

Transportation

- Derived from the Latin words "portate", to carry and "trans", to cross.
- In the context of patient transportation, "to carry the patient to a nursing entity"





Mouskou S, Troizos-Papavasilevou, P., Xanthis, T., Iacoudou, N. (2015) Neonatal Transportation through The Course of History, J Pediatr Neonatal Care, 3(1):00104

First Reported Neonatal Transport in Mythology

- Dionysus, the god of the grape harvest, winemaking and wine, ritual madness, fertility, theatre and religious ecstacy was born prematurely.
- Mercury the first neonatal transporter ever recorded, transferred Dionysus to Mountain Nyssa where Nymphs took care of him.
- The nymphs placed Dionysus in a cave, at the entrance a thick ivy curtain, and pines and its dome was covered with vine branches.....
- He remained there until he grew and attained is normal weight



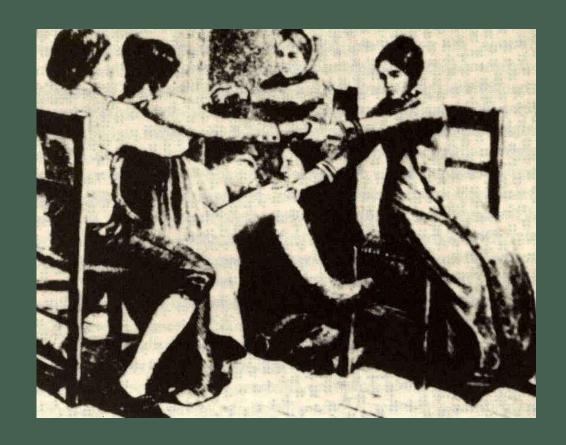
Soranus of Ephesus: On the Care of the Infant

- How to recognize the infant who deserve further nuture
 - Gender
 - Physical and mental status
 - Considering pregnancy duration and course
 - Health problems during pregnancy
 - Intensity and quality of cry or its absence
 - In the case of handicaps or weakness they would not be considered for further support.



From Ancient Times to the 19th Century

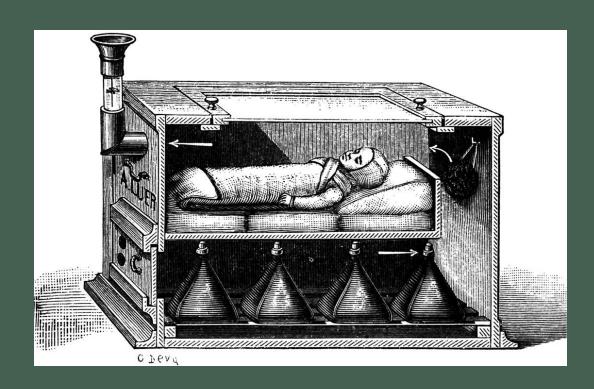
- Home delivery was the usual practice
- Preterm and sick newborns died without interventions
- Except for orphanges there were no other environments for neonatal care
- Mortality rates were 85-95%



Milestones in Neonatal and Perinatal Medicine

1834	First description of neonatal intubation				
1853-55	Establishment of children's hospitals, Great Ormand Street, Nursery and Child's Hospital in NYC and Children's Hospital of Philadelphia				
1864	Correlation of cerebral palsy with birth trauma and asyhxia1891				
1891	Support for the first time of oxygen use in premature infants				

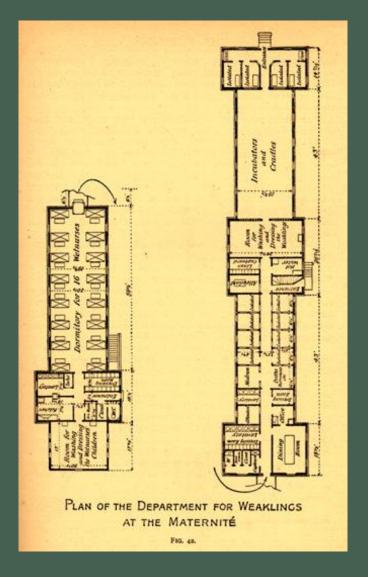
Incubators



- "At the Paris zoo in 1880, on a visit to its director, Odile Martin, Tarnier saw in use an incubator (couveuse) for hatching the eggs of exotic birds, and persuaded Martin to make him one for premature babies.
- This was the first closed incubator for hospital use.
- Earlier some hospitals had been using the warm cradle introduced by Denucé in Bordeaux in 1857, a double-walled metal cot with warm water in the cavity but with no lid over the baby".

