Challenges and Lessons Learned from Transport ECMO.

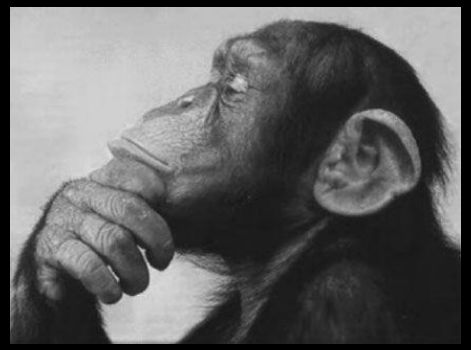
Klayton Buckley RN, CCP, FPP
MSPS 2018


MARINE
SALVAGE
SHIPSERVICE COMPANY
PIER 54

First successful ECLS patient, 1971

J Donald Hill MD and Maury Bramson BME, Santa Barbara, Ca, 1971. (Courtesy of Robert Bartlett, MD)







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DISCLAIMER

- These guidelines describe useful and safe practice for extracorporeal life support (ECLS), but these are not necessarily consensus recommendations. These guidelines are not intended as a standard of care, and are revised at regular intervals as new information, devices, and techniques become available. This talk is intended for educational use to build the knowledge of health care professionals in assessing the conditions and managing the treatment of patients requiring ECLS. These guidelines are not a substitute for a health-care provider's professional judgement and must be interpreted with reqard to specific information about the patient and in consultation with other medical authorities as appropriate.

ECMO INTER-FACILITY TRANSPORTS ARE DEFINED IN THE FOLLOWING MANNER:

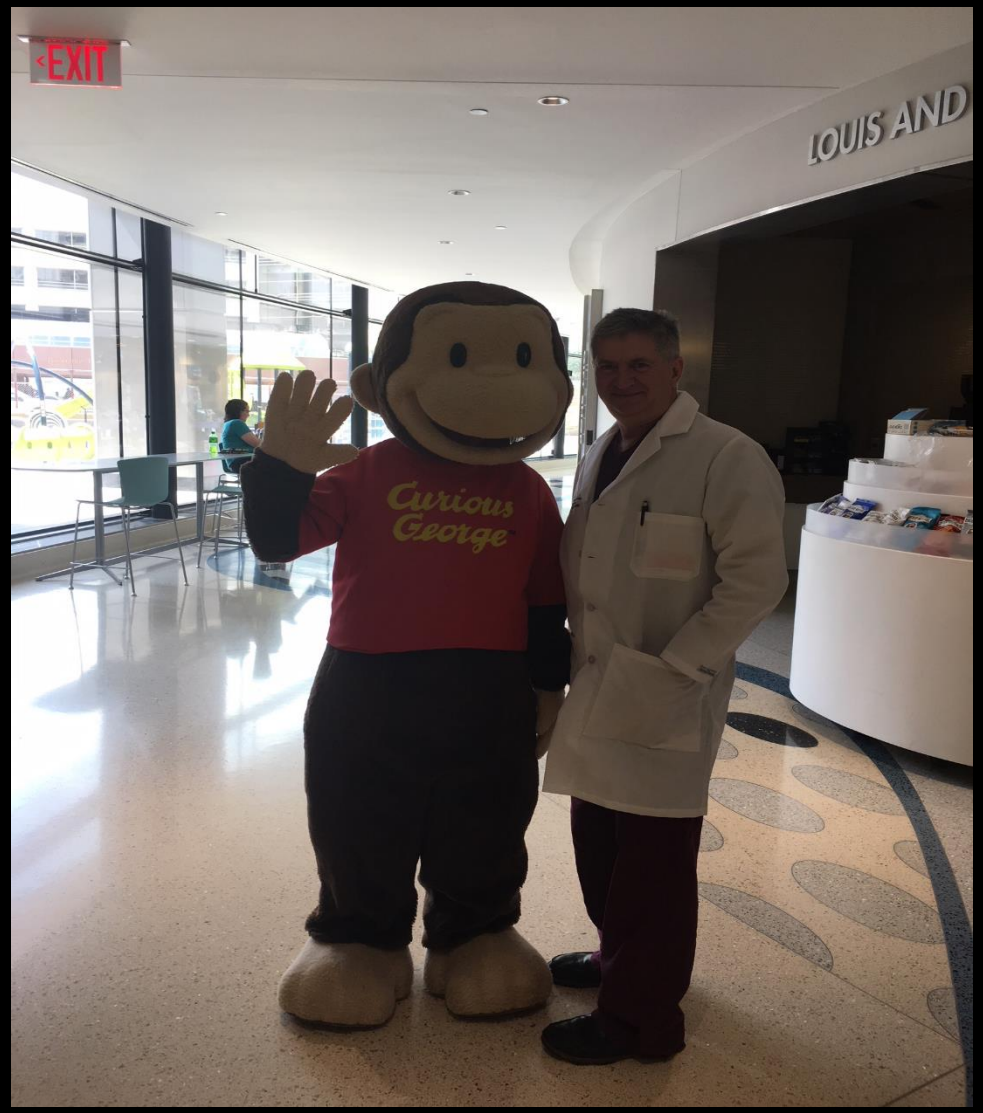
Primary Transports

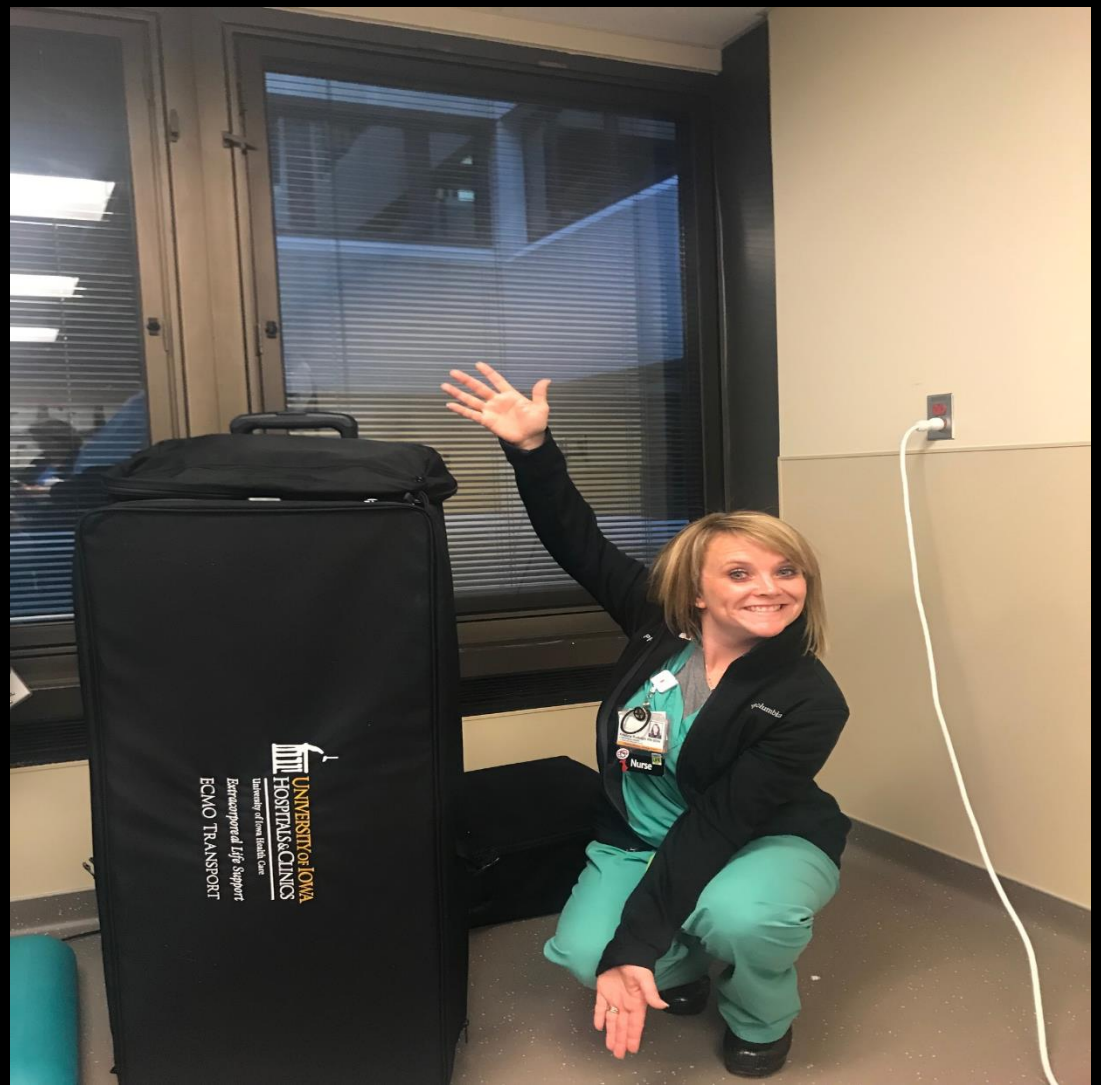
situations in which the transport team is required to perform cannulation for ECLS support at the referring facility and then transported to an ECMO facility.

Secondary Transports

situations in which the patient is already supported with ECLS at the referring facility and needs to be transported to another center for a variety of reason, or level of care provided.

REMOTE CANNULATION





Choice of Cannulation

ALL PATIENTS SHOULD HAVE A CAREFUL EVALUATION OF THEIR HEMODYNAMICALLY STATUS BEFORE CANNULATION, COMPRISING AN ECHOCARDIOGRAPHY TO ASSESS THEIR MYOCARDIAL FUNCTION AND EVALUATE THEIR CARDIO OUTPUT.

1. Venvenous (VV) ECMO may be used for transport of patients with severe respiratory failure who have clinical and echocardiographic evidence of adequate cardiac function at the time of transport.
2. Venoarterial (VA) ECMO should be considered for transport of hemodynamically unstable patients and/or in cases of significant cardiac dysfunction.

FACTORS IMPORTANT IN PLANNING FOR ECMO TRANSPORT

1. A major priority in planning a Primary Transport is expediting the arrival of the ECMO team at the referring facility.
2. For Secondary Transports the timeliness of the team's at the referring facility may not be as critical.
3. The overriding priority in transporting the patient to the ECMO center is patient safety.

* The time required for patient stabilization prior to moving (ground time) may be lengthy and is of secondary priority to patient safety during the transport

* When a prolonged ground time at the referring facility is anticipated, additional supplies, personnel, and equipment may be required and must be available.

