Challenges of a Transport ECMO/ VAD Program

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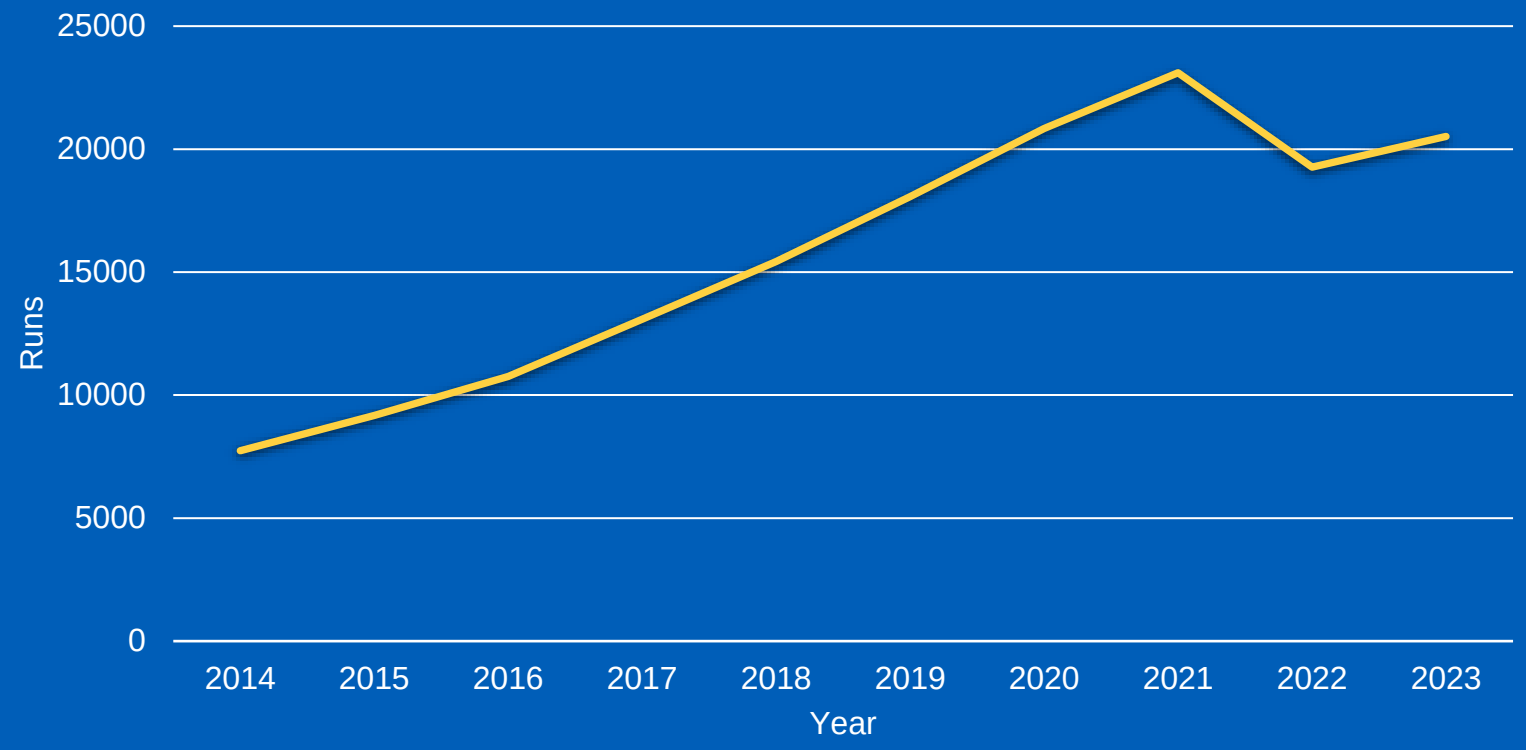
ECMO runs 2014-2023 (total)



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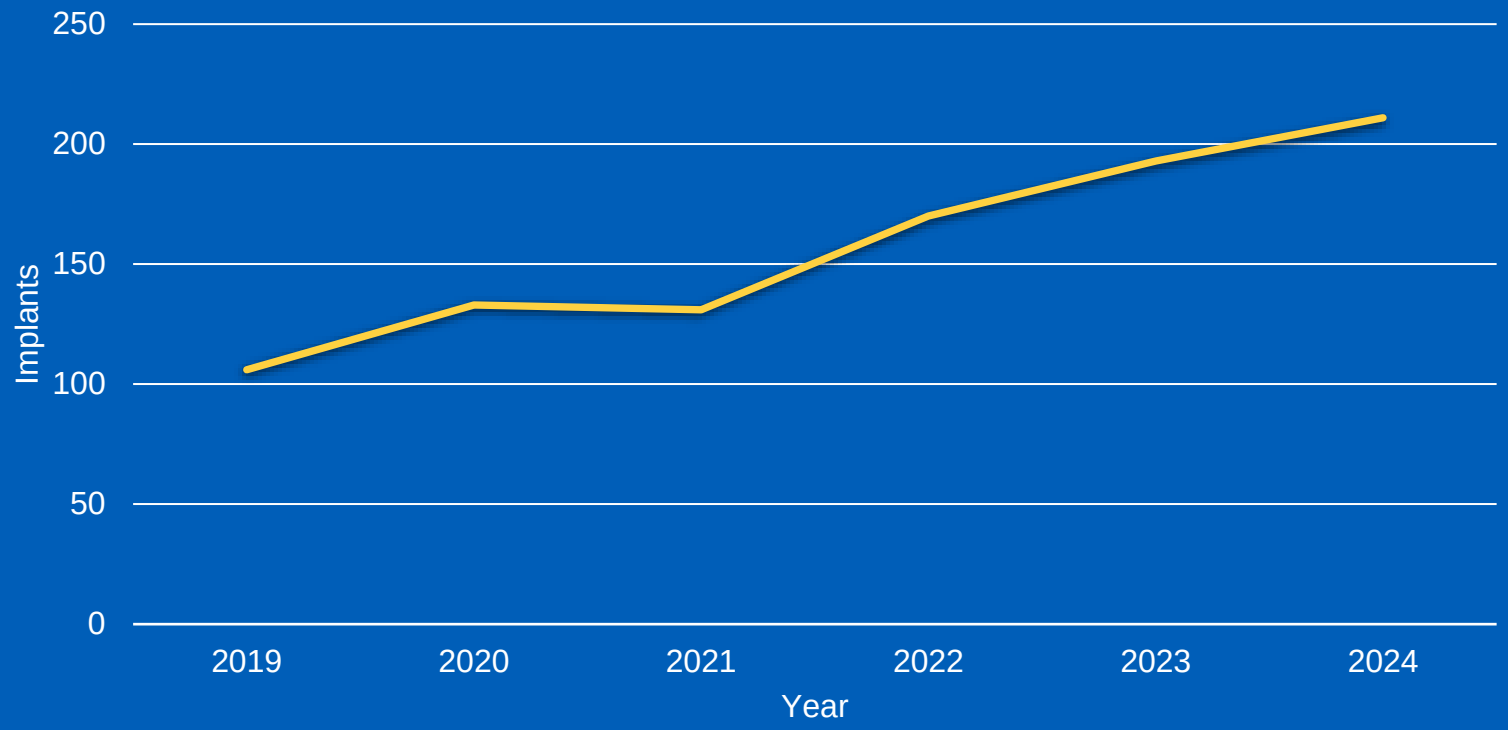
1. ELSO Registry Report, International Summary, October 2024. Available at https://www.elso.org. Accessed 1/6/25

Berlin VAD full system implants 2019-2024



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1. Berlin Heart, 1/17/2025.

Increase in pediatric ECMO/VAD transfers

- Increase in indications for ECMO/VADs
  - ECPR
- Inadequate resources to support transports
  - Staffing
  - Equipment
- Increased awareness
- Improvements in technology and patient management
  - Anticoagulation

1. Kalra R, Kosmopoulos M, Goslar T, et al. Extracorporeal Cardiopulmonary Resuscitation for Cardiac Arrest. Curr Opin Crit Care. 2020; 26 (3): 228-235.
2. Javidfar J, Labib A, Ragazzo G, et al. Mobile Extracorporeal Membrane Oxygenation for Covid-19 Does Not Pose Extra Risk to Transport Team. ASAIO J. 2022; 68: 163-168.
3. Zafar F, Conway J, Bleiweis M, et al. Berlin Heart EXCOR and ACTION post-approval surveillance study report. J Heart Lung Transplant. 2021; 40 (4): 251-259.
4. Dhar A, Morrison T, Barraro R, et al. Starting and Sustaining an Extracorporeal Membrane Oygenation Program. ASAIO J. 2022; doi: 10.1097/MAT00000000000017B3.
5. Browning Carmo KA, Liava'a M, Festa M. et al. Retrieval of neonatal and paediatric patients on extracorporeal membrane oxygenation support n New South Wales, Austratlia. Journal of Paediatrics and Child Health. 2021; 57: 1164-1169.

