DEVELOPMENT OF AN ECMO PROGRAM IN A COMMUNITY HOSPITAL: PLANNING UNTIL THE COWS COME HOME

Bob Longenecker, LCP, CCP
Manager of Perfusion Services
ECMO Coordinator
Mercy Hospital St. Louis

The Missouri Perfusion Society Annual Meeting
June 3, 2017
DISCLOSURE

• Employed by Mercy Hospital St. Louis since April, 1984
• Manager of Perfusion Services
• ECMO Coordinator
• New Technologies Committee Coordinator
• Administrative Co-Lead Mercy Healthcare Cardiac Surgery Specialty Council
• John Brooks & I did not collaborate on this talk
“What can you tell me about ECMO?”

Robert Taylor, MD
Chairman of Critical Care Medicine
December, 2013

“I was wondering when I would be asked that question” (Me)

“We probably ought to get some people together to talk about it” (RT)
THE PLAN

• Conceptualize what we wanted for our hospital.
• Talk to as many potential stakeholders as possible.
• Take the posture that we wanted a multidisciplinary program rather than providing such care “on the fly”.
• Have an organized program structure with key leaders, defined roles, comprehensive guidelines, appropriate equipment; rather than “we can put this together whenever we need to”.
• Present all options to administration.
• Have a full understanding of the financial implications to this program, including capital expenses, operating expenses, and reimbursement analysis.
• Produce a 5 year financial pro forma.
THE REALITY

• The push for ECMO was coming from Critical Care Medicine. (>100 ICU beds, Level I Trauma Center, large ARDS population)

• A much smaller need felt by Cardiovascular Surgery.

• “Measured” posture by Perfusion Services with a realization that Perfusion cannot do this alone. (*I knew this would happen sooner or later!*)

• Perfusion didn’t have the needed equipment; what to recommend for purchase? *Must* also be aware of MTS & Epic needs.

• The hospital was not going to import a new surgeon as the ECMO/VAD physician; this was going to be homegrown.

• Our sister hospital in Springfield was planning an ECMO program and was ahead of us; how can we build from that?

• There’s a big ECMO, transplant, and device center down the road (Barnes).

• Cardiology is also laying the groundwork here for a destination VAD program.
MULTIDISCIPLINARY

- Critical Care Medicine
- CT Surgery
- Perfusion Services
- Cardiology
- Pulmonary Medicine
- Nursing Services
- Respiratory Therapy
- Physical Therapy/Rehab
- Medical Ethics
- Palliative Care
- Vascular Surgery
- Anesthesiology
- Hematology/Blood Bank
- Laboratory Medicine
- General Surgery
- Neurology
- Pastoral Services
- Supply Chain
- Administration
- Nephrology
- Trauma Surgery
- MTS & Epic Team
### OUR TIMELINE OF EVENTS

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Late 2013</td>
<td>Rob Taylor &amp; Bob discuss “ECMO” following a monthly New Technology meeting.</td>
</tr>
<tr>
<td>1-30-14</td>
<td>Multidisciplinary group discussion concerning the need for ECMO at Mercy STL (Trish, my direct VP, asks me to coordinate a task force).</td>
</tr>
<tr>
<td>2-13-14</td>
<td>ECMO Exploratory Committee update #1. (What’s it going to take?)</td>
</tr>
<tr>
<td>6-(18-21)-14</td>
<td>Bob &amp; Mike Plisco, MD, attend 4-day ELSO course on ECMO at the University of Iowa.</td>
</tr>
<tr>
<td>8-21-14</td>
<td>ECMO Exploratory Committee Update #2. (Here are the recommendations)</td>
</tr>
<tr>
<td>12-10-14</td>
<td>Begin in-depth discussions with Critical Care physicians.</td>
</tr>
<tr>
<td>Jan-Jun, 2015</td>
<td>Hold multiple meetings to formulate our ECMO program.</td>
</tr>
<tr>
<td>5-13-15</td>
<td>Review and refine pro forma.</td>
</tr>
<tr>
<td>8-19-15</td>
<td>ECMO presentation to hospital President Jeff Johnston, approval given to proceed.</td>
</tr>
<tr>
<td>Sep, 2015</td>
<td>Begin weekly meetings with Critical Care to plan our program &amp; write our own unique set of comprehensive patient care guidelines. (1-2 times/week for a year)</td>
</tr>
<tr>
<td>4-(7-9)-16</td>
<td>Mercy Hospital 3-day education seminar for 37 clinicians.</td>
</tr>
<tr>
<td>6-6-16</td>
<td>Bob’s new perfusionist begins work. (part of the deal)</td>
</tr>
<tr>
<td>Oct 3, 2016</td>
<td>Formal launch of ECMO at Mercy Hospital St. Louis.</td>
</tr>
</tbody>
</table>
WE NEED TO BRING ELSO HERE

