I. Introduction
A. Optimal outcomes for transported very low birth weight (VLBW) infants begin with detailed, advanced planning and preparation so that the level of care experienced within the NICU walls can be delivered over distance.
B. Transport can be a challenging and unpredictable environment; but experienced, vigilant, and compassionate team members with the correct equipment can make the process flow more smoothly.

II. Essential points to ponder
A. Care of the VLBW infant in the transport setting should reflect the same principles and evidence-based practice standards expected in a tertiary level NICU.
B. Numerous studies have shown that transport teams with experience in the care of sick infants decrease the morbidity and mortality of infants born in a non-tertiary level facility, where an estimated 14%–30% of VLBW infant births occur.
C. Optimal outcomes are supported when specialized neonatal teams take time at the referring facility to assess, perform essential management, and “package” the VLBW infant to avoid the need for procedures and interventions during the motion of transport.
D. Communication is a critical element in the overall transport process, including the following:
   1. Initial exchange between referring hospital and tertiary center
   2. Intra-transport communication between the referring and receiving physicians and the team for problem resolution and/or plan of care
   3. The team’s interaction with staff upon arrival to receive, report, and review referring hospital assessments, diagnostics, and interventions
   4. Follow-up communication from the tertiary center to the referring hospital to provide updates to staff and family
E. In-house transport of the VLBW infant requires meticulous pre-transport preparation, followed by monitoring the infant’s clinical status in transit and providing appropriate hand-off.
III. General considerations for transport of the VLBW infant

A. Patient safety

1. Patient safety begins with selection of the appropriate team and transport mode to initiate and maintain the optimal level of care for each infant.

2. Prior to actual transport use, evaluate equipment function under motion and vibration conditions.
   a. If planning to transport in aircraft at altitude, pay attention to ventilator calibration and proper function of flow meters and infusion pumps.
      (1) Ventilators are generally calibrated at sea level, and changes in barometric pressure have been shown to decrease the actual respiratory rate delivered vs. the desired rate set on the ventilator and to increase tidal volumes (Tv) at altitude in a variety of ventilator models.
      (2) Infusion pump rates and gas flow may vary with altitude changes in flight.
   b. Equipment to accompany any transport should be appropriately secured at an assigned location to avoid injury to patient/personnel or equipment failure.
   c. All federal, state and system regulations in place must be followed to ensure that the judgment and performance of air and ground team members are maximized for patient safety.
   d. Positioning of infant(s) and crew must allow for unimpeded access to all patients and equipment.

3. Infection control should follow standard procedures used in the NICU.
   a. Hand hygiene (hand washing and/or the use of approved hand sanitizers) is critical in the much larger and potentially contaminated areas encountered during the transport process.
   b. All equipment and non-disposable supplies used in transport should be cleaned according to hospital standards to reduce the chance of nosocomial infections.

4. Allow for thorough drying and dissipation of cleaning-agent odors prior to equipment use.

5. At any time an infant is in a transport incubator, the unit should be “on” and powered by wall outlet (AC) or battery power (DC) — otherwise, the incubator becomes a closed plastic box.
6. All modes of transport generate mean sound levels that exceed recommendations for NICU sound-level limits.

7. To minimize the impact of noise, use earmuffs or other approved forms of hearing protection for the VLBW infant.

8. Restraining the VLBW infant for safety purposes can be difficult based on size; however, it is important to utilize an approach that provides the maximum degree of body stabilization without impeding airway, circulation, or visibility.

9. When positioning the incubator and/or infant, consider the potential gravitational effects on blood flow created by sudden stops/starts or changes of direction during transport, such as sudden acceleration/deceleration in ambulances and takeoffs/landings in fixed-wing aircraft.
   a. When the head is toward the front of the vehicle or aircraft, there is a tendency for blood to move to the lower body during acceleration or takeoffs and toward the head during sudden stops or landings.
   b. When the head is toward the rear of the vehicle or aircraft, there is a tendency for blood to move to the head and upper body during acceleration or takeoffs and toward the lower body during sudden stops or landings.
   c. Although positioning cannot always be changed, a side-lying (crossways) position to the forces of acceleration and deceleration should be considered.
   d. For ground transport, set the expectation that vehicle stops/starts will be as smooth as possible and that the return to the receiving facility will be accomplished without lights and sirens, if possible.
   e. The infant’s head should be maintained in a neutral position during transport. To prevent intraventricular hemorrhage (IVH), it should be level or slightly elevated, but never in a down position.

