ICU in Europe was opened in Copenhagen by Dr Bjorn Ibsen known as ‘the father of intensive care.’

https://www.researchgate.net/publication/9010703_The_first_intensive_care_unit_in_the_world_Copenhagen_1953



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1500 medical &
dental students
hand ventilate trach
patients for
165,000 hours.

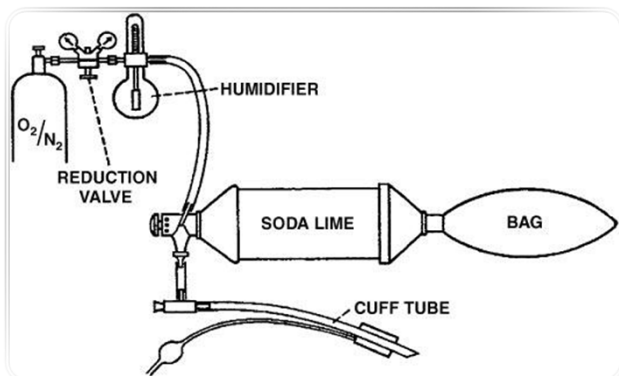
https://www.researchgate.net/publication/9010703_The_first_intensive_care_unit_in_the_world_Copenhagen_1953



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Ambu Bags 1953



- Tank: 50% O₂ / 50% N₂
- Soda lime absorber: Assist with CO₂ removal
- Only lab test available: Total CO₂ (bicarb)

https://www.researchgate.net/publication/5675882_Surge_capacity_mechanical_ventilation



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1958 Dr. Weil,
establishes a 4-bed
'shock ward' at
USCMC



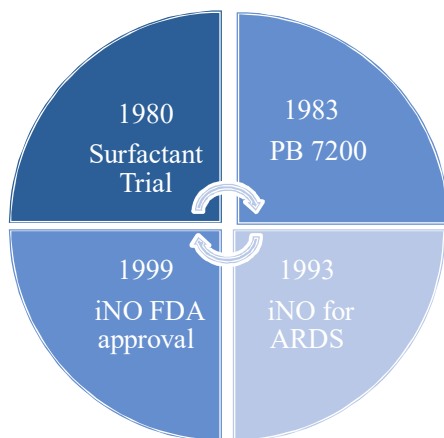
John H. Gibbon and the development of the heart-lung machine: The beginnings of open cardiac surgery



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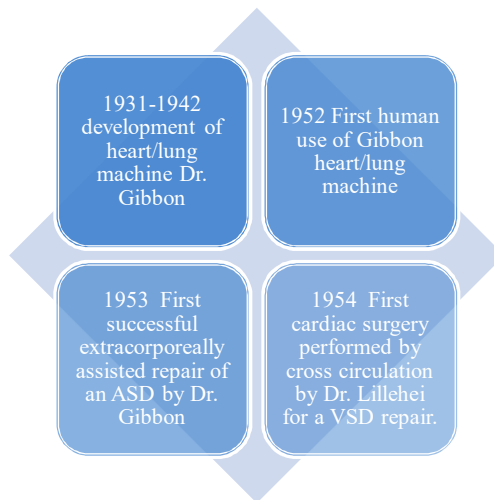
Notable Moments in Critical Care



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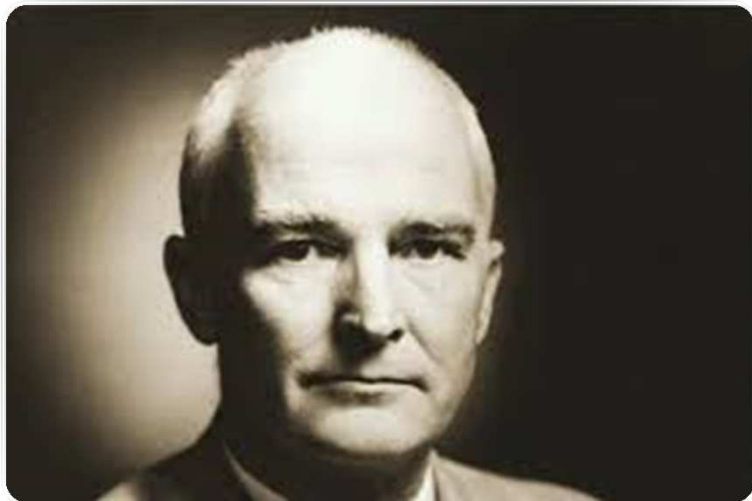
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Notable Moments in ECLS