- We realized early on that to educated everyone meant holding an on-site educational training program prior to launch.
- Everyone needed to talk the same language and have a uniform understanding of how to provide ECMO support and how it would work at our facility.
- Bob & a few Critical Care MDs had earlier attended a formal ELSO 4-day training conference.
- Proposal: bring ELSO to Mercy STL to hold one of their training course here.
- Critical care acted as the facilitator and engaged ELSO to formulate a plan for holding one of their courses for us (Bob coordinated simulation training needs).
- The issue: ~$100,000! (hospital to pay for non-MD training, Busch fund pays for MD training)
- We wrapped the cost for this into our financial plan.
ELSO: MERCY TRAINING PROGRAM

- April 7-9, 2016 (Thursday-Saturday)
- 37 clinicians: perfusionists (3), CT surgeons (3), CT anesthesiologist (1), critical care MDs (12), nurses (8), RRTs (8), CT physician assistants (2).
- CT surgery schedule closed for emergency-only status.
- 2 lecture groups, 3 simulation groups within each larger group.
- ELSO brings 5 physicians for lectures and 9 specialists for the simulation sessions (CCP, RN, RRT)
- 12 lectures during the course, 10 hours of simulation in 4 sessions using our equipment.
- The plan was to start our program in June (didn’t happen)
MERCY STL ECMO TEAM
ADMINISTRATIVE STRUCTURE
PROGRAM STRUCTURE

• Defined organizational structure.
• Defined Medical Director(s).
• Defined Perfusionist Coordinator.
• Defined Specialist qualifications.
• Comprehensive guidelines to direct care in an orderly & referenced-based manner.
• Patient management to include daily ECMO rounds x 2.
• Defined physician management roles & structure.
• Creation of ECMO-specific order sets, flow sheets, work flow.
• Integration of equipment (case record) into hospital EMR (Epic).
• Hospital membership in ELSO.
• Participation in ELSO Registry.
EXTRACORPOREAL LIFE SUPPORT ORGANIZATION

An international non-profit consortium of health care institutions who are dedicated to the development and evaluation of novel therapies for support of failing organ systems. Crucial is the promotion of a broad multidisciplinary collaboration. The primary mission of the Organization is to maintain a registry of, at least, use of extracorporeal membrane oxygenation in active ELSO centers.
ELSO MEMBER SITES
# ST. LOUIS ELSO MEMBERS

## Center Directory

### North America
- Canada
- United States
- Alabama
- Arizona
- Arkansas
- California
- Colorado
- Connecticut
- Delaware
- District of Columbia
- Florida
- Georgia
- Hawaii
- Idaho
- Illinois
- Indiana
- Iowa
- Kansas
- Kentucky
- Louisiana
- Maine
- Maryland
- Massachusetts
- Michigan
- Minnesota

### Asia-Pacific
- Australia
- China
- Indonesia
- Japan
- Malaysia
- New Zealand
- Singapore
- South Korea
- Taiwan
- Thailand
- Vietnam

### Missouri
- St. Louis
  - Cardinal Glennon Children’s Medical Center
  - Mercy Hospital St. Louis
  - St. Louis Children’s Hospital

### South and West Asia, Africa
- Egypt
- India
- Iran
- Israel
- Kazakhstan
- Kuwait
- Pakistan
- Qatar
- Russia
- Saudi Arabia
- South Africa
- United Arab Emirates
ELSO CENTER OF EXCELLENCE
PROGRAM LEADERSHIP

- Program Co-Medical Directors
  Jan Kasal, MD  Quality & Operations
  Mike Plisco, MD  Education & Financial
  Steve Trottier, MD  Chair, Critical Care Medicine

- Program Coordinator
  Bob Longenecker, LCP, CCP
  Equipment, Supplies, Specialists
PERFUSION SERVICES ROLE

• Oversees equipment aspect of ECMO program and the work of ECMO Specialists.
• Sets up and primes all ECMO circuits. (all supplies in Perfusion Services budget)
• Initiates all ECMO support and sits the first shift.
• Terminates all ECMO support.
• Present during all ECMO transports, either in hospital or between hospitals.
• On-call 24/7 for ECMO equipment and Specialist troubleshooting & support.
• Present at morning ECMO rounds and visits the patient(s) and care team numerous times during the day, and during morning rounds on weekends.
• We charge for our manpower for anytime we are present except during rounds.
• Present at the debrief that follows every ECMO run.
ECMO SPECIALISTS

- Person specially trained to sit, monitor, troubleshoot, and maintain the ECMO equipment & circuit.
- In addition to, and **not** the bedside RN.
- Overseen by Perfusion Services Department.
- 4 Clinical Perfusionists.
- 4 Registered Nurses. *(originally 8)*
- 8 Respiratory Therapists.
- All participated in ELSO training.
- Will maintain a unique Epic flow sheet specific to ECMO.
- Additional RN & RRT personnel to train in the future.
  *(May, 2017: added 2 additional RTs & 7 RNs)*
CLINICAL EDUCATION CENTER
SIMULATION ROOM 4
CONTROL ROOM
DEBRIEF ROOM
## SPECIALIST COURSE 5-16-17

### SESSION ONE

<table>
<thead>
<tr>
<th>TIME</th>
<th>LECTURE</th>
<th>SPEAKER</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 AM</td>
<td>Welcome &amp; overview of Mercy ECMO program</td>
<td>Bob Longenecker, CCP</td>
</tr>
<tr>
<td></td>
<td>Basics of Equipment and Circuit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ECMO Cannulation and Initiation</td>
<td></td>
</tr>
<tr>
<td>8:40 AM</td>
<td>ECMO Physiology</td>
<td>Steve Trottier, MD</td>
</tr>
<tr>
<td>BREAK</td>
<td>9:20 AM</td>
<td></td>
</tr>
<tr>
<td>9:30 AM</td>
<td>VV ECMO: ARDS and other indications</td>
<td>Mike Plisco, MD</td>
</tr>
<tr>
<td>10:10 AM</td>
<td>VA ECMO: indications/differential hypoxia</td>
<td>Jan Kasal, MD</td>
</tr>
<tr>
<td>10:50 AM</td>
<td>Equipment Practicum: operations, charting</td>
<td>Bob Longenecker, CCP</td>
</tr>
<tr>
<td>LUNCH</td>
<td>11:30 AM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>On your own, one hour</td>
<td></td>
</tr>
</tbody>
</table>

### SESSION TWO

<table>
<thead>
<tr>
<th>TIME</th>
<th>LECTURE</th>
<th>SPEAKER</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:30 PM</td>
<td>Anticoagulation, laboratory testing, and the bleeding patient</td>
<td>Jan Kasal, MD</td>
</tr>
<tr>
<td>1:00 PM</td>
<td>Weaning and de-cannulation to bridge or?</td>
<td>Mike Plisco, MD</td>
</tr>
<tr>
<td>1:30 PM</td>
<td>Patient management while on ECMO (non-ECMO related care issues)</td>
<td>Jan Kasal, MD</td>
</tr>
<tr>
<td>BREAK</td>
<td>10 MINUTES</td>
<td></td>
</tr>
</tbody>
</table>

### SESSION THREE

<table>
<thead>
<tr>
<th>TIME</th>
<th>LECTURE</th>
<th>SPEAKER</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:10 PM</td>
<td>Practicum with equipment &amp; circuit: Troubleshooting in real time</td>
<td>All Instructors</td>
</tr>
<tr>
<td></td>
<td>Practicum #1</td>
<td>Sim Room 4</td>
</tr>
<tr>
<td></td>
<td>Practicum #2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practicum #3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practicum #4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practicum #5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Practicum #6</td>
<td></td>
</tr>
<tr>
<td>CLOSE</td>
<td>5:30 PM</td>
<td>Bob Longenecker, CCP</td>
</tr>
</tbody>
</table>

Following the didactic class all new specialists are required to shadow an existing specialist for 10 hours.
COMPREHENSIVE GUIDELINES