B. Monitoring the VLBW infant in transport

1. At minimum, the ability to monitor temperature, heart rate, respiratory rate, oxygen saturation, and blood pressure is required.
   a. Continuous monitoring is preferable.
   b. Monitoring devices should have visual alarms in addition to any audible alarms.
c. Based on noise, vibration, and potential signal interference during transport, continuous visual assessment is essential.

2. For intubated or mechanically ventilated infants, a method of monitoring end-tidal CO$_2$ levels is indicated. End-tidal CO$_2$ levels can be reliably measured in intubated infants down to 1,000 g. If a continuous setup is unavailable for transport of the VLBW infant, an appropriately sized disposable adaptor for confirmation of tube placement and intermittent checks should be available.

3. Continuous oximetry monitoring is essential.

4. Point of care (POC) testing
   a. Obtain the infant’s blood glucose level and temperature immediately before transport departure.
   b. Monitor glucose levels during transport.
   c. If available, use of approved POC systems to monitor blood gases and electrolytes can provide valuable information for addressing changes in oxygenation/ventilation and/or fluid and electrolyte balance on extended transports.

C. Family support
   1. It is essential for the team to project a sense of experience, as well as a caring, compassionate nature that is reflected in their approach to care of the VLBW infant and their concern for the family.
   2. Provide an opportunity for the mother and other significant family members to see and touch the infant prior to transport, which may require moving the infant to the mother after stabilization is complete or bringing the mother to an unstable infant’s bedside if necessary.
   3. If the infant’s condition is such that survival during transport is deemed unlikely, the team should have a plan that involves discussion between the referring facility and tertiary center staff, and with the infant’s family, to determine if the best approach is to avoid separating the infant from the family unnecessarily.
      a. It is crucial that staff of the referring hospital, tertiary center, and transport team be in agreement as to the plan of care and communication with the family to facilitate the best possible bonding and/or grieving processes.
b. If the decision is made to transport an infant whose survival during or immediately following transport is extremely doubtful, it is important to provide pre-transport support options for the family, such as:
(1) Encouraging and supporting the family’s presence during stabilization
(2) Obtaining photographs of the family with and touching the infant
(3) Providing a small sample of the infant’s hair for the mother, if feasible and approved by the family
(4) Facilitating the performance of religious rites as requested by the family
(5) With the help of the referring facility, selecting a route out of the facility that allows the extended family (including siblings, if desired) a private viewing of the infant in the incubator prior to transport departure

4. Describe how the infant will be transported, where the infant will be admitted, and the name of the receiving provider, if known.
   a. For separate informed consents for transport obtained by the transport team, the potential risks of transport in general and of the specific mode of transport should be discussed with the parent or guardian signing the consent.
   b. Provide written information about the receiving NICU, pertinent telephone numbers, and a detailed map for locating both the facility and the NICU.
   c. If possible, brochures should have a separate map with a perforated page that can be removed and used immediately by family coming to the regional center, while the brochure with pictures and information should be left for the mother if she must remain hospitalized.

5. Obtain telephone numbers from significant family members.
6. Assure the mother that if she remains hospitalized, she will receive a call from the transport team as soon as her infant is admitted to the NICU — it is very important to follow up on this promise.
7. Take a photograph that can be printed and left with the mother prior to departure.
8. If transporting in a specialized ambulance, consider having small pictures available that the transport team can give to the infant’s mother on the occasion of discharge from the NICU for inclusion in the baby book under “first ride or trip”.

D. Transport documentation
1. Should include copies of maternal and infant records, lab reports and imaging provided by the referring facility, and all consents for referral and transport.
2. Transport team documentation should contain information that outlines the continuum of care, including the infant’s status at the time of arrival at the referral hospital, through stabilization, transport, and hand-off to the receiving NICU staff.
   a. Any medications administered should be recorded as dictated by policy.
   b. Any interventions performed should be documented, along with the infant’s response.

