The practice of pediatric/neonatal interfacility transport continues to expand. Transport teams have evolved into mobile ICUs capable of delivering state-of-the-art critical care during pediatric and neonatal transport. The most recent document regarding the practice of pediatric/neonatal transport is more than a decade old. The following article details changes in the practice of interfacility transport over the past decade and expresses the consensus views of leaders in the field of transport medicine, including the American Academy of Pediatrics' Section on Transport Medicine. Pediatrics 2013;132:1–8
The practice of pediatric/neonatal interfacility transport has changed. Teams have evolved into mobile ICUs, delivering state-of-the-art care outside tertiary centers. Evidence shows such teams improve patient outcomes. Literature concerning pediatric/neonatal transport continues to grow and will direct its practice in coming years. The most recent consensus document regarding interfacility transport is more than a decade old. Many things have changed, necessitating a revised consensus statement. This document summarizes the current evidence and expert opinions regarding pediatric/neonatal interfacility transport in the United States.

The American Academy of Pediatrics’ (AAP) Section on Transport Medicine (SOTM) advocates for improving care provided to transport patients. Membership is open to AAP members and affiliate members practicing pediatric/neonatal transport. An executive committee representing emergency medicine, neonatal intensive care medicine, and pediatric intensive care medicine directs the section mission, including issues related to clinical care, service delivery, access to care, education, administration, and research.

The SOTM directs a yearly program at the AAP National Conference & Exhibition and offers the Course on Neonatal and Pediatric Critical Care Transport Medicine biannually. In 2011, the SOTM executive committee and invited experts discussed the current state of interfacility transport and made recommendations regarding its future direction. Experts presented materials on transport topics and solicited audience opinions. The meeting consisted of 75 attendees (executive committee members, section members, and invited guests). Attendees included all levels of pediatric/neonatal transport directors and providers. Attendees were physicians involved in pediatric/neonatal transport, registered nurses, registered respiratory therapists, pediatric critical care and neonatology fellows, and pediatric residents. The meeting was publicized a year in advance, and all levels of transport providers were encouraged to attend. The current article summarizes the meeting conclusions and SOTM consensus views. In addition, the article was reviewed by the AAP sections of emergency medicine, neonatal/perinatal medicine, critical care, hospital medicine, and disaster medicine biannually. The medical director role has not expanded or been modified. Medical directors have 4 areas of responsibility: administrative/organizational, educational, safety and quality improvement, and operational. The medical director should be licensed in the state or jurisdiction where the service operates, be subspecialty trained, and maintain a working knowledge of transport medicine. If not subspecialty trained, the medical director must have access to subspecialists. Fellowship programs in neonatology, pediatric critical care medicine, and pediatric emergency medicine should include transport medicine and medical control training. Medical directors should also have protected administrative time consistent with volume, scope, and mission. The medical director should be recognized by the hospital and ensure that transport system procedures are integrated within the hospital system. In addition to expertise in medical care, transport environmental training should include program safety, sleep/stress medicine, flight physiology, mode utilization, and equipment. Managerial science training including stress management and quality improvement is necessary. National educational conferences should be considered part of ongoing education.

Administrative and organizational duties include mission statement and strategic plan development, team structure, advocacy, development of transport agreements, service as liaison for administrative staff and referral physicians, financial planning and revenue generation, accreditation issues, legal awareness/compliance, and marketing plan development/supervision (including outreach and visibility). The medical director should play a role in educating referring institutions and physicians about transport capabilities, including appropriate modes, team composition, and patient stabilization. The medical director should also oversee transport research, such as coordinating projects, ensuring institutional review board compliance, data collection, and publication.

The medical director should maintain oversight of education to include team members, caregivers at referring and receiving hospitals, and medical control physicians. Educational responsibilities include establishment of transport standards, compliance with local/national standards, protocol/guideline design and review, determination of education needs, and training plans. Training should include simulation experiences for case management, team interaction and function, and procedures, as well as didactic presentations and transport observation/participation.

Oversight of safety and quality is an important medical director role. Although aviation and ground vehicle safety issues are the responsibility of a program or operations director, the medical director should understand the safety structure. Patient safety and quality care are the responsibility of the medical director. Benchmarks should be developed internally and nationally, with goals for transport systems to
achieve or exceed. Responsibilities include team development and supervision, on-line and off-line medical command, patient review provision, logistic review provision, ensuring clinical competence, ensuring efficient access, and quality assurance and quality improvement resource provision. Data are imperative for quality improvement; thus, the medical director should ensure complete data collection and documentation as well as development of appropriate databases. Data collection should support quality of care issues, financial issues, and guide research.