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Dr. John Gibbon

- ▶ 1927 began fellowship at MGH
- ▶ 1930 assisted Dr. Churchill in emergent pulmonary embolectomy



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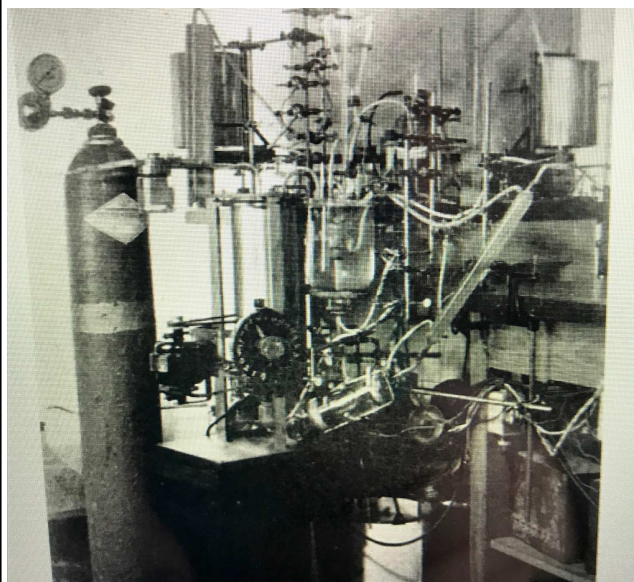
Design born out of a life lost

“If only we could remove the blood from her body by bypassing her lungs, and oxygenate it, then return it to her heart, we could almost certainly save her life.”



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**Early Version
Gibbon heart/lung
machine**