E. Standard supplies and medications
1. Supplies and medications carried for transport of the VLBW infant should mimic as closely as possible those available within the NICU.
2. Medications such as surfactant, which requires refrigeration, will need to be transported in appropriate carriers with cool packs.
3. Supply and medication bags should be assembled for transport based on the neonatal populations stabilized and transported by the individual facility, using national standards as guidelines.

IV. Factors exerting physiologic impact on the VLBW infant
A. Noise and vibration
1. Both noise and vibration are aspects of transport that are very difficult to address in ground and air transport.
   a. Use of a stethoscope for auscultation is generally not an option in ambulances and rotor-wing aircraft, based on noise levels.
   b. Use clinical assessment of the infant’s oximetry, perfusion, chest rise, and changes in respiratory rate/depth.
   c. Note EKG, blood pressure (BP), pulse oximetry oxygen saturation (SpO₂), and end-tidal carbon dioxide monitoring trends.
2. Noise levels in transport that exceed the recommended levels for the NICU setting can increase respiratory rate, heart rate, BP, and anxiety levels; use earmuffs or a thermal cap with a padded lining that can be pulled down over the infant’s ears.

3. Vibration at moderate levels has been shown to increase metabolic rate and oxygen demands.
   a. It is preferable to leave gel mattresses or similar cushioning in the transport incubator at all times so that the mattress or padding is pre-warmed.
   b. Provide safety restraints that also incorporate padding measures around the infant for stabilization.

B. Laws of flight physiology — effects of Boyle’s law
1. As altitude increases, atmospheric pressure decreases, resulting in:
   a. An increase in gas volume
   b. Additional impact (not generally emphasized for Boyle’s law) — a wider spread of molecules

2. Physiologic impact of increased gas volume in closed cavities:
   a. Clinical implications include worsening of pulmonary air leaks and increase in abdominal and intestinal distention, with potential for rupture or worsening pneumatosis intestinalis.
      (1) Consider insertion of a vented orogastric tube for every VLBW infant transported, with specific attention to those with a suspected gastrointestinal anomaly or disorder or those being transported at altitude.
      (2) Confirm that any chest tubes or endotracheal (ET) tubes are clear and patent; suction ET tube as indicated to maintain patency.
      (3) Assess for and/or manage any air leaks prior to flight.
   b. Equipment implications include potential for gas expansion in any non-vented device or supplies, e.g., IV drip chambers, BP cuffs, ventilators, non-vented incubator mattresses.
      (1) If using external BP cuffs, do not leave connected between readings.
      (2) If special circumstances require a cuffed ET tube or tracheostomy tube; use water, rather than air, to inflate the cuff for flights at altitude.
3. Physiologic impact of more widely spread molecules, including water vapor:
   a. A decrease in the number of molecules of oxygen available per volume of inspired gas
      (1) Clinical implication includes hypoxia.
      (2) Close assessment for signs of hypoxia with immediate action as indicated in transport-specific airway approaches is required.
   b. Wider dispersion of molecules of water vapor
      (1) Clinical implications include drier air and less humidification of ambient gases.
      (2) All inspired gases should be heated and humidified.

4. Under Boyle’s law, as altitude decreases, atmospheric pressure increases, resulting in a compression of gas molecules and leading to a decrease in gas volume.
   a. Physiologic impact of gas compression — contraction of air/soft tissues in closed cavities
   b. Clinical implication — small size of Eustachian tube in VLBW infants can lead to collapse and pain
      (1) Assess infant for indications of pain or stress.
      (2) Offer non-nutritive sucking option, if feasible.

C. Laws of flight physiology — effects of Dalton’s law
1. At any given altitude, total barometric pressure equals the sum of all the partial pressures of the gases within a mixture.
2. Oxygen remains 21% of the atmospheric pressure; however, coupled with Boyle’s law, fewer oxygen molecules are present per volume of gas, thereby exerting decreased partial pressure.
3. Physiologic impact of decreasing arterial oxygen tension at increasing altitude:
   a. Clinical implication includes hypoxia.
   b. A modest decrease in the partial pressure of alveolar oxygen results in neonatal hypoxia.
   c. Hypoxia is a greater risk for neonates than adults, as there is a larger alveolar-oxygen difference: 25 mmHg in neonates vs. 10 mmHg in adults.
   d. For infants on supplemental oxygen, anticipate the need for an increase in the fraction of inspired oxygen \( (\text{FiO}_2) \) and closely follow pulse oximeter readings with response as indicated by \( \text{SpO}_2 \).
e. Formula to adjust:

$$\text{New Fio}_2 = \left( \text{Fio}_2 \times \frac{P_{B1}}{P_{B2}} \right)$$

Where:

$P_{B1}$ = Current barometric pressure

$P_{B2}$ = Barometric pressure anticipated at highest flight altitude

D. Laws of flight physiology — effects of Charles’ law (some attribute to Gay-Lussac’s gas law)

1. Following the volume effects of Boyle’s law, the more widely molecules are spread within an increased volume of gas, the less often they collide, thereby generating less heat.

2. Physiologic impact of decreased molecular collision is a decrease in ambient temperature.

3. Clinical implications include hypothermia/increased metabolic rate and oxygen consumption.

V. Transport-specific aspects of care

A. Thermoregulation

1. One of the most critical and challenging aspects of transport.

   a. Advanced planning and preventive approaches are critical to successful thermal regulation.

   b. Transport incubators on standby for use should be under AC power with a preset temperature of 35°C–36.1°C (95°F–97°F) to provide immediate warmth. For the extremely low birth weight (ELBW) infant, the preset temperature should be 37°C (98.6°F), with the goal of maintaining the infant’s temperature at 36.5°C–37.5°C (97.7°F–99.5°F).

   c. Mattresses and other items for contact with the infant must be pre-warmed in the transport incubator or by other means prior to application.

   d. Any IV fluids to be administered should be pre-warmed, if possible.

2. All heat-loss mechanisms pose an even greater risk in the transport environment.

   a. Double-walled transport incubators should always be used, if available, for this population.

   b. Radiant heat losses are markedly increased if attention is not paid to the ambient temperature of ambulance compartments, aircraft cabins, or location of the incubator in radiology and surgery areas of the hospital.
(1) Aim for an ambient environmental temperature between 24°C and 27°C (75°F and 80°F); for ELBW infants, environmental temperatures may need to be even higher.

(2) If the incubator needs to be opened during transport (beyond use of the portholes) or the external environmental temperature is very cold, increase the ambient temperature to compensate for major increases in heat loss.

(3) All infants <29 weeks should be wrapped in polyethylene plastic wrap, bubble wrap (air-caps), or bowel bags to reduce evaporative losses.
   (a) Once the infant is wrapped, assessments and care should be done without removing the wrap, including obtaining a weight prior to final placement on the NICU bed at the tertiary center.
   (b) A hat should be used on all infants since there is major heat loss through the head.

c. Use pre-warmed gel or chemical thermal mattresses to avoid conductive losses if wrap is not available or if hypothermia persists despite the wrap.
   (1) Be cautious of any uncontrollable source of heating in contact with the VLBW infant’s skin — use padding between the device and the infant and frequently monitor skin appearance.
   (a) Use of chemical thermal mattresses and wrap can cause hyperthermia, which should be avoided.

(2) Reduce evaporative and convective losses.

(3) Heat and humidify all medical gases delivered to the infant.

(4) May not be able to achieve target humidity levels with some setups available for transport; however, maximum effort should be made to provide humidity.

3. To combat extremes in cold or hot environmental conditions, cover the transport incubator with a blanket or quilt during movement in and out of vehicles, aircraft, and/or buildings.