Scientific Observation

- Tarnier and Anvard published the first work on incubation and improved survival
- Demonstrated a reduction in neonatal mortality for babies <2000 grams from 66 to 38%.
- Established by Pierre Budin: the "Pavillion for Weaklings". The first Neonatal Intensive Care Unit.



Formalizing Newborn Transfer

- Started in 1900 by Joseph Bolivar DeLee
- Recognized the need for a thermal controlled environment to improve outcome
- Developed the hand ambulance
 - 12x22x11 of quarter sawed oak
 - Cans of hot water were the heat source
 - Metal water iacket lined the box
 - A battery powered light buld allowed for vision of the infant and temperature monitoring
- Babies weighing 1 to 4 ponds were received in the baby ambulance with prompt response to the delivery of a premature infant being the standard of care
- Soon after J. Zahorsky (St. Louis) published "Recognizing that the prevention of the initial heat loss is most important the management early made provisions to minimize this danger. An ambulance with a driver were provided which could be called upon day or night.







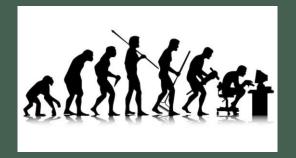
New York Premature Transport Service

NYC Department of Health, 1948.

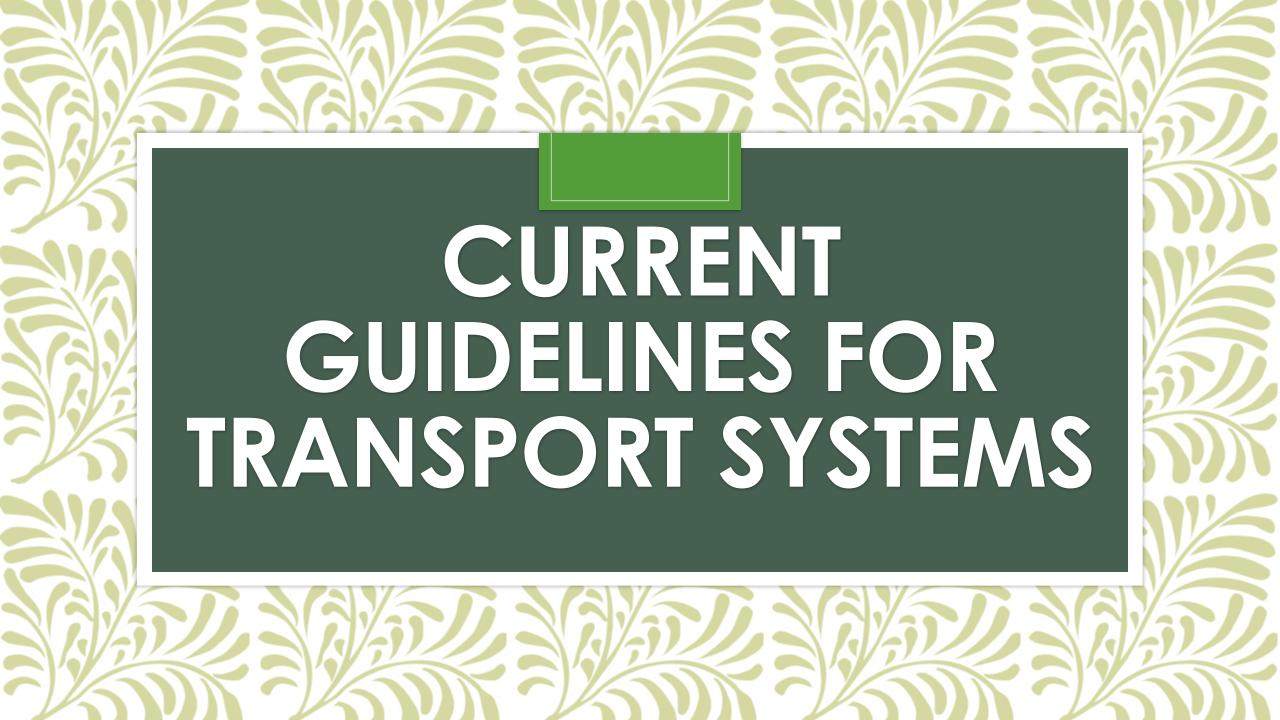
- Specially trained nurses available 24 hours a day
- A vehicle for exclusive use
- Someone in charge of recording phone calls
- Someone in charge of the required equipment and transportation
- In their first two years they transported 1209 patients, 194 < 1 kg.