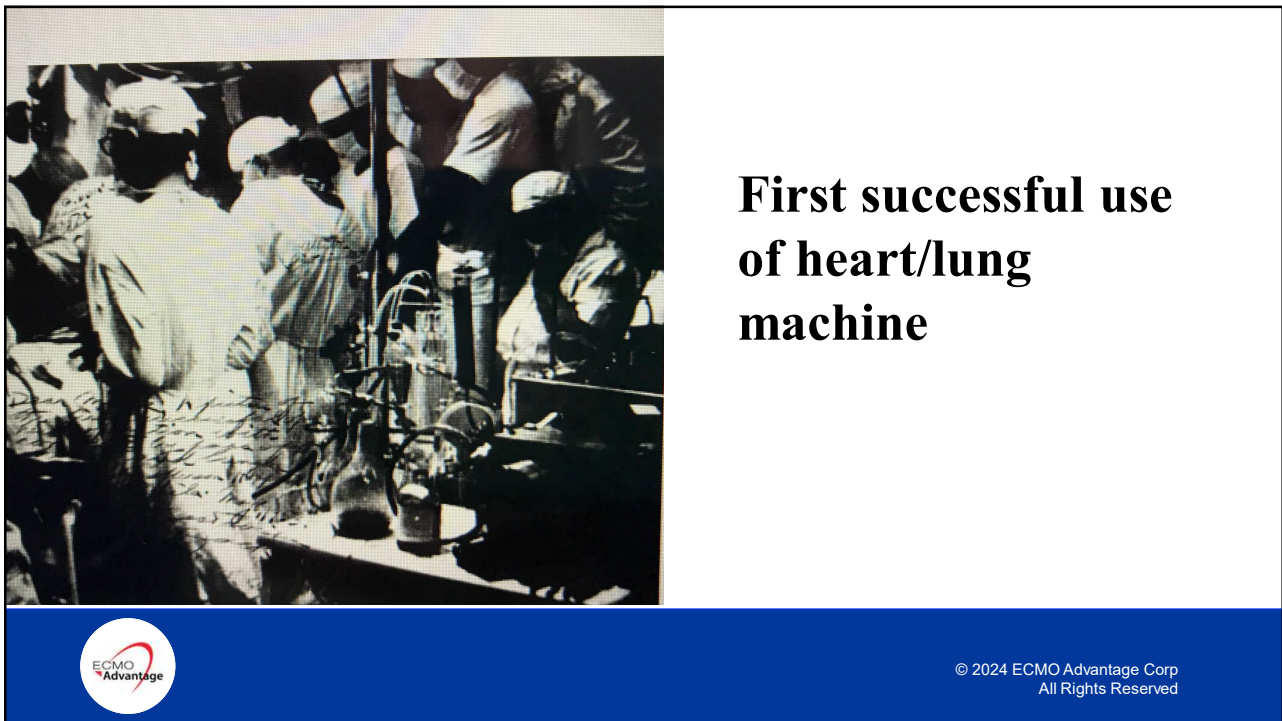


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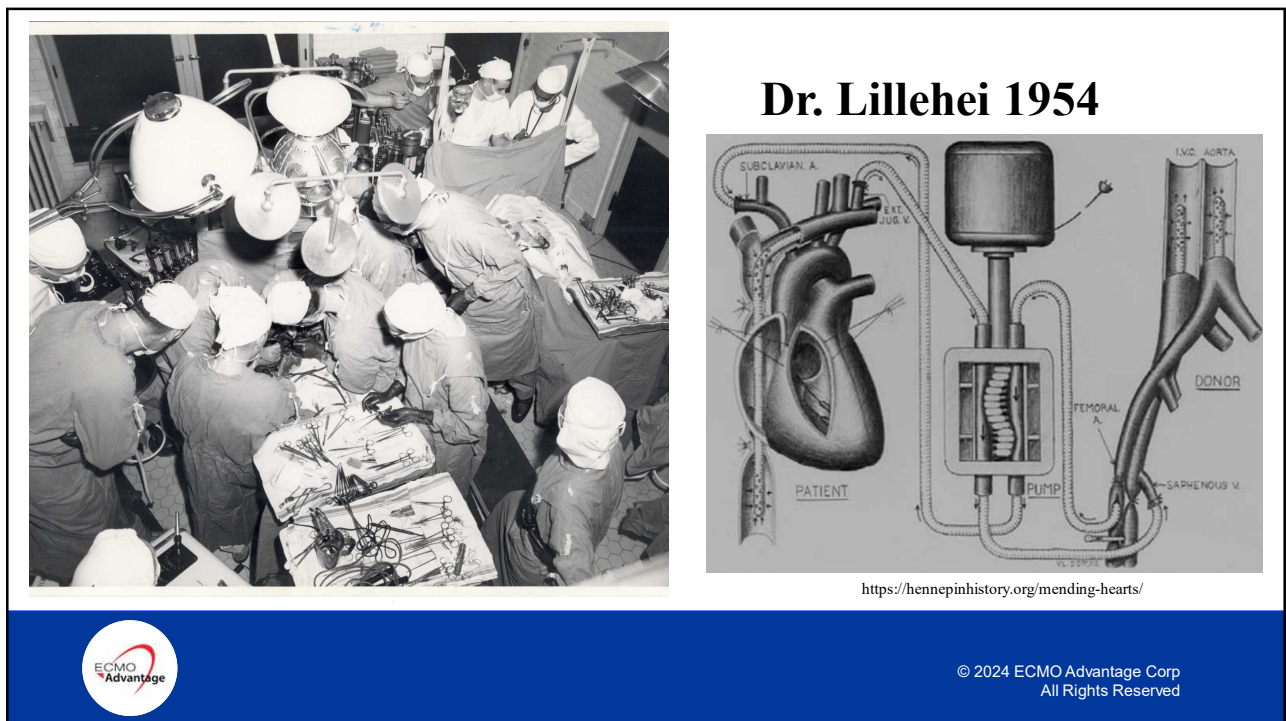
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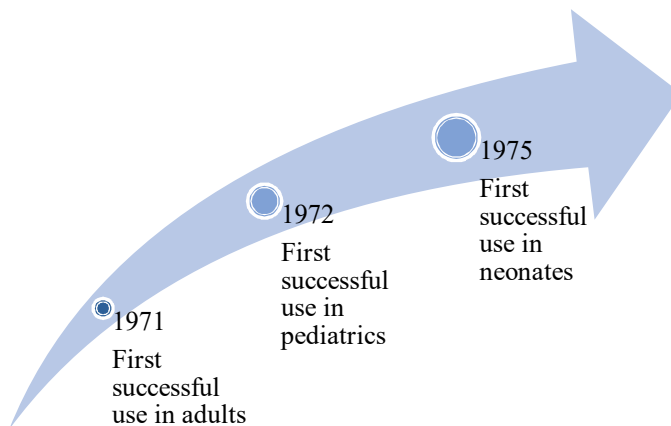