• Start with ELSO guidelines and heavily modify to our hospital culture & needs.
• 93 pages, bound and color printed; includes references.
• Each team member is given a copy.
• Describes everything about ECMO at Mercy STL, including defined roles for all caregivers at each step during ECMO support.
• Document and all ECMO program files stored on Critical Care SharePoint and in our administrative Dropbox.
ECMO EQUIPMENT

- Thoratec ECMO Cart
- Twin CentriMag Drive Consoles (primary + backup)
- Twin CentriMag Drive Motors (primary + backup)
- CardioQuip Mini Heater/Cooler with thermoelectric cooling
- Seachrist Blender with Air & Oxygen Hoses
- Spare Oxygen Tank
- Spectrum Medical M3 Monitor
- Spectrum Medical QDMU Monitor for Perfusion EMR
- Pressure Transducer Holder (pre-pump & pre-membrane)
- Temperature Monitor Box
CIRCUIT SCHEMATIC

MERCY HOSPITAL ST. LOUIS
ECMO CIRCUIT SCHEMATIC
REFERENCE FOR BLOOD CLOT & CIRCUIT INTEGRITY ASSESSMENT

1. Venous (Drainage) Cannula Dressing Inspection
2. Venous Cannula Connector to Venous Tubing
3. Connector/Pigtail for P1 Site
4. Centrifugal Pump Inlet Connector
5. Centrifugal Pump Internal Space
6. Centrifugal Pump Outlet
7. Tubing to Oxygenator Inlet Connector with Pigtail P2 Site
8. Venous Side of Oxygenator
9. Arterial Side of Oxygenator
10. Oxygenator Outlet Connector with Pigtail P3 Site to Tubing
11. Arterial Connector with Supplemental Pigtail Site
12. Arterial Tubing to Arterial Cannula Connector
13. Arterial (Infusion) Canula Dressing Inspection
SPECTRUM VIPER QDMU
QDMU MAIN RECORD PAGE
QDMU DEMOGRAPHICS SCREEN
Who is on call for perfusion?

Mike Plisco, MD

They called me – 474 bed 10. Can’t oxygenate, already proned, flolan-truma-head bleed…. wouldn’t be able to anticoagulate for 3 days.

Mike Plisco, MD

Karen, what’s up?

Bob

Head bleed? Good Lord! Not ideal.

Bob

I’m off on a long weekend. At a party and have had some beers. I CAN’T COME IN!

Bob

Will keep u and Karen posted---I am not on ECMO call but MD is very uneasy about making the call. I am heading in to look at patient.

Mike Plisco, MD
PATIENT #4

Won’t know how his head will do for 3 weeks, if it’s a survivable head injury. Will talk to neuro surgery.

Mike Plisco, MD

Sounds like he will die without ECMO to even see what brain will do.

Mike Plisco, MD

I’d make very sure about neuro status with a head bleed and also talk to the CT surgeon on call.

Bob

And CT surgery. I’d get them all together.

Bob

Out of my pay grade to call that.

Bob

Neurosurgeon said anticoagulation was OK in two days. Limited brain injury from what she saw but it could swell so will need another CAT scan tomorrow.

Mike Plisco, MD

Hmm. Good luck!

Bob
PATIENT #4

- 51 year old male, fairly healthy. 1-21-17
- Fell out of a tree while cutting it down, landed on the ground, trunk & branch fell on him, head trauma, aspiration with cardiac arrest, CPR by wife, paramedics arrived & intubated him, continued CPR for about 45 minutes until arrival at Mercy STL.
- Admission to Mercy STL with acute respiratory failure and hypoxia.
- Imaging studies revealed multiple skull fractures, facial fractures, subarachnoid hemorrhage, and some C2 facet joint widening as well as extensive lung consolidation opacities secondary to contusion, edema, and possible aspiration. Traumatic brain injury.
- His facial and skull fractures did not require any surgery. His brain bleed did not require any surgery. He required ICP monitoring.
- He developed ARDS and required full ventilator support. Critical care assessment for ECMO completed.
- Decision to proceed to ECMO; cannulation for VV ECMO on Sunday, January 22, bedside in CVICU. (right FV to right IJ)
PATIENT #4

• ECMO initiated uneventfully and without heparin anticoagulation due to traumatic brain injury. (small heparin dose to cannulate)

• Heparin anticoagulation begins evening of 1-23-17. Weaning vasopressors, lactate clearing, blood gases show acceptable ventilation/oxygenation. Taken to radiology for CT of head/neck & abdomen.