ADVERSE EVENTS DURING TRANSPORT

- January 2010 and June 2016 536 transports identified, in 163 of these (31.7%) 206 adverse events occurred
- 65% (134) of the complications were patient related
- In 34 transports, 2 or more events occurred
- Lack of control of equipment was the most common staff related flaw
- Transportation related complications were reported in 26 transfers
- From Ericsson, Frenckner, and Broman Pre Hospital Emergency care Feb. 2017

GEOGRAPHIC FACTORS

Distance between referral center and ECMO center, and therefore duration of the mission, plays a large role in dictating the mode of transportation. In each case, geographic considerations must be viewed in the context of clinical, weather, and resource priorities. If the duration of en route care is expected to exceed 3-4 hours by ground, then air transport should be considered

GEOGRAPHIC FACTORS

Ground ambulance feasible for distances < 250 miles (400 km).

Helicopter is feasible for distances < 400 miles (650 km).

Fixed wing aircraft is usually necessary for missions > 400 miles (650 km).

WEATHER-RELATED ISSUES

Great impact on air transport (helicopter and fixed wing).

Ice/snow or other hazardous road conditions may impact the feasibility of ground transport.

Some helicopters and all commercial fixed wing air ambulances are capable of flight in IFR (instrument flight rules) conditions.

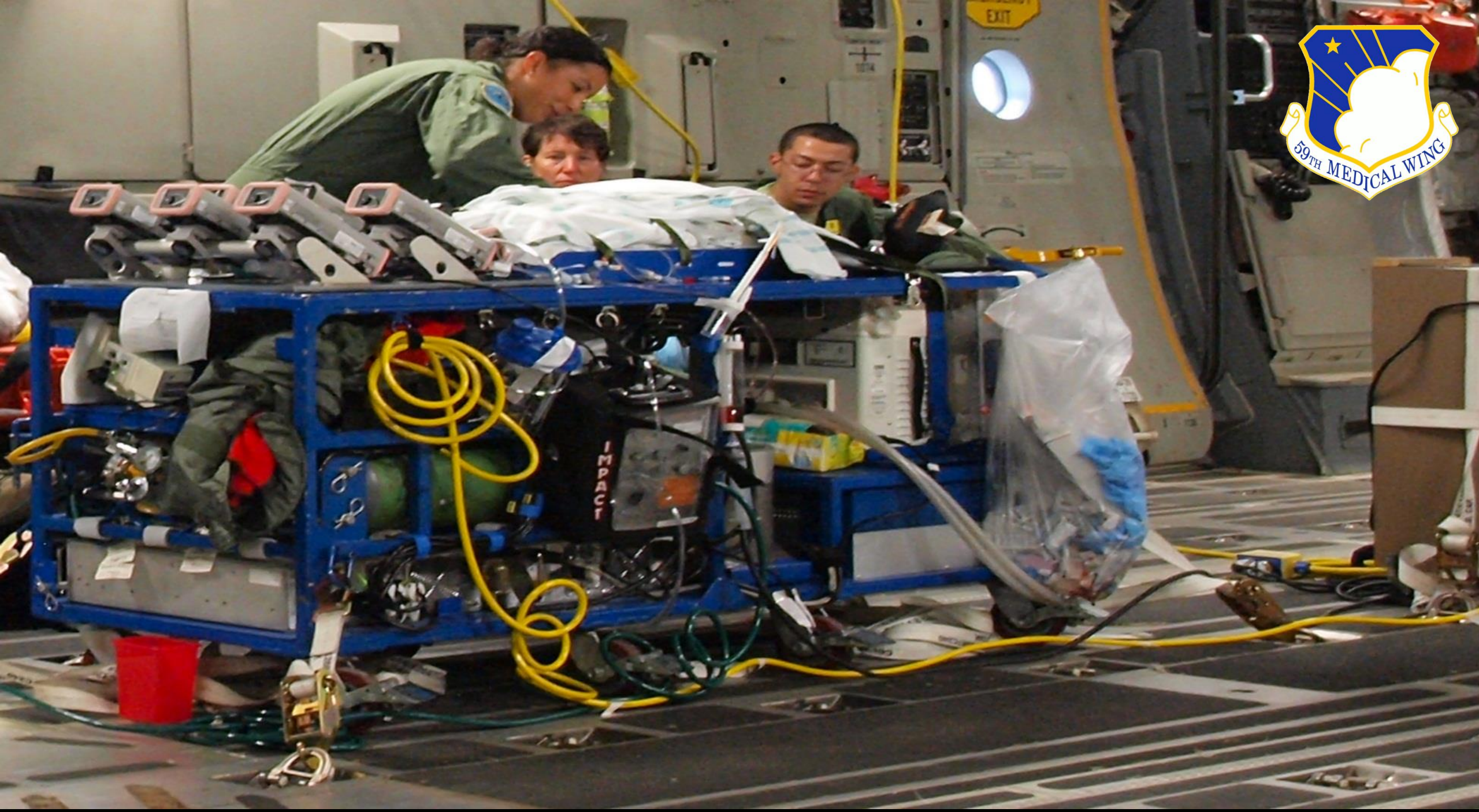
IFR mission may necessitate arrival and departure from a local airport rather than a hospital to hospital direct.