4. Maintain the ability to provide close visual assessment during these transitions, which increase the risk for unanticipated changes in condition.
5. If temperature is not on continuous monitoring:
   a. Obtain a baseline axillary temperature prior to any major change with potential thermal impact, e.g., a move from radiant warmer to incubator, from inside facility to outside vehicle, after opening main incubator hood/door; and obtain another temperature determination following such events.
   b. During rewarming of any hypothermic infant, obtain temperature every 15 min with minimal disruption of heating interventions.
   c. Monitor to avoid iatrogenic hyperthermia caused by aggressive or inappropriate heating or rewarming interventions.
   d. Hyperthermia increases metabolic rate, oxygen demands, vasodilation, and insensible water loss (IWL).
   e. Observe for apnea, hypotension, dehydration, and possible seizure activity.

B. Airway — with focus on supporting oxygenation and ventilation during transport
   1. Depending upon available resources and mode of transport, VLBW infants can be transported with respiratory support ranging from supplemental oxygen to continuous positive airway pressure (CPAP) to high frequency ventilation (HFV).
      a. It is important to ensure that the equipment/supplies to be used are “transport worthy”, meeting national standards for use in a transport environment.
      b. Select the airway option based on the individual infant’s needs and the approach that is most likely to provide a secure airway and to maintain or improve respiratory status during transport.
      c. If nasal CPAP is planned for transport, keep in mind that it is more difficult to maintain and requires careful attention to infant positioning, prong stabilization, and use of all available airway monitoring devices, as well as increased visual assessment.
      d. At least one transport team member should be knowledgeable about the placement and maintenance of an ET tube and the operation and troubleshooting of any ventilator to be used.
      e. Approximately 10% of transports experience a ventilator- or ET tube-related problem.
f. Meticulous attention should be given to securing the ET tube prior to moving the infant.

2. Recognize that hypoxia is an increased risk during transport, secondary to the VLBW infant’s underlying condition, physiologic responses to fluctuations in temperature, barometric pressure at altitude, and as a potential response to increased vibration; therefore, evaluate and act accordingly.
   a. Observe for signs of increasing respiratory rate if spontaneous respirations are present.
   b. Trend heart rate for any evidence of subtle-onset tachycardia.
   c. Maintain close visual attention to SpO₂ monitor, as audible alarms may not be heard.
   d. Anticipate the need to increase FiO₂ levels and/or increase positive end-expiratory pressure (PEEP) if mechanically ventilated.

3. Surfactant use
   a. A number of referring hospitals do not stock surfactant.
   b. Develop a system to remind team members to obtain the medication prior to departure on any transport in which its use is anticipated.
   c. Provide an approved method of refrigerating this medication for transport.
   d. If surfactant is administered by the referring hospital just prior to transport team arrival, or is administered by the team upon their arrival:
      (1) Additional bedside stabilization time may be warranted (~20–30 min) following administration to:
         (a) Confirm that the ET tube does not become obstructed or dislodged
         (b) Allow for early changes in pulmonary compliance that impact optimal ventilator settings for transport
         (c) Detect any potential air leaks
      (2) A pre-departure arterial blood gas to establish new baseline is recommended; repeat 15–30 min into transport if POC testing and an arterial line are available.
4. Assess/manage pneumothorax
   a. Rule out the presence of an existing air leak prior to moving any VLBW infant to the transport incubator.
   b. Evacuation of a pneumothorax is critical prior to air transport at altitude.
   c. Chest tube placement is indicated for mechanically ventilated infants.
   d. With limited ability to monitor during ground transport, consideration should be given to needle aspiration of any existing pneumothorax.
   e. For unstable or mechanically ventilated infants, have an appropriately trained provider place a chest tube prior to departure from the referring facility if return transport time will be prolonged.
   f. For any infant with increased risk factors for pneumothorax, a portable transilluminator and needle aspiration setup should be readily available on the transport incubator.
   g. Attention to pain and sedation needs should not be overlooked in the transport setting.
      (1) Consider transport mode, monitoring capabilities, and potential impact on infant’s current diagnosis/status when selecting drugs and dosing.
      (2) Recommend use of tertiary center protocols and/or direct communication to ensure infant’s comfort with minimal undesirable effects.

C. Cardiovascular status
   1. Key to successful transport management is establishing an acceptable baseline prior to departing from the referring facility.
   2. If possible, acceptable pulses, perfusion, BP, and acid/base status should be achieved; or actions should be initiated to address any unacceptable parameters that may occur during transport.
   3. If the infant remains unstable or if stability is difficult to achieve, prepare volume solutions or pressors before transport so they are ready for use if necessary.
   4. There is high variability in monitor function and difficulty in clinically assessing cardiovascular status under circumstances of motion.
5. Whenever possible, avoid invasive or repeated interventions during the transport process to minimize disruption in thermal measures and to avoid increasing the infant’s stress level.
6. Once an acceptable baseline is achieved, close monitoring for changes in transport are indicated, with appropriate measures taken as necessary.

D. Metabolic — with focus on glucose homeostasis
1. Obtaining baseline labs at the referring facility is highly desirable so that pre-departure stabilization can be individualized to address any major deviations in values and a maintenance plan for the transport period can be developed.
   a. A repeat glucose value is recommended just prior to departure.
2. Fluid and glucose requirements are based on the VLBW infant’s gestational age, weight, chronologic age, current clinical status, and the anticipated transport environment.
3. At minimum, determination of the infant’s glucose status is critical prior to selection of fluid and IV rate for transport to achieve/maintain target glucose levels and appropriate fluid balance.
4. If possible without delaying transport team departure, obtain a parenteral nutrition solution so that increased protein losses can be addressed during stabilization and return transport.
5. Transport factors that may increase fluid needs or alter the ability to achieve/maintain target glucose levels include:
   a. Current thermal status and availability of a double-walled incubator
   b. Expected outside temperatures and number of vehicle or aircraft transfers required
   c. Vibration level of transport, which may increase the metabolic rate
   d. Level of ability to provide humidity in the infant’s environment and inspired gases

VI. Key points regarding in-house transports within the birth facility
A. Pre-transport preparation of equipment/supplies
   1. Pre-warmed transport incubator with thermal support supplies for the infant
2. Portable equipment and supplies capable of providing all necessary support of the infant’s needs while moving from one area of the facility to another
   a. At a minimum, this would include oxygen and air with blender capability; airway supplies to handle supplemental oxygen administration, bag/mask ventilation, CPAP and ET intubation; portable suction; EKG monitor; pulse oximeter capable of reliable display of saturation and heart rate; and medications appropriate for VLBW resuscitation.
   b. In addition, battery-powered equipment, including an appropriate transport ventilator to support ongoing or anticipated treatment is recommended.
3. Equipment checklist that includes power status, temperature setting, adequate medical gas pressure, appropriate gas connectors
4. Assigned schedule to confirm devices secured to the incubator are clean, charging, and ready for immediate use
   a. The availability of additional supply and/or medication bags to accompany the incubator should be confirmed during checks to avoid delays.
   b. Medical gas and battery supplies should be adequate to support unexpected delays.
B. Transport from the delivery area to the nursery
   1. In-house transports present an increased risk for adverse events.
   2. Adult studies of in-house transports between the emergency department and ICU documented 68% with unanticipated events, with 5% of those events being serious in nature.
   3. Any infant whose status excludes transport from the delivery area with the mother should be transported to the nursery in a pre-warmed incubator with readily available, blended medical gases and support supplies, as previously noted.
   4. Application of a heat-conserving head covering and polyurethane plastic or bubble wrap (air caps) blanket is essential.
   5. Adjustments to the incubator temperature for appropriate response to the infant's current thermal status should be made prior to departure from the delivery suite.
   6. Maintain close attention to the infant's appearance and SpO₂ readings throughout the transfer.
7. Do not hesitate to pull aside and address any signs of deterioration.
8. Provide a hand-off report to the receiving nursery staff that includes pertinent maternal history, intrapartum events, infant’s condition at birth, Apgar scores, and the infant’s response to any interventions performed after birth, as well as any changes in condition and/or interventions performed in transit.
9. Obtain baseline vital signs to include axillary temperature prior to moving the infant from the incubator to the radiant warmer or other nursery location for admission.