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Brief History of ECMO



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ECMO 1971

<https://x.com/ezmanshariff/status/1462379779202551813/photo/1>



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ECMO 1972



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ECMO 1975



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Dr. Bartlett



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ELSO



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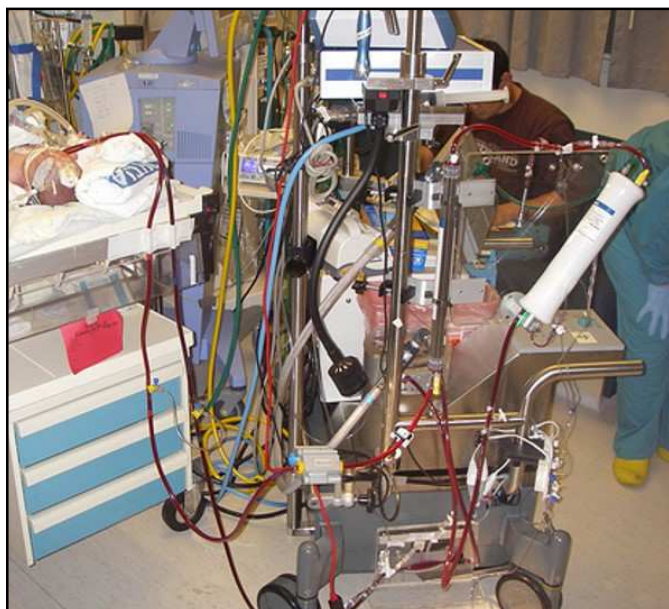
Life-Saving ECMO Device Made Possible By Sheep Research

It was thought to be strange and risky in the 1970s, but research with sheep paved the way to a new machine that gave critically-ill patients with failing hearts and lungs a chance for their organs to rest and repair themselves. To date: 50,000 patients treated; more than 2,000 of them right here at U-M, and thousands of lives saved



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ECMO 1990's to early 2000's



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ECMO 2000-2010's



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ECMO 2024



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**“Next time, let’s
not eat the bones”**



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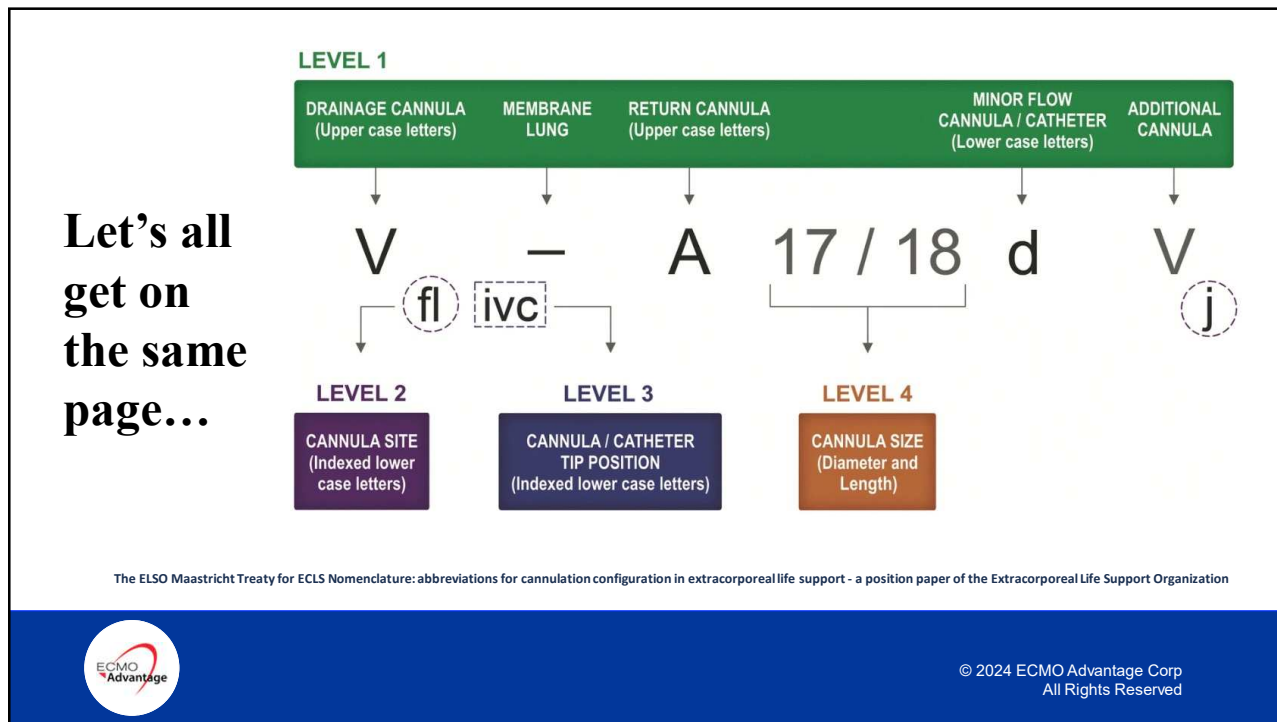
**“ECLS technology and application
to patient care is the unique result
of a long-standing history of
ambitious attempt, evaluation,
debate, and collaboration.”**