Continued Evolution



- Evolution of care unit from premature neonate unit to special care unit to NICU
- The first sub specialty board exam for neonatologists in 1975
- The development of the Perinatal section of the AAP
- In collaboration with the March of Dimes the development of regionalization and perinatal levels of care
- The development of air transport for neonates
- Development of formal maternal and neonatal transport guidelines
- Development of the section on Transport Medicine of the AAP (1990)
- Continued refinement of transfer processes and appropriate antenatal care and maternal transport



Transport Systems: Medical Director

- Administrative
 - Organization
 - Mission statement
 - Strategic plan development
 - Advocacy
 - Development of transport agreements
 - Financial planning and revenue generation
 - Compliance with regulations
 - Outreach

- Education
 - Transport research
 - Coordinating projects
 - IRB compliance
 - Data collection
 - Publication
 - Other educational responsibilities
 - Ongoing education to team members
 - Care givers at receiving hospitals
 - Establishment of transport standards
 - Compliance with national/local standards
 - Simulation drills

Transport Systems: Medical Director

- Administrative
 - Safety and Quality
 - Team development and composition
 - On and off line medical command
 - Patient review provisions
 - Ensuring clinical competence
 - Efficient access
 - Quality improvement resources

- Operational
 - Establishment of a managerial structure
 - Program director to oversee team
 - Safe system use
 - Efficient and succinct communication
 - Awareness of resource utilization
 - Identification of referral patterns

Transport Systems: Accreditation

- Currently Federal accreditation is voluntary*
- Commission on Accreditation of Medical Transport Systems
 - Has representation from AAP and NANN



https://www.camts.org/

Transport Systems: Benchmarking

- Ohio Neonatal/Pediatric Transport Quality Collaborative
- Quality metrics in neonatal and pediatric critical care transport: a consensus statement.
 - 257 metrics identified
 - After review 70 final candidates/23 final metrics
 - Sample includes:
 - measurement of family presence, pain management, intubation success, neonatal temperature control, use of lights and sirens, and medication errors.
 - A definition for each metric was established and agreed upon for consistency among institutions.

Pediatr Crit Care Med. 2013 Jun;14(5):518-24. doi: 10.1097/PCC.0b013e31828a7fc1.



Transport Systems: Training, Simulation, Safety and Work Hours

- Tailored to the patient population, travel modalities and services provided
- Curricula should reflect common set of expectations for knowledge, skills practice standards and competency
- Simulation can provide reproducible clinical and safety scenarios that provide the
 participants with the opportunity to learn in a protected environment and discuss
 through the process of debriefing what went well and where improvements can be
 made.
- Safety is foundational to the philosophy of transport. Safety training begins early in training and should consider patient, family, staff and workplace safety.
- Work hours have been identified as a safety concern-no regulations exist for transport teams

Transport Systems: EMTALA

- Emergency Medical Treatment and Labor Act
 - Cornerstone of transport law
 - Established to prevent inappropriate transfers and transfer decisions made on financial considerations
 - An emergency medical condition is defined as a clinical situation with acute symptoms of sufficient severity in which the absence of immediate medical attention could seriously a patient's health or that of an unborn child.
 - An accepting physician and hospital must be secured
 - Once identified, the referring physician remains responsible for the care of the patient(s) until the accepting transport physician and transport team leaves the referring organization.
 - The referring team is required to provide ongoing updatesand support to the accepting team. Both teams need to be courteous, professional and avoid insinuation of suboptimal management.

