Abstract:
Regionalized perinatal care has improved neonatal outcomes, but the transport of critically ill neonates from nontertiary centers continues to be affected by the type of care provided during pretransport stabilization and transport itself. Although the use of highly trained personnel during transports has reduced adverse events, there are still opportunities to standardize care and improve patient outcomes, particularly through improvements in key areas identified by quality and patient safety drivers. An important goal of transport care is to be an effective bridge to the type of intensive care provided by the receiving units. Delivering the ultimate patient experience with consideration to family-centered care and community relations is discussed as a way to improve the interhospital transport process.

Keywords:
neonate; regionalized care; specialized interhospital transport; transport care; quality metrics; adverse events; patient safety; family-centered care; back transport

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Interhospital Transport of the Neonatal Patient

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The regionalization of perinatal care, a strategy involving the coordination of obstetric and neonatal services within a designated network of perinatal centers, has led to major improvements in maternal and neonatal outcomes.[1–3] Since the 1960s, there have been substantial declines in neonatal morbidity and mortality, largely due to effective antepartum risk assessments leading to increases in the number of in utero transfers to tertiary centers for delivery and prompt access to the appropriate level of intensive care.[1,2,4] This continues to be the practice model today, which, coupled to rapid advances in neonatal care and technology, has allowed for the effective management of critically ill newborns.[2,4]

The reality is that despite increases in neonatal survival resulting from antenatal transfer and delivery at tertiary care centers, not all high-risk fetuses have the benefit of timely identification. This results in a number of infants who are delivered at primary or secondary community settings and require transfer for higher level of care. In this setting, reported outcomes are not as positive.[2,3,5,6] For example, when looking at antenatal versus postnatal transfers to tertiary care centers, 1 study found a significantly increased need for neonatal intensive care services and total length of stay for newborns transported postnatally.[7] They also reported significantly higher incidence of bronchopulmonary dysplasia, intraventricular hemorrhage, higher staged intraventricular hemorrhage, patent ductus arteriosus, and mortality among those infants.[7] This significance held true when comparing the postnatally transferred group to a similar cohort of inborn babies at tertiary centers.[2,6] In fact, postnatally transferred infants were twice as likely as inborn admissions to have death or major disability, particularly in the very low birth weight category.[6]

There are several reasons why transferred infants tend to do worse with regard to neonatal outcomes. Studies have shown that negative outcomes from transfers originating at referring

institutions likely result from equipment failure, unavailability of monitoring devices, iatrogenic trauma, and temperature instability.[5] The degree to which the clinical staff is prepared for high-impact, low-frequency events also influences these outcomes as deterioration of skills and knowledge gaps exist even with Neonatal Resuscitation Program–trained personnel.[8] Because of these potential deficiencies, the transfer process of high-risk infants has to include specialized support consisting of appropriately trained teams with the capacity to provide goal-directed therapies, critical care interventions, and continuous monitoring.[9]

The American Academy of Pediatrics' Section of Transport Medicine, in keeping with efforts to provide the best care to transported patients, has made several recommendations for conducting safe and effective transport of infants to tertiary hospitals for advanced neonatal care.[10] In particular, they support the mobilization of specialized pediatric teams over nonspecialized teams due to their dedicated expertise and ability to treat infants in case of clinical deterioration.[9] In other words, these teams can jointly manage patients with providers at referring institutions as needed, ensuring optimal patient safety even while stabilizing for transport. In fact, studies have consistently shown that specialized teams, irrespective of composition, have overall improved outcomes.[9,11,12] One study found a significant difference with regard to morbidity, mortality, and hospital length of stay, and specifically noted decreased hypothermia, hypotension, and acidosis in premature infants when transported by trained staff.[12] Another study found that unplanned events during transport, such as unintended extubations, and 28-day mortality were also significantly improved when the transport team had specialized training.[11] Thus, the participation of skilled pediatric personnel is a key element of quality care during transport, with immediate and long-term impact.

Transport of newborns, even with an ideal team, is still subject to substantial practice variation in both transport operations and clinical care. This not only influences neonatal outcomes but also curtails any type of quality initiatives to improve transport medicine. In an effort to establish best practices, Schwartz et al[13] endeavored to develop quality metrics for neonatal transport, and through a Delphi process, came up with 12 core measures from which to benchmark performance and drive change. Most measures focused on patient safety, particularly as it pertained to issues of airway stabilization and management of respiratory conditions, adverse events including medical errors and equipment failures, unintended hypothermia, and patient handoffs. Details regarding each measure can be accessed elsewhere.[13] The remainder of this manuscript aims to inform on key concepts of neonatal pretransfer stabilization and transport care with the intent to standardize care and improve clinical outcomes for infants born in the community. It focuses on patient symptoms and clinical practice guidelines (where applicable) for management of sick infants until arrival at a receiving tertiary institution.

RESPIRATORY CONDITIONS AND THEIR MANAGEMENT DURING TRANSPORT

Respiratory distress ranks among the top reasons for neonatal transport requests and requires advanced knowledge of airway maintenance and management.[14] As such, the transport team must be prepared to play a critical role in patient stabilization, particularly as an infant's condition deteriorates beyond the referring hospital's resource capabilities.[9] This joint management requires that transport personnel perform a rapid assessment of an infant's condition upon arrival, review response to already attempted therapies, and intervene with either noninvasive techniques or invasive ventilatory support as needed. Most importantly, it requires a clear understanding of the severity of illness to be able to anticipate the patient's clinical trajectory and needs once the infant arrives in the neonatal intensive care unit (NICU). To that end, close attention must be paid to rapidly changing infant parameters such as vital signs, work of breathing, inspired oxygen requirements, pulse oximeter readings, and acid-base status.[14]

There are 3 common respiratory conditions that are typically encountered in transport. Prompt identification and targeted therapy can result in decreased infant morbidity and mortality, even before receiving specialized NICU care. A short review of respiratory distress syndrome (RDS), persistent pulmonary hypertension of the newborn (PPHN), and pneumothorax will be presented to elucidate the extent of transport capabilities needed in patient management.

Respiratory distress syndrome is a condition affecting mostly premature babies secondary to surfactant deficiency. Surfactant is a complex protein that provides an air/water interface within an alveolus, or breathing unit, leading to reduced surface tension and effective expansion of the air space during a breathing cycle.[15] Deficiency of this protein results in a complex disease that is