The impact of weather on the suitability of air transport for a given mission should **always**, be a pilot decision with no imput from the medical team.

AIRCRAFT/VEHICLE AVAILABILITY AND CAPABILITIES

	Ground Ambulance	Helicopter	Fixed Wing
Space for team and equipment	Sufficient (3-4 team members)	Limited (3-4 team members)	Variable (> 4 team members)
Noise	Relatively Little (can be ruff riding)	Very Loud (helments with mics)	Load
Distance range for reasonable times	Up to 250-300 miles	Up to 300-400 miles Can be very fast < 30 minutes (ECPR)	Any distance
Weight Limitations	Unlimited	Limited by aircraft, weather, distance,	Variable, depends on aircraft and conditions
Loading and securing equipment and ECMO circuit/patient	Relatively easy	Relatively easy	Variable, depends on equipment and aircraft model
Cost	++	+++	++++


59TH MEDICAL WING


EXIT
IMPACT
59TH MEDICAL WING

Centrimag vs Cardiohelp vs Rotaflow

FOR TRANSPORT

INNOVATIVE
ECMO CONCEPTS

AEROMEDICAL TRANSPORT AND HYPOXIA

- Pediatric patients have different anatomical and physical parameters when compared to the adult population.
- For fixed wing transport, at maximum altitude of 8,000 feet:
- Dalton's Law- states that each gas in a mixture exerts the same pressure as if it were present, alone, in the same volume. (decrease FiO2).
- Boyle's Law- the volume of a fixed gas is inversely proportional to the pressure to which it is subjected. (8,000 feet, volume increases by 40%)
- May need to consider lowering maximum cabin pressure (3700 feet), may have an effect on times, fuel, flight.


CARE
AMBULANCE
MAQUET
CARDIOHELP

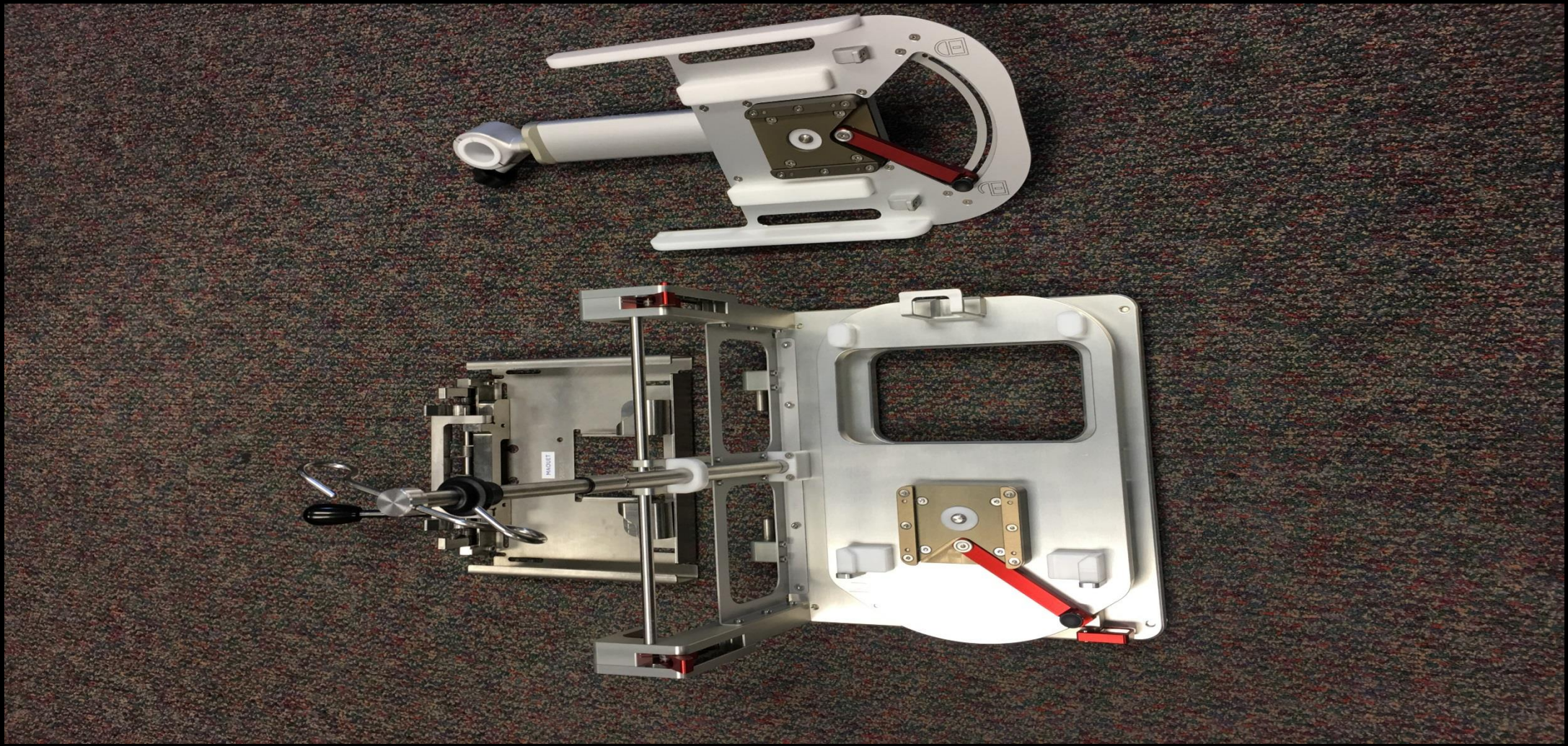

COVIDIEN
HUMAN WHOLE BLOOD
RUSH-PERISHABLE

DRINK TIME!


OSF
LIFELINE AMBULANCE
OSF
LIFELINE AMBULANCE


RLW Photo

CARDIOHELP HOLDERS




N762D
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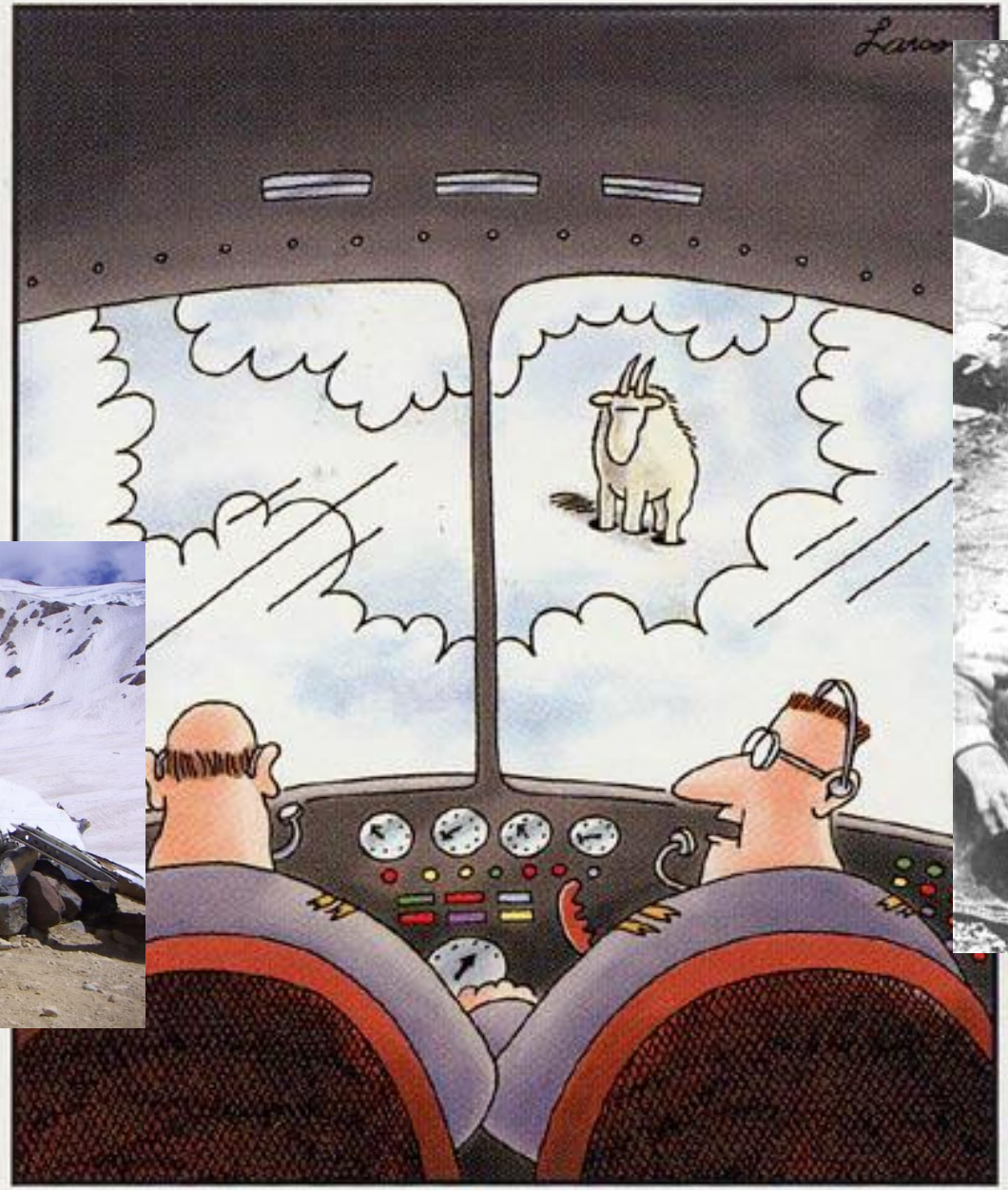
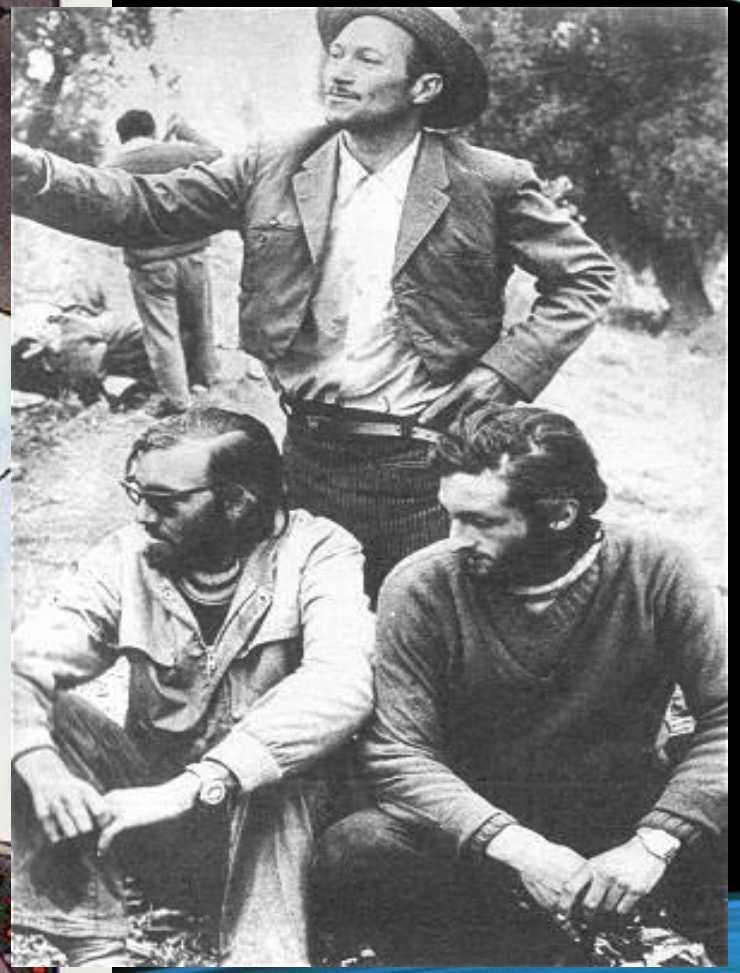


"Say … what's a mountain goat doing way up here in a cloud bank?"



PERSONNEL/TEAM COMPOSITION

- Cannulating Physician
  - Surgical Assist
  - ECMO Specialist
  - Transport RN/RRT
- ECMO Physician
  - ECMO Specialist
  - Transport RN/RRT

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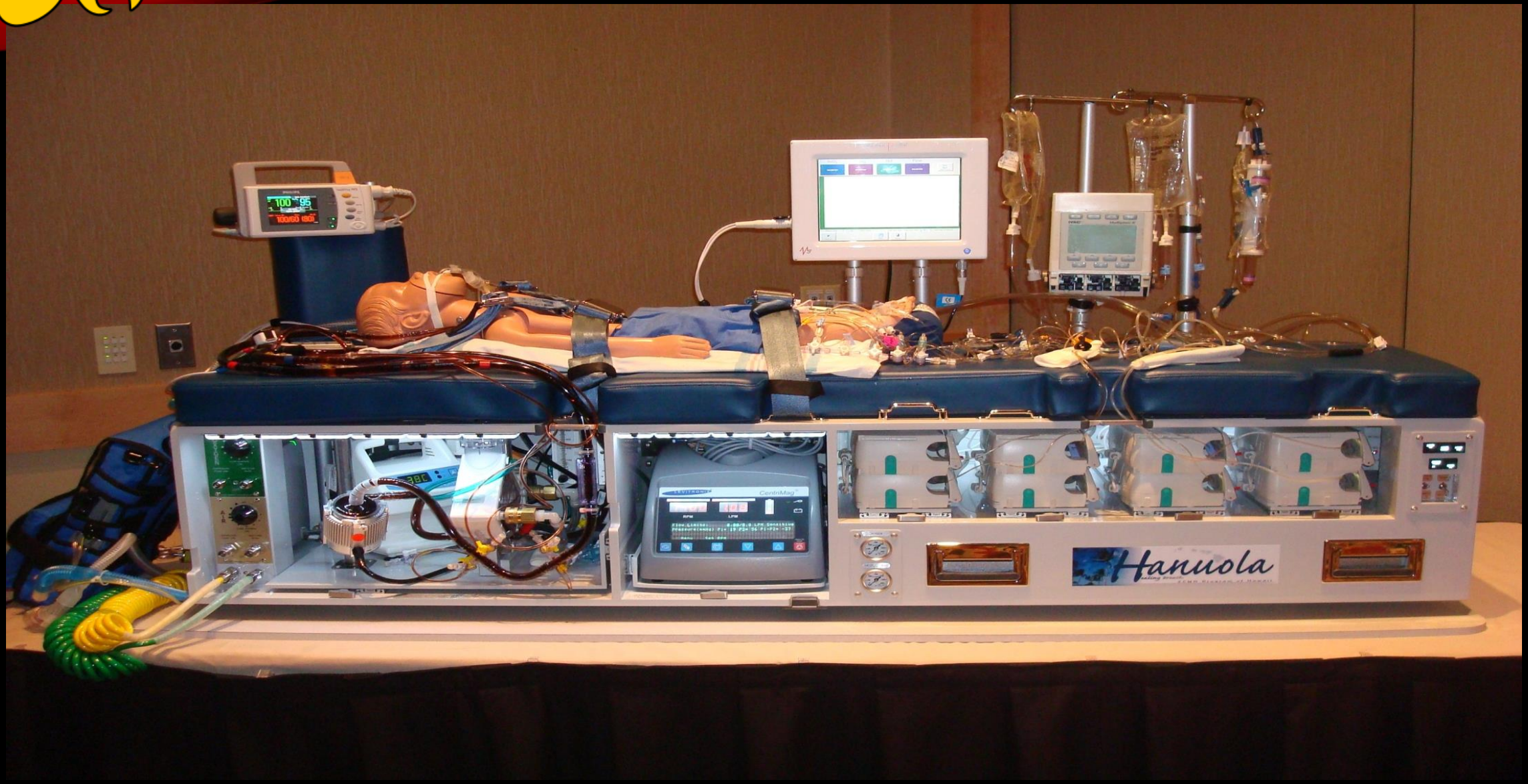
Extracorporeal Life Support
ECMO TRANSPORT

FIRST RULE IN ECMO, YOU HAVE TO HAVE A SENSE OF HUMOR!

CHANGES IN TECHNOLOGY


Hanuola

SIDE BY SIDE

Feature	Centrimag	Cardiohelp	Rotaflow
Inlet pressure regulation	✗	✓	✗
Pre-ox pressure regulation	✗	✓	✗
Post-ox pressure regulation	✗	✓	✗
Venous temperature monitor	✗	✓	✗
Arterial temperature monitor	✗	✓	✗
SvO2 monitor	✗	✓	✗
HCT monitor	✗	✓	✗
Arterial bubble detection	✗	✓	✓
Venous bubble detection	✗	✓	✗
Hand crank	✗	✓	✓
Integral battery	✓	✓	✓

RATIONALE

- Gaseous micro emboli will enlarge during the decrease in cabin pressure with increased cabin elevation
  - Bubble detection
    - Arterial side to protect air from going forward
    - Venous side will protect circuit from IV air administered pre-transport

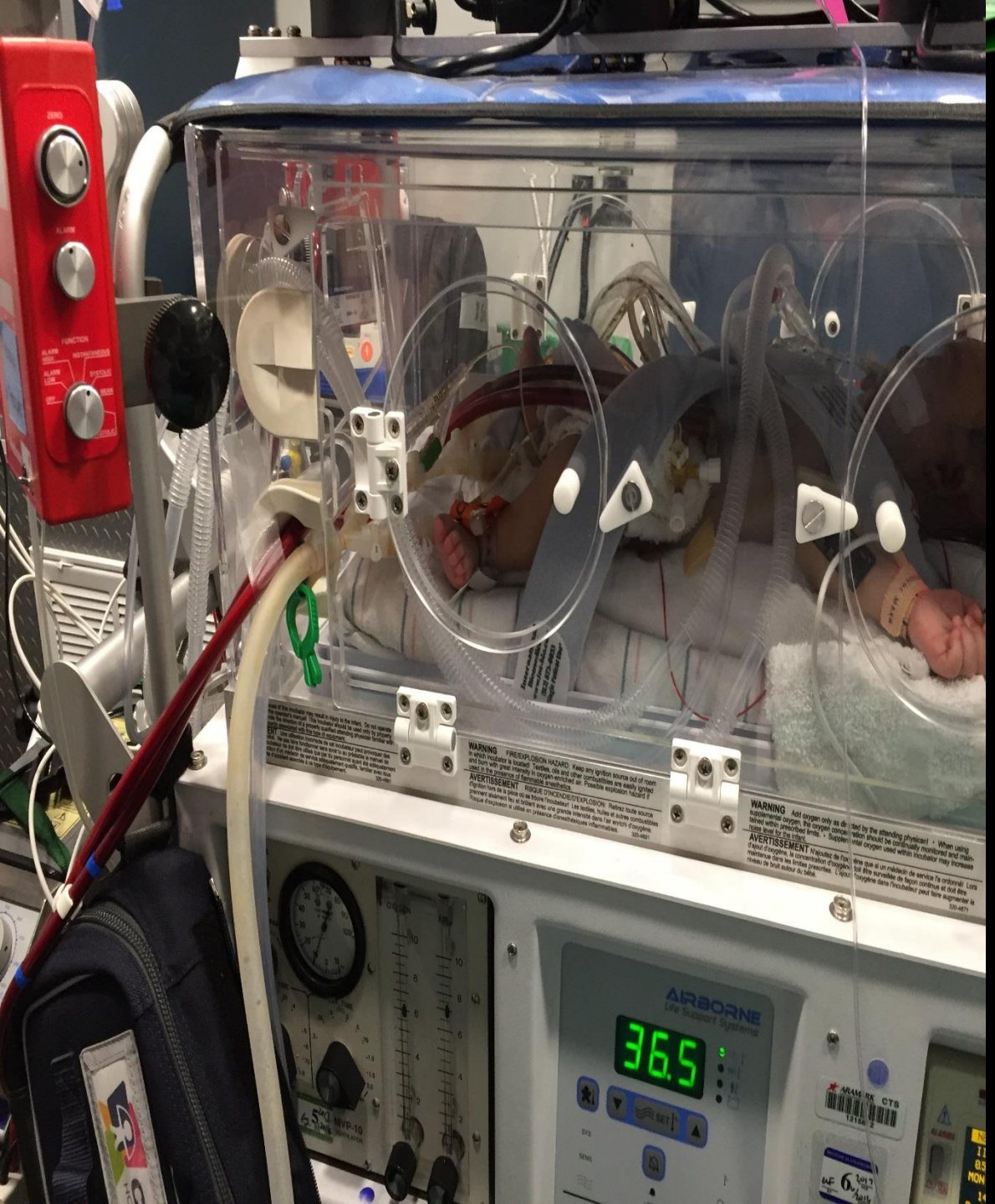
COST

Item	Centrimag	Cardiohelp	Rotaflow
Device (pump)	$45,000	$100,000	$25,000
Disposables			
Centrifugal pump	$9,000 - $12,500	$12,000 - $15,000	$250
Oxygenator	$1,200	Included	$1,200
Tubing pack	$200 - $500	Included	$200 - $500
Per transport total	**$10,400 - $14,200**	**$12,000 – $15,000**	**$1,650 - $1,950**