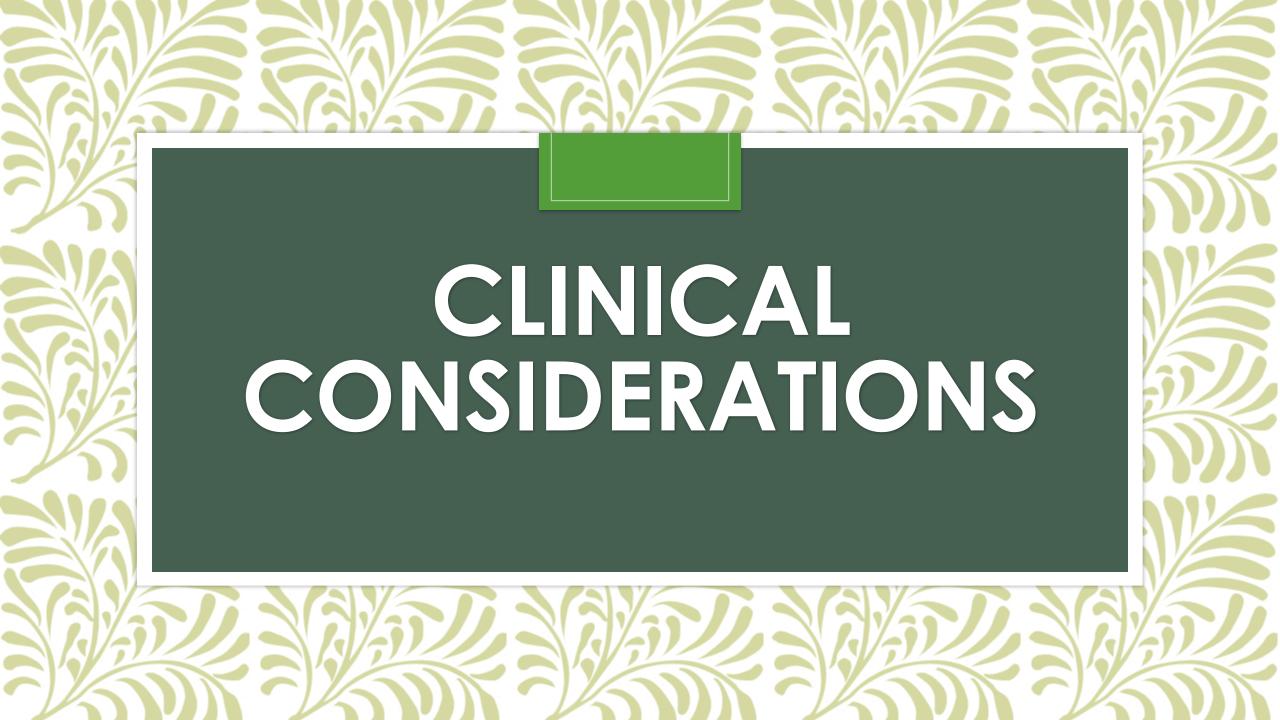
It's the Law

If you have a medical emergency or are in labor

You have the right to receive, within the capabilities of this hospital's staff and facilities:

- An appropriate medical screening examination;
- Necessary stabilizing treatment (including treatment for an unborn child);
- And, if necessary, an appropriate transfer to another facility even if you cannot pay, you do not have medical insurance or you are not entitled to Medicare or Medi-Cal.

This hospital [does/does not] participate in the Medi-Cal program.



Maternal vs. Newborn Transfer

Maternal stability

- Underlying maternal morbidity
- Placental/fetal position
- Maternal obstetric history
- Resources at current location
- Antenatal steroid exposure
- Known fetal anomalies
- Risk to mother on transport
 - Resources for maternal care en route
- Risk of delivery on transport
 - Resources for neonatal resuscitation/stabilization





SUGAR AND SAFE CARE

TEMPERATURE

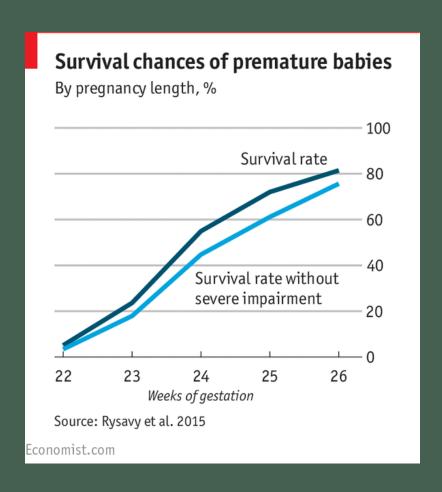
AIRWAY

BLOOD PRESSURE

LAB WORK

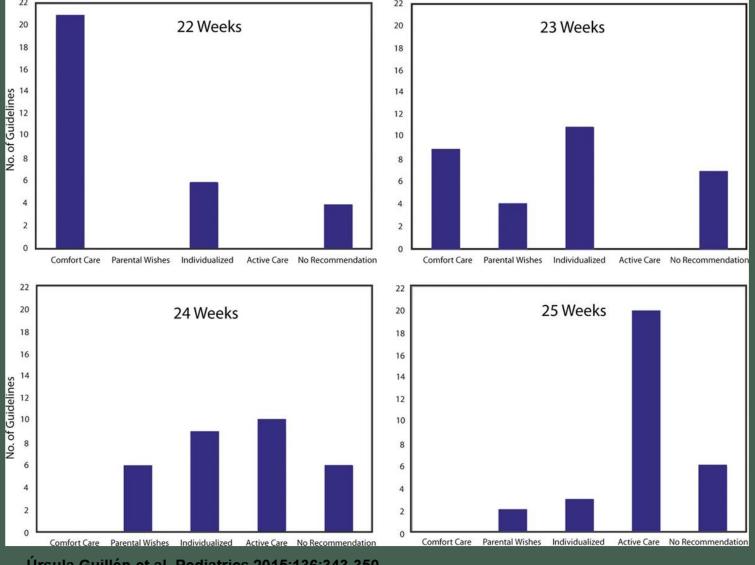
EMOTIONAL SUPPORT

- Limits of Viability
- Thermoregulation
- Surfactant
- Hypoxic respiratory failure
- Therapeutic hypothermia
- Seizures
- Congenital heart disease
- Surgical emergencies
 - Diaphragmatic hernia
 - Abdominal wall defects
 - CNS malformations



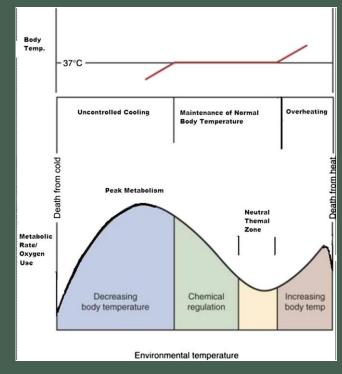
Recommendations between 22 and 25 completed weeks of gestation.

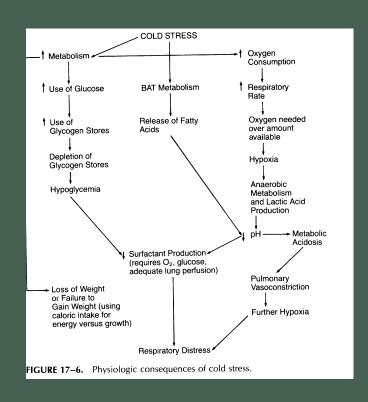
GUIDELINES FOR THE MANAGEMENT OF EXTREMELY PRETERM DELIVERIES: A SYSTEMATIC REVIEW



Úrsula Guillén et al. Pediatrics 2015;136:343-350

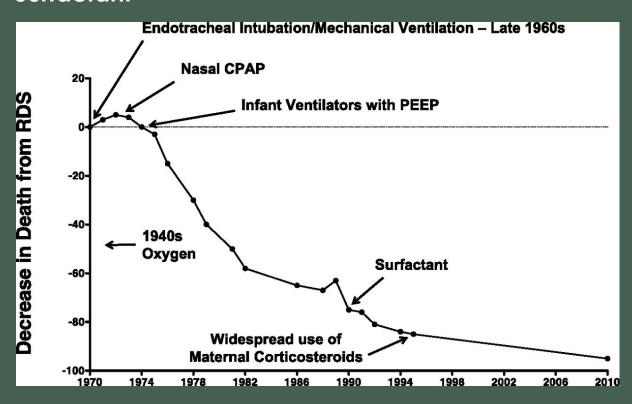
Thermoregulation

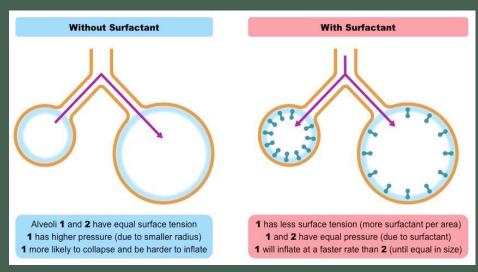




HYPOTHERMIA: SHORTAND LONG TERMCONSEQUENCES: FOR EVERY 1°C DECREASE IN BODY TEMPERATURE <36°C MORTALITY INCREASES BY28% AND LATE ONSETSEPSIS BY 11%.

Surfactant





ATTAINING AND SUSTAINING FRC WITH THE LEAST AMOUNT OF PRESSURE AND OXYGEN

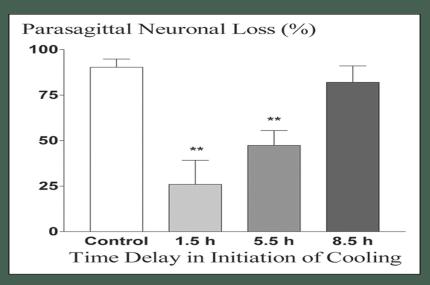
Hypoxic respiratory failure

- Preterm infants born at <30 wk of gestation who need mechanical ventilation because of severe RDS should be given surfactant after initial stabilization.
- Using CPAP immediately after birth with subsequent selective surfactant administration should be considered as an alternative to routine intubation with prophylactic or early surfactant administration in preterm infants.
- Rescue surfactant may be considered for infants with hypoxic respiratory failure attributable to secondary surfactant deficiency (eg, meconium aspiration syndrome or sepsis/ pneumonia). 2
 Recommendation

Therapeutic hypothermia



							A SHALL HAVE AND A SHAL		
	Hypoth	ermia	Normoti	nermia					
Study or subgroup	Events	Total	Events	Total	Risk ratio (95% CI)	Weight (%)	Risk ratio (95% CI)		
Infants with moderate encephalopathy									
CoolCap	28	62	39	69	-	37.9	0.80 (0.57 to 1.13)		
NICHD	22	69	30	66	-	31.5	0.70 (0.45 to 1.08)		
TOBY	20	66	30	67	-	30.6	0.68 (0.43 to 1.06)		
Subtotal (95% CI)		197		202	•	100.00	0.73 (0.58 to 0.92)		
Total events	70		99						
Infants with severe	encepha	lopathy	,						
CoolCap	28	40	32	35	-	28.6	0.77 (0.61 to 0.96)		
NICHD	23	32	34	40	-	25.4	0.85 (0.66 to 1.09)		
TOBY	53	98	54	95	+	46.0	0.95 (0.74 to 1.23)		
Subtotal (95% CI)		170		170	•	100.00	0.87 (0.75 to 1.01)		
Total events	104		120	0.	1 0.2 0.5 1 2 5 1	0			
Favours Favours hypothermia normothermia									



Gunn, A. J. et al. Neoreviews 22002;3:e116-e12

Seizures

TABLE 1

ETIOLOGY OF NEONATAL SEIZURES

Metabolic

- 1. Hypoglycemia
- 2. Hypocalcemia
- 3. Hypomagnesemia
- 4. Pyridoxine dependency
- 5. Hyponatremia and hypernatremia
- 6. Aminoaciduria
- 7. Drug withdrawal
- 8. Kernicterus

Infection

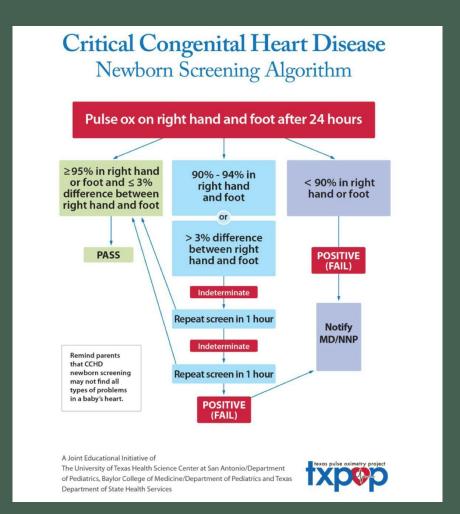
- 1. Meningitis
- 2. Sepsis
- 3. Encephalitis intrauterine infection

Perinatal anoxia

Intracranial birth injury

Congenital anomalies

Congenital heart disease



- Surgical emergencies
 - Diaphragmatic hernia
 - Abdominal wall defects
 - CNS malformations
- Antenatal diagnosis and consultation for parents prior to delivery is critical
- Center where communication between maternal fetal medicine, neonatology and all other subspecialists is coordinated are associated with improved outcomes
- Undiagnosed surgical emergencies born outside of tertiary care centers require prompt transfer to appropriate resources
- Consider ECMO centers and/or fetal surgery centers for certain anomalies
- Parents are critical for improving both short and long term outcomes







Conclusions

- Neonatal transport is a complex series of events that requires constant communication and exquisite attention to detail on the part of all members of the system.
- Regular critical appraisal of outcomes are necessary to prevent unexpected outcomes, morbidity and mortality.
- As participants we have a unique opportunity and responsibility to families in crisis.
- From our earliest roots prompt departure and thermoregulation remain foundational to improving outcome.