• 1-24-17: “cruising” on ECMO support. His course over numerous days entailed adjustments in anticoagulation, diuresis for fluid overload, transfusions.

• 1-(26-27)-17: tracheostomy. Continued issues with fluid management, bleeding from cannulation sites and tracheostomy, bloody pulmonary secretions, concern over clot build-up in oxygenator. Another trip to radiology for CT.

• 2-2-17: Patient improving but oxygenator is failing. Diagnosis made for HIT. Perfusion Services changes out ECMO oxygenator. Decannulation being discussed. (switch anticoagulation to Bivalrudin)

• Ongoing complications from anemia, bleeding, thrombocytopenia, multiple skull fractures, traumatic brain injury, encephalopathy, respiratory failure, HIT, now septic.
PATIENT #4

- We don’t touch our circuits except to change out a component.
- No gases drawn from the circuit.
- No anticoagulation, other meds, fluids, or blood products given through the circuit.
- No CRRT via the circuit.
- Assessment of oxygenator performance made non-invasively by Spectrum M3 system.
PATIENT #4

- 2-3-17: Decision to terminated ECMO support due to improving pulmonary function. Patient taken to CVOR for decannulation and repair of cannulation sites.
- Duration of ECMO support: 12 days.
- 2-13-17: Tracheostomy decannulation.
- 2-14-17: Plan is to discharge to rehab tomorrow, I pay a visit and talk with patient and family.
- 2-15-17: Discharge to Mercy rehabilitation facility. LOS 25 days.
- 2-22-17: After completing a rehab course for traumatic brain injury, patient is discharged to home.
- 3-8-17: Office visit; “I feel pretty good except for some pain in my shoulder”. Ongoing evaluation & treatment.
SUCCESS
SOMEDAY......PERHAPS

“AWAKE” ECMO

“WALKING” ECMO
OUR LESSON

• We did the right thing by planning for so long. *It worked for us!*  
• We weren’t overly “pressured” to hurry up and get going.  
• As we got closer, we sent a number of patients to Barnes for ECMO (they came out and cannulated a couple and took them downtown).  
• Our team members were on the same page once we pulled the trigger and launched our program. The month prior we held intensive reviews.  
• It *is a “program” in the truest sense:* multidisciplinary, guided by defined roles, guidelines, order sets, care pathways. It’s a team sport!  
• I can sleep at night because our core group did our homework. We “know” how to do this in a planned, guided, and organized manner.  
• I can also sleep at night because I have helped create a “best practice” collaborative group to provide specialist manpower.  
• For *me,* I learned that true collaboration yields a good product; I was always treated with respect, as an equal, and one whose opinion was valued.
WHAT’S THE DIFFERENCE?

• I have noticed one glaring difference between our experience and others.
• We grew our program from within, from conception to realization.
• We did not import a new CT surgeon to run the ECMO program who came to us directly from an established center or right out of a fellowship geared to this type of patient care.
• I have noticed that other centers who used that approach (bring the new MD here) start ECMO programs with a far greater sense of urgency and without such exhaustive planning.
• Those programs go from 0 ECMO patients to 20 or more in a year.
• Most of our patients are for VV ECMO. “We’re getting better at managing ARDS”, says the Chairman of Critical Care Medicine.
• 8 months into our program we are on patient #7. CCM has said “no” to ECMO on some patients; severe ARDS does not automatically mean ECMO.
• We’ve stumbled a bit, but things will improve. This isn’t going away.
MY FINAL THOUGHTS

• I have given an “Introduction to ECMO” talk numerous times all around the medical center to varied groups of people including administration.

• People are impressed when they see the work it took us to bring this to reality.

• I was a key individual who worked to start the cardiac surgery program at St. John’s Mercy Medical Center in April, 1984.

• I was a key individual who work collaboratively to bring ECMO to Mercy Hospital St. Louis in October, 2016.

• Starting the cardiac surgery program at my hospital was a Sunday walk in the park compared to starting the ECMO program.

• It’s gotten perfusion out of the OR and into areas of the medical center we typically did not spend a lot of time in. Lots of people know us now and we’re viewed very favorably.

• This recent and ongoing experience of bring ECMO to my hospital is the single most rewarding thing I have done there in 33 years.