Operational activities overlap with the aforementioned areas but incorporate establishment of an appropriate managerial structure, including a program director to oversee the multidisciplinary team. The medical director may be involved in personnel selection and assessment, medical command development and assessment, assurance of appropriate and safe system use, centralized communications management, maintaining awareness of referral patterns, integration with other hospital services, vehicle selection, equipment and medication selection, competency assurance, and introduction of new technologies and treatments.

The SOTM has taken on the role of medical director education. The Guidelines for Air and Ground Transport of Neonatal and Pediatric Patients (4th edition) includes chapters on administrative and operational issues for medical directors and leadership. Biannually, the SOTM presents a course on Neonatal and Pediatric Critical Care Transport that includes topics pertinent to medical directors. In addition to the SOTM, the Air Medical Physician’s Association has a comprehensive monograph on the Role of the Air Medical Director and conducts ongoing education. Future efforts should include continual reevaluation of educational efforts, especially in the areas of quality improvement, transport safety, and managerial science.

**ACCREDITATION OF PROGRAMS**

Accreditation is a process in which an external agency assesses a program to determine if it meets quality of care and safety standards initially and continually. Federal accreditation remains voluntary, although state and regional accreditation may be required for licensing or local contracts. Proposed federal legislation would mandate accreditation for programs receiving federal funding. US Senate Bill 1407 before the 112th Congress proposes to amend Medicare legislation, making payment for air services based on meeting the highest accreditation “tier” within a newly created system. Five agencies currently provide accreditation for air/ground critical care transport: the Commission on Accreditation of Medical Transport Systems, the Commission on Accreditation of Ambulance Services, the National Accreditation Alliance of Medical Transport Applications, the Joint Commission International, and the European Aero-Medical Institute. Accreditation standards vary, but all lack depth regarding pediatric/neonatal components. The SOTM encourages agencies to incorporate pediatric and neonatal specialty representation into their boards. Only the Commission on Accreditation of Medical Transport Systems includes pediatric and neonatal board representation, with seats for both AAP and National Association of Neonatal Nurses representatives. If pediatric and neonatal subcommittees do not exist within agencies, models must evolve to provide pediatric- and neonatal-specific accreditation to transport programs. Evidence linking accreditation to patient outcomes and safety remains elusive. A single study links accreditation standards with difficult airway patients. Research linking accreditation to quality should remain a major focus of future investigations and funding.

**BENCHMARKING OF NEONATAL AND PEDIATRIC TRANSPORT PROGRAMS**

Over the past 10 years, much attention has been devoted to establishing definitions of quality care in medicine. Quality improvement concepts have crept into standard operations for many teams. The Institute of Medicine’s dimensions of quality, the National Quality Forum’s characteristics of appropriate performance measures, and Donabedian’s categories of quality metrics are increasingly recognized by team members responsible for quality assurance. Performance measures for emergency medicine, critical care, and neonatology exist but are lacking in pediatric/neonatal transport. Most programs track local quality indicators, but few have the opportunity to compare successes with others.

Benchmarking progress has begun in Ohio, where 6 large neonatal and pediatric transport teams met in 2011 to agree on transport-specific quality measures, define those metrics, and begin tracking for benchmarking. Twenty measures representing each of the Institute of Medicine’s dimensions of quality were chosen and defined. Data collection is underway, and the first investigations into best practices for several measures are in progress. The AAP SOTM recently held a similar metrics conference with much larger representation in 2012.

Transport-specific benchmarks must be established, and they should be established by those in the industry, not imposed by entities less familiar with pediatric/neonatal transport. This action will identify the highest performing transport programs and allow
their best practices to be shared. There is strong support for developing and maintaining a national pediatric/neonatal transport-specific database to facilitate tracking quality metrics and strengthen efforts to define practice standards.