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Children's Mercy Kansas City Critical Care Transport

- Only 24/7 transport program in the region dedicated almost exclusively to pediatrics and neonates
- Over 5,800 neonatal, pediatric and maternal fetal transports a year

- 14 ambulances (0-120 miles)
- S-76 Sikorsky C++ helicopter (0-300 miles)
- Beechcraft King Air 200 Turbo Prop (120-600 miles)
- Lear 31 Jet (> 400 miles)

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Setting up/maintaining a transport ECMO/VAD program

Questions to answer

1. Type of transports
2. Team composition
3. Staffing
4. Equipment
5. Training/competency
6. Anticipated program growth

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1. Zavadil D. Small Hearts: Mobile Pediatric/Neonatal ECMO, where we are and where we're going. AmSECT Today. 2023; 26(1): 18-21.
2. Labib A, Auust E, Agerstrand C, et al. Extracorporeal Life Support Organizaton Guidelines for Transport and Retrieval of Adult and Pediatric Patients with ECMO Support. ASAIO J. 2022; doi: 10.1097/MAT.0000000000001653.
3. Camts.org/wp-content/uploads/2023/10/Special-Operations-2023-Standards-Final.pdf.

ECMO equipment

- ECMO/VAD transport sled
- Mobile ECMO system
- Gas blender
  - CO2
- Heater cooler/ chemical blanket
- Point of care instruments
- Backup equipment/disposables

1. Zavadil D. Small Hearts: Mobile Pediatric/Neonatal ECMO, where we are and where we're going. AmSECT Today. 2023; 26(1): 18-21.

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VAD equipment

- Abbott CentriMag Acute Circulatory Support System LVAD/RVAD
  - No hand crank, backup console required
  - Monitor not needed
- Berlin EXCOR Pediatric LVAD/RVAD
  - Backup driver (Ikus 220 lbs, Active Driver 33lbs)
    - Second ambulance, aircraft with lift
  - Power requirements
  - Ikus driver compressor based, Active Driver piston based
  - Backup disposables, extra batteries (Active Driver)

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1. Berlin Heart, 1/17/2025.
2. Abbott, 1/17.2025.
3. Woolley JR, Dady S, Spinnato J, et al. First Berlin Heart EXCOR Pediatric VAD Interhospital Transports of Nonambulatory Patients with the Ikus Stationary Driver. ASAIO J, 2013; 59: 537-541.

Ongoing challenges

- Expenses (equipment/personnel)
- Staffing/compensation
- Reimbursement
- Pilot flight hours
- Weather
- Surprises/wide variation of transports

#1 VA ECMO transport via ground

- 55 kg 12 yr old female with hx of William's Syndrome, LCA stenosis, anomalous RCA from LCA, PA stenosis presented to our ER following episodes of syncope and chest pain
- Found to have a-fib with ST depression, admitted to CICU
- Later that evening, became unresponsive, developed bradycardia, intubated, cardiac arrest, CPR, placed on VA ECMO
- Transferred on ECMO to neighboring adult hospital for emergent CAB x 2
- Was placed back on ECMO secondary to inability to wean from CPB
- Transferred back to Children's Mercy on ECMO the following day
- Concerns: Anemia requiring transfusion, additional antibodies discovered delaying blood availability/departure

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#2 CentriMag LVAD lateral transport via ground/air

- 19 kg 6 yr old female with DORV, S/P Fontan Procedure
- Presented to referring hospital with increased Fontan pressures, EDP, PLE, refractory arrhythmias and decreased LVEF
- Placed on VA ECMO, transitioned to CentriMag LVAD (Berlin cannulas) consulted for lateral transfer to another institution to be evaluated for heart transplant
- Extubated, awake on 20 L HFNC 100% O2 with iNO2 and BiPAP
- Transport: **ground** Children's Mercy-KC airport, **air** KC airport-airport A, **ground** airport A-hospital A, pickup patient, **ground** hosp A-airport A, **air** airport A-airport B, **ground** airport B-hosp B, drop off patient, **ground** hosp B to airport B, **air** airport B-Kansas City airport
- Concerns: acute respiratory decompensation enroute, temperature/fluid management with VAD, length/complexity of transport

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#3 VV ECMO transport via ground/ air

- 7 kg 7 month old male with hypoplastic aortic arch, mitral stenosis, aortic stenosis, S/P balloon atrial septostomy, S/P hybrid procedure, S/P comprehensive stage II, with hx of rhino/enterovirus and parainfluenza placed on VV ECMO for persistent hypoxemia
- Several failed attempts to wean from ECMO
- Children's Mercy consulted for transport to active heart transplant center for evaluation
- Unable to take rotor or fixed wing aircraft to referring hospital's city because of weather. After significant delay, obtained clearance to take fixed wing aircraft to airport approx. 1 hr from referring city.
- Transport: **ground** Children's Mercy-KC airport, **air** KC airport-secondary airport, **ground** secondary airport-referring hospital, picked up patient, **ground** referring hospital-secondary airport, **air** secondary airport-KC airport, **ground** KC airport-Children's Mercy with patient
- Concerns: temperature management with size, VV ECMO, power sources with additional equipment (ECMO heater cooler)

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Questions?

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