Source: The evolution of patient selection criteria and indications for extracorporeal life support in pediatric cardiopulmonary failure

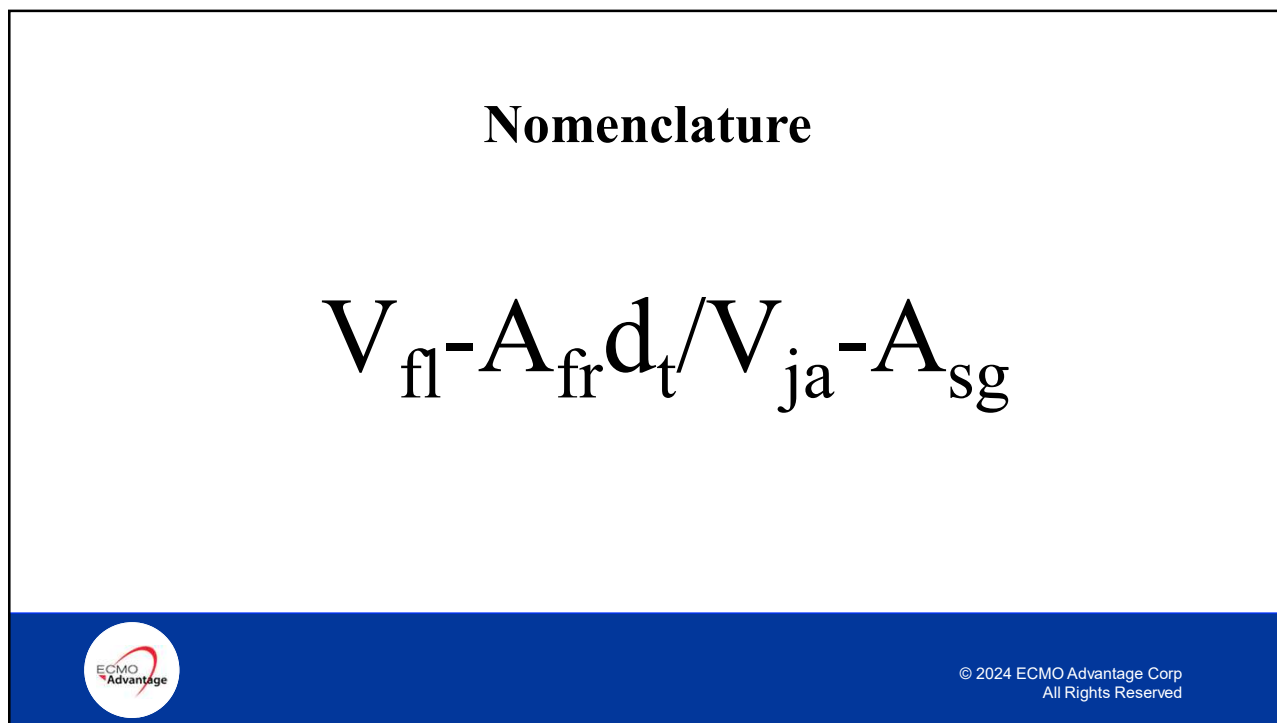


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Source: <https://www.youtube.com/watch?v=JfS1M73EKRY>



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**Play Ball!
ECMO is a
Team Sport**