VII. Transport from the NICU to another area of the hospital
   A. Commonly done to access advanced imaging or interventional radiology or surgical interventions.
   B. These infants generally require more support, so preparation prior to leaving the unit is critical.
   C. Personnel trained in the care of the VLBW infant should accompany and remain with the infant during imaging procedures and in the surgery area until the definitive transfer of the infant to the surgical suite.
   D. The incubator should be AC-powered any time it is immobile to conserve batteries.
   E. The incubator should be positioned away from cold interior walls during any waiting periods.
   F. Standard transport supplies/equipment, as well as any specific to the individual infant, should accompany the transport.

VIII. Inter-facility transport aspects
   A. Recognize that successful outcomes in neonatal transport are often attributed more to the expertise of the transport team than to the specific mode of transport chosen.
      1. All team members providing transport to the VLBW infant should be experienced in the assessment and care of VLBW infants and skilled in providing this level of care in a mobile environment.
      2. Plan to be completely self-sufficient.
      3. The team should not expect that the referring facility will have equipment, supplies, medications, or additional experienced staff to support the transport needs of the VLBW infant, and should prepare and proceed accordingly.
      4. Medical gas supplies should be adequate to cover double the expected time for a given transport.
5. If the infant is not in the transport incubator (e.g., being stabilized prior to moving from the referring hospital equipment), medical gas supplies on the incubator should be turned off to avoid risk of inadvertent depletion.

6. Medical gas connectors should be compatible to provide quick connections between incubator and ambulance/aircraft or wall outlets in referral facilities.

7. Battery support for all necessary equipment should be provided to meet twice the expected time anticipated in transport.

8. Plug the transport incubator into an AC-power outlet while the infant is being stabilized prior to moving from the referring hospital equipment.

B. Selection of transport mode is multifactorial and includes:

1. Current clinical status of the VLBW infant and any anticipated changes in condition

2. Ability of the referring facility to initiate recommended stabilization and perform urgent interventions

3. Readily available modes of acceptable transportation

4. Equipment and number of personnel indicated for care of the infant

5. Distance to be traveled and geography involved

6. Current and short-term weather patterns

C. Comparison of modes of transport for the VLBW infant

1. Ground (surface)
   a. Most common form of transport for sick neonates
   b. Depending on terrain and traffic, can be useful up to 100 miles from home base or travel times of 60–90 min

2. Rotor-wing (helicopter)
   a. Consider for transports from 100 to 200 miles away and/or if travel time is >90 min
   b. May be indicated in congested or hard-to-reach areas for much shorter distances

3. Fixed-wing aircraft — generally considered for distances >150 miles

D. Advantages of ground transport

1. Provides “door-to-door” service, which reduces multiple moves of the infant and exposure to external temperature extremes

2. Generally more spacious, allowing for fewer weight constraints, increased number of personnel, and more room to manage the infant
3. Environmental lighting usually better
4. Vehicle can be pulled over and stopped for emergent stabilization needs
5. Less impacted by effects of weather and aspects of flight physiology
6. Fuel, parts, and backup vehicles more easily accessed if needed

E. Limitations of ground transport
1. Much slower than other modes of transport
2. Ride can be rough, depending on construction of vehicle
3. Subject to traffic congestion, unanticipated highway delays/closures, weather

F. Advantages of rotor-wing transport
1. Possible to decrease one-way travel time by 75% over ground transport
2. Able to avoid traffic delays in congested locations and/or at congested times of day
3. Can be valuable resource when rapid acquisition of the unstable infant is needed
4. Useful to deliver team to site for initiation of stabilization and await ground transport for return

G. Limitations of rotor-wing transport
1. Not pressurized; VLBW infants may experience physiologic problems at lower altitudes
2. Noise and potential for significant vibration in hover or takeoff mode
3. Require landing zone and often some form of transport to the hospital
4. Can be severely limited by weather
5. Size of aircraft can restrict ability to perform interventions in flight
6. Weight restrictions limit number of team members and equipment

H. Advantages of fixed-wing transport
1. Much faster to reach distant locations
2. Generally able to carry more personnel and equipment than rotor-wing
3. Usually have pressurization to decrease impact of physiologic concerns
4. Less noise and vibration than rotor-wing and some ambulances
I. Limitations of fixed-wing transport
   1. Require an airport for landing and ground transport to the hospital, increasing the number of high-risk transfers required for the infant
   2. Usually the most costly transport option

References