CLINICAL RESEARCH

Research literature related to pediatric/neonatal interfacility transport continues to be sparse compared with other areas of medicine. Pediatric transport research has mainly focused on team justification and optimal composition and has been almost exclusively retrospective. In 2002, the SOTM called for increased clinical research to answer relevant questions. Since then, research has increased and led to several publications relevant to clinical practice and improving the quality of care provided during transport. The broad diversity of, practice differences, and geography served by programs across the United States continues to challenge collaborative research efforts. An organized transport research network designed to answer relevant clinical questions in a multicentered collaborative fashion is urgently needed.

Recent publications have refuted the “golden hour” in pediatric/neonatal transport, continuing to emphasize timely delivery of definitive care over speed of transfer. Additional publications have shown the benefit of specialized teams, indicating improved care and better outcomes. Specialized pediatric teams are trained and equipped to deliver definitive care outside tertiary care centers. Although sending such teams may prolong the arrival time of critically ill patients to tertiary care centers, evidence shows that such teams should be considered for transport when available. Adult air transport services and emergency medical services (EMS) crews are often not trained or equipped to deliver needed interventions for critically ill pediatric patients. Others have focused on severity of illness scoring systems for interfacility transport, with 1 recently published study and several abstracts at recent SOTM meetings. Several studies have evaluated equipment and efficacy of therapeutic interventions. In addition, the first prospective, randomized clinical trial in pediatric interfacility transport was recently published, illustrating the need for enhanced monitoring and timely resuscitation of critically ill transport patients. It also demonstrated the ability to conduct clinical trials in the transport environment, even with informed consent requirements and concerns. The SOTM continues to emphasize the need for clinical research designed to guide future practice.

Research funding continues to be a concern in all areas of medicine. This concern is particularly problematic in transport medicine, where no precedent for federal research funding exists. At the time of the 2011 SOTM meeting, 4 institutions reported intramural research funding totaling $130 000. One reported an ongoing National Institutes of Health/Eunice Kennedy Shriver National Institute of Child Health and Human Development–funded trial, with direct costs totaling approximately $500 000. In the current funding climate, creative ways to finance clinical research will be needed. These funding limitations also emphasize the continued need for a multicenter, collaborative research network. Funded projects should answer relevant clinical questions and include large cohorts that are representative of transport patients across the country. These studies should be carefully designed and nationally directed to ensure relevance across institutions.

TRAINING, SIMULATION, SAFETY, AND WORK HOURS

Training

Transport teams vary in scope of practice, team composition, and experience. Teams use nurses as well as physicians, nurse practitioners, respiratory therapists, physician assistants, and paramedics. Even with such diversity, the training curriculum defines transport practice standards. Training must be tailored to patient population, travel modalities, and services provided. Curricula should reflect team characteristics while providing a common set of expectations for knowledge, skills, practice standards, and competency. Achieving this knowledge base begins during an orientation/training period and must be maintained throughout the individual’s career. Recent surveys show wide variability of orientation duration and measures of readiness for independence. These variances may reflect differing scopes of practice but can also highlight differences in educational resources and expectations.

Personnel selection includes consideration of individual attributes such as experience, communication skills, and ability to function independently and within a small multidisciplinary team. Previous experience should be considered, allowing quick advancement through areas of proficiency to focus on areas of need. Training for skills unique to transport is needed for all personnel. Most programs use didactic and process curricula, including preceptor-supervised transport activities. Completion of orientation materials and a specified number of transports or period of time with preceptor supervision are often used to determine readiness for independence. Competency assessment is used in medical education to objectively measure knowledge and skills. Adopting a similar approach for transport education would allow
teams to evaluate individual personnel, focus on educational needs, and assure acquisition of necessary knowledge and skills.

Continuing education, skills maintenance, and quality assessment are essential. Multiple modalities are used in continuing education programs, including quality improvement initiatives, didactics, skills laboratories, case conferences, case simulations, literature/practice reviews, computer-based activities, and peer performance. Coupling continuing education with competency assessments allows programs to provide individual support while maintaining overall performance standards.

Transport patient care remains an essential part of resident/fellow training, especially in neonatology, pediatric critical care, and pediatric emergency medicine, although the need for a physician presence on transport teams remains controversial. As resident/fellow training regulations and work hour restrictions have changed, fewer trainees are exposed to the unique learning environment of a transport program. The impact of this loss may become apparent as trainees advance to careers in critical care disciplines and transport medical direction.