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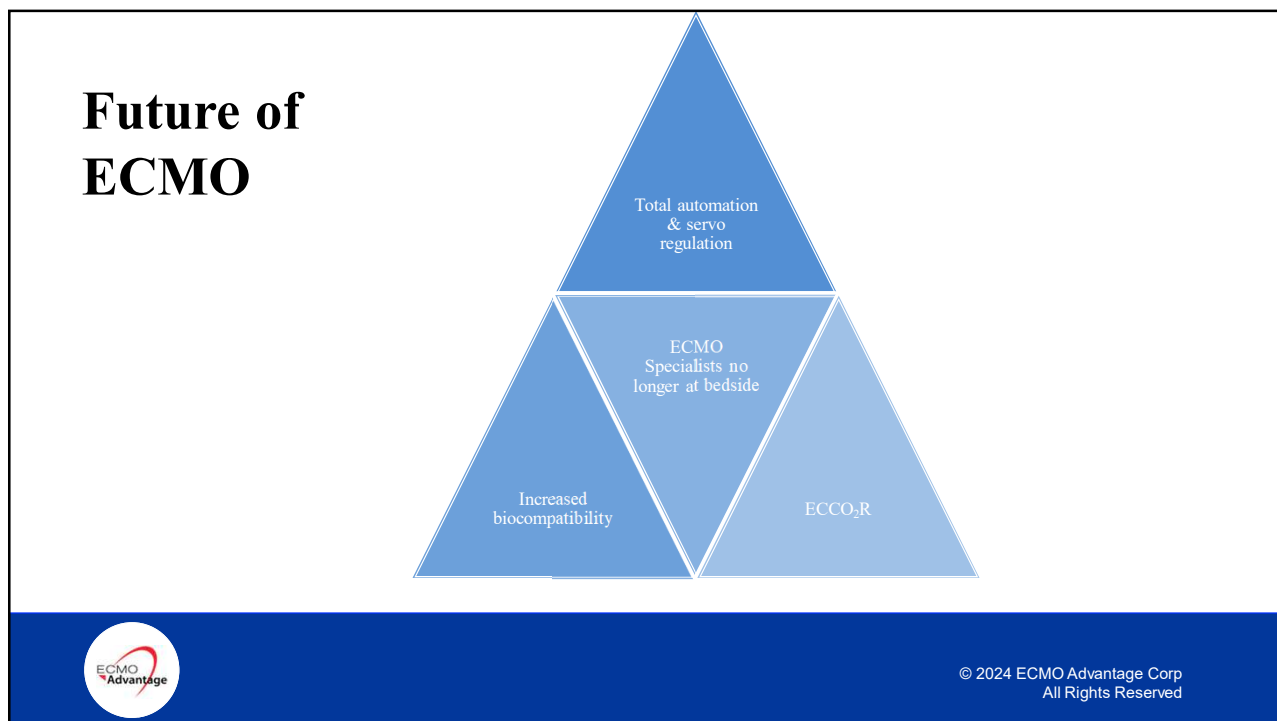
ECMO Era's

ECMO I, 1980-2008	ECMO II, 2009-2017	ECMO III, 2018-20??
Sedation, Paralysis	Awake, spontaneous breathing	Awake, ambulatory
Intubated	Tracheostomy, extubate	Extubated
Resting ventilator settings	CPAP	No ventilator
ECMO Specialist 24/7	ICU RN, ECMO Team Support	Conventional care, weeks Home, months
Lung recruitment	Watch and wait	Spontaneous breathing
Bleeding; major	Bleeding; minor	No anticoagulation

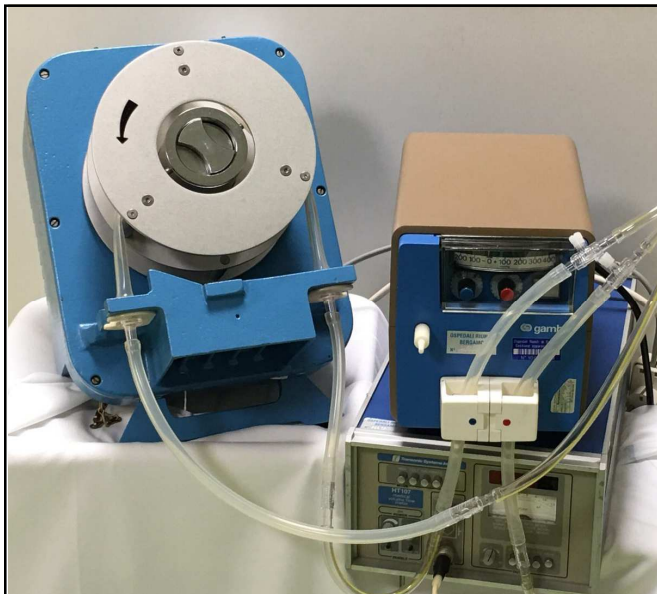


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Rhone-poulenc



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OASSIST

<https://www.frontiersin.org/journals/medicine/articles/10.3389/fmed.2021.712205/full#F1>

FIGURE 1 | Macro-inspection the OASSIST ECMO system. (A) The macro-inspection of the pump drive. (B) The macro-inspection of the control console. (C) The pump drive hold by a staff. (D) The control console hold by a staff.



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ECCO₂R & Oxygenation?




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Membrane type	Examples	Membrane characteristics
Biomimetic surfaces	Heparin bonded	Reduced cellular activation and inflammation, but systemic anticoagulation still required
	Nitric oxide bonded	Reduced platelet consumption and thrombosis in animals, NO release and longevity difficult ³²
Biopassive surfaces	Phosphorylcholine lined	Reduced heparin needs in cardiopulmonary bypass, unclear if better than heparin bonded
	PMEA	Reduced platelet aggregation and protein adsorption, mixed performance compared to heparin bonded
	Fluid repellent	Air-liquid membrane would avoid contact with tubing, but not yet technically feasible
Endothelialization	In vitro	Reduced thrombosis and stenosis when used in grafts, but currently very slow to create and limited to short devices
	In vivo	Mimics native endothelium, but currently not technically feasible

Biocompatibility

Source: <https://onlinelibrary.wiley.com/doi/full/10.1002/rth2.12346>



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Long-term care facility for ECMO?



Source: <https://www.dnaz.org/in-with-the-new-magnifying-a-donors-impact/>



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EXTRACORPOREAL CPR

ECPR		
COR	LOE	Recommendation
2a	B-R	1. Use of ECPR for patients with cardiac arrest refractory to standard ACLS is reasonable in select patients when provided within an appropriately trained and equipped system of care.

Source: <https://www.ahajournals.org/doi/10.1161/CIR.000000000001194>




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	ARREST	Prague OHCA	INCEPTION
ECPR/invasive group	15	124	70
CCPR group	15	132	64
Age (mean, SD)	59 (10)	57 (14)	55 (11)
Male sex (%)	25 (83%)	212 (83%)	39 (29%)
Primary Rhythm:			
VT/VF	30 (100%)	156 (61%)	132 (99%)
PEA	0	45 (17%)	NA
Asystole	0	55 (22%)	NA
Bystander CPR (%)	25 (83%)	252 (85%)	130 (97%)
Defibrillation attempts (prehospital, mean, SD)	6 (3)	4 (3)	9 (6)
Mechanical CPR (%)	30 (100%)	218 (85%)	120 (90%)
Lactate on admission (mmol/L, mean, SD)	11.1 (3.8)	11.5 (4.9)	13.5 (4.6)
pH on admission (mean, SD)	6.95 (0.11)	6.99 (0.23)	6.92 (0.17)
Cannulation location	Cardiac cath lab	Cardiac cath lab	Emergency dept
Cannulator specialty	Interventional cardiology	Interventional cardiology	Surgery, interventional cardiology, intensivists
Time from 911 to VA ECMO initiation (min, mean, SD)	59 (28)	62 (11.3)	74.7 (18.2)
Six-month survival (*CPC 1-2)			
ECPR/invasive group	6 (43%)	39 (32%)	14 (20%)
CCPR group	0	29 (22%)	10 (16%)

ECPR
RCTs

Source: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10800292/>



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ECPR: *Saving money and lives*

2018 Data

U.S. OHCA cases: 235,055

Total annual productivity loss \$11,335,314,369

Total lifetime productivity loss \$150,187,979,225



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Service d'Aide Medical d'Urgence (SAMU) in Paris

Source: <https://www.jems.com/patient-care/how-physicians-perform-prehospital-ecmo-on-the-streets-of-paris/>



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SAMU ECPR Louvre



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U of M Mobile ECMO Truck



Source: <https://med.umn.edu/news/u-m-medical-schools-innovative-mobile-ecmo-truck-saving-lives-twin-cities>



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First ECMO Outpatient Center??



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RRTs as ECMO Specialists



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Unsure of your career path?



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