DART
DARTMOUTH HITCHCOCK ADVANCED RESPON
SPECIALTY CARE TRANSPORT


LONG


DART


AIRBORNE
Life Support Systems
36.5
SET
MVP-10


AVIATOR
Airborne Life Support Systems
ATRIUM

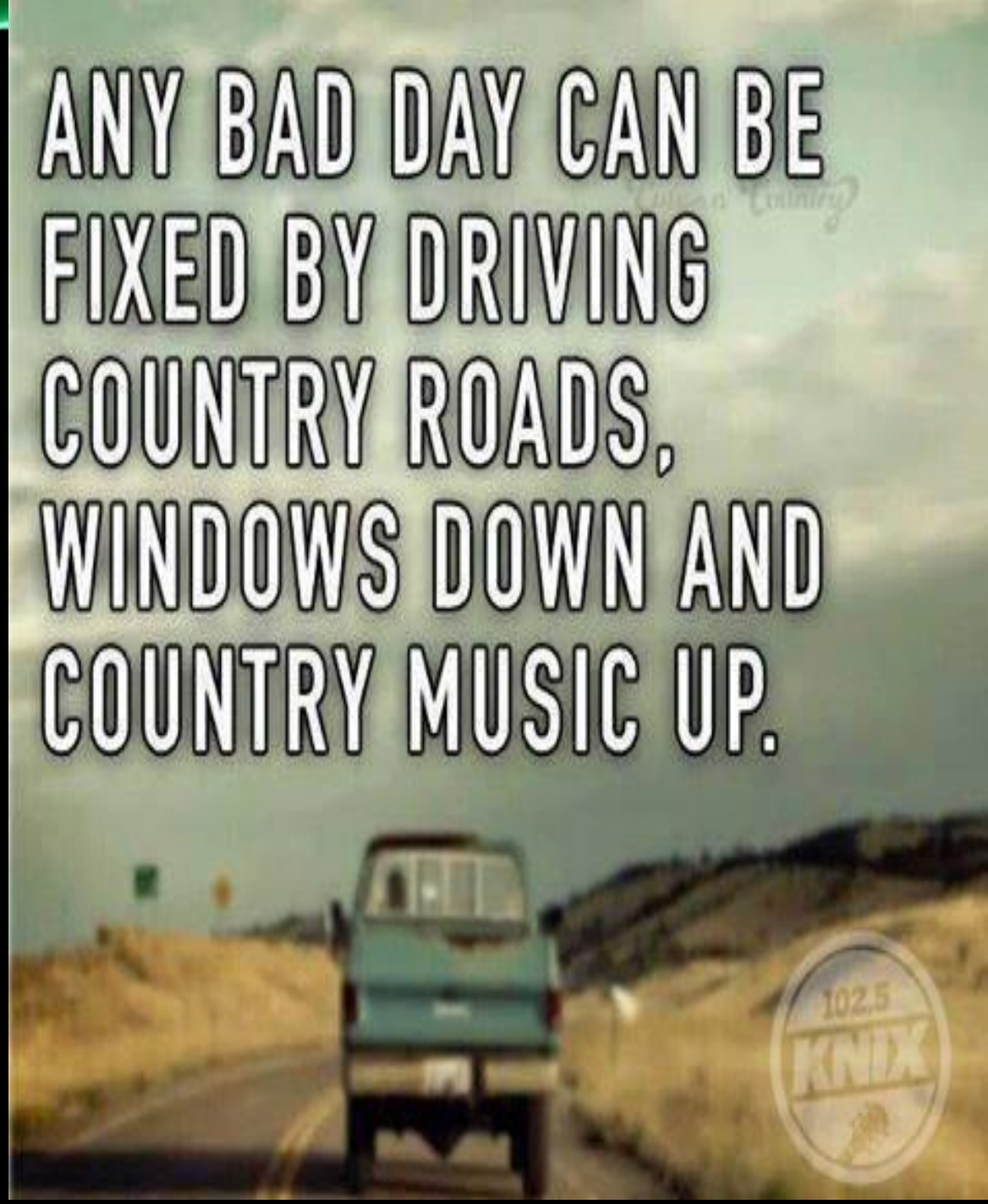

SECURITY

VenoVeno (VV) ECMO

The Children's Heart Institute of Illinois

VA ECMO


Cigar
aficiona
THE GOOD LIFE MAGAZINE FOR MEN


ANY BAD DAY CAN BE
FIXED BY DRIVING
COUNTRY ROADS,
WINDOWS DOWN AND
COUNTRY MUSIC UP.
102.5
KNIX

HEALTHCARE ADMINISTRATION

Congenital Heart Center at Children's Hospital of Illinois

THANK YOU