**Simulation**

Mannequins and high-fidelity simulation laboratories are excellent training adjuncts. Procedural skills can be developed by using teaching aids and mannequins in a safe, controlled environment. Scenarios with reproducible clinical events can recreate patient care environments, including transport vehicle workspace. Simulation can extend beyond resuscitation skills to include precode status recognition, team dynamics, difficult social encounters, and more. Simulation-based learning includes debriefing, in which facilitated discussion allows participants to review and critique their experiences. Although simulation offers many options for team training, it is not universally available. Data linking the impact of simulation training in pediatric/neonatal transport on patient outcomes and team training are lacking.

**Safety**

Increasing numbers of helicopter accidents have heightened awareness among the medical community, public, and regulatory agencies about the dangers encountered during transport. Regulations governing commercial airline pilots are now enforced for air medical pilots, and a growing safety culture has resulted in a decreased number of accidents despite increased providers and missions. Ambulance safety remains relatively neglected, however. More effort is needed to guarantee that vehicles, patient care areas, and operational procedures advance to meet safety standards similar to the air medical transport industry. Safety training should begin during orientation and be stressed through all levels of operational and educational forums. Teams will benefit from establishing a safety culture that includes policies designed to maintain patient, family, staff, and workplace safety.

**Work Hours**

Shift length and workweek hours vary greatly. Unit-based teams often adhere to hospital shift norms, whereas shifts for dedicated teams may vary depending on trip volumes, duration, and team preferences. In a recent survey of critical care transport teams, approximately one-half work 24-hour shifts, with 36- to 48-hour total workweeks. Workweek length has been identified as a safety concern related to alertness and fatigue. The Federal Aviation Administration strictly enforces duty hour limits for pilots, and work hour restrictions are in place for training physicians. Although standards do not exist for transport medical staff, the impact of fatigue on clinical performance and safety for transport staff seems similar to that facing physicians and pilots.

**Economics of Transport**

The benefit of pediatric/neonatal specialty transport programs beyond service to the community is to capture patients and revenue for sponsoring institutions. The complexities of transport finance platforms have increased over the last decade. Transport administration must continuously evaluate financial performance and search for cost-cutting and cost-sharing opportunities. The transport community should remain vigilant regarding measurement, validity, and transparency of outcomes.

There are 4 types of transport systems: hospital-based, community-based, EMS-based, and a hybrid (mix of the 3 systems). Hospital-based teams are owned and operated by sponsoring institutions. They are designed to serve hospital needs, and they usually operate at a net loss. They generate indirect revenue streams, providing an overall profit. Community-based models are typically owned and operated by private companies. They depend on a mix of adult transports, high volume, and low expenses. EMS models are frequently owned and subsidized by local, regional, and state government funding, including tax payer revenue. Hybrid models are gaining popularity as awareness of cost and resource sharing has improved collaboration. All systems provide an economic and structural framework for pediatric/neonatal transport programs. These systems will continue to evolve in response to evolution of financial platform.
complexities. Transparency of outcomes, quality improvement initiatives, and cost-cutting/cost-sharing collaboratives, paired with vigilant financial oversight, will provide a healthy framework for survival.

TEAM COMPOSITION

Team composition varies greatly across institutions. Karlsen et al19 surveyed 335 neonatal transport programs and found 26 different team configurations. The most common was a registered nurse and respiratory therapist. Leslie and Stephenson compared advanced nurse and respiratory therapist. Leslie The most common was a registered the neonatal nurse practitioners 25 Stabilization times with the neonatal nurse practitioners were longer, but patients had improved pH, PaO2, temperature regulation, and oxygen saturations.

The goal of critical care transport is to take services to the patient and begin advanced care rapidly. Teams must match the mission and scope of practice for each patient. Factors that affect team composition include program resources, program design, unit-based versus dedicated teams, transport volume, and transport mode. In addition, local, state, and regional regulatory agencies may influence team composition. Accreditation agencies and professional associations can provide guidance for experience, qualifications, and training.

JUSTIFICATION OF TEAM, COLLABORATION, AND REGIONALIZATION

Justification of transport teams is complex because it involves proving need in ways other than generating revenue. It involves a balance between developing, marketing, and maintaining a service with direct benefits of increasing patient volume and indirect benefits of branding and outreach. Key components include financial ramifications, regionalization, competition, and medical/legal issues. Individual programs vary depending on hospital/network mission, geography, special services, patient demographic characteristics, team composition, referral patterns, and classification as cost or revenue centers. Forecasts into referral population changes must be considered when contemplating reducing or expanding services. Collaborative efforts should be made to contain cost and offer high-acuity specialty services more efficiently.

When justifying a new or expanded team, supply and demand economics must be considered. Will the program fill a need or compete for a fixed population served by existing teams? Collaborative opportunities should be evaluated to control cost and increase services. Intangible institutional benefits must be considered, including added patient volume, institutional branding, outreach, and, most importantly, affecting the quality of regional health care for children.

DISASTER AND INTERNATIONAL TRANSPORT

No other portion of transport medicine has received more attention over the past decade than disaster planning and management. The events of September 11, 2001, Hurricane Katrina, the earthquake in Haiti, and other smaller disasters have indicated a clear need for better disaster planning. During Katrina, several services transported neonatal and pediatric patients from involved areas. Similarly, many injured children were evacuated from Haiti with the use of private ambulance services. In both, the transport of children seemed to be based on individual hospital requests rather than a coordinated effort.

In 2006, the Institute of Medicine noted significant disparities in pediatric emergency services across the United States. The American Board of Pediatrics appointed a disaster preparedness advisory council in 2006 to develop strategic plans for disaster preparedness, work with AAP committees and sections, and advocate for children in disaster planning. Several individual states have developed plans for local disasters, and at least 1 regional plan exists (Region VI: Texas, Arkansas, Louisiana, Oklahoma, and New Mexico).

As illustrated by recent disasters, state and local resources are often quickly overwhelmed. Assistance from the National Disaster Medical System and other federal assets is necessary during large disasters. The National Disaster Medical System partners with the Department of Defense and US Transportation Command to coordinate evacuation and transport. Disaster medical assistance teams provide medical personnel, including physicians, to assist in these efforts. Few teams contain members specifically trained in pediatric care, however. The SOTM strongly encourages teams to encompass members trained in the care of pediatric/neonatal transport patients to direct coordinated evacuation efforts.

As transport resources have expanded, so have opportunities for international transport. International transport requires specific resources and skills not routinely incorporated into most programs, and regional resources should be pooled to handle these unique situations. Standards and guidelines should be developed that address team configuration, patient management, communication, and equipment compatibility. Opportunities exist to provide instruction in basic transport skills to providers in low-resource environments internationally. These must be individually tailored but should include
basic life support training as well as more advanced training such as pediatric advanced life support. The SOTM should take an active role in planning and coordinating such activities.

EMTALA AND TRANSPORT: THE LAWS OF TRANSPORTING AND RECEIVING PATIENTS

The Emergency Medical Treatment and Active Labor Act (EMTALA), passed in 1986 as part of the Consolidated Omnibus Budget Reconciliation Act, is the cornerstone of transport law.26 These federal acts were established to prevent inappropriate transfers and prohibit any transfer decision based on financial considerations. EMTALA mandates that patients presenting to emergency departments receive a medical screening examination by a qualified person to ascertain if an emergency medical condition exists.27 An emergency medical condition is one with acute symptoms of sufficient severity in which the absence of immediate medical attention could seriously jeopardize patient health or the health of an unborn child.28 If none exists, the EMTALA obligation ends. If an emergency medical condition exists, the hospital must admit, stabilize, or transfer. If the hospital cannot provide the necessary patient care, then transfer is warranted.

The question of stability is often raised when patients are referred for transport. EMTALA defines “stabilized” to mean that no deterioration is likely to result from, or occur during, transfer. Stability is not a prerequisite for transport, although patients in unstable condition should not be placed in less-equivalent care environments to expedite transfer. The referring institution is required to stabilize the patient to the best of their institutional capabilities.29 A classic example is the pediatric patient with an epidural hematoma. Although optimal management would include surgical evacuation, if this option is not available, transfer is warranted.

Once the transfer decision is made, the referring physician must obtain acceptance from a receiving physician. A receiving hospital must accept a transfer request if it can provide specialized care not available at the referring facility and has the capacity to do so.30 Even if the receiving hospital believes that a transfer is not warranted, it is highly suspect to refuse. The receiving hospital should avoid judgment about referring hospital capabilities. When in doubt, the patient should be accepted and a complaint filed with the Centers for Medicare & Medicaid Services.

Considerable debate surrounds the decision-making responsibilities of referring versus accepting physicians with respect to transport mode. This discussion should be a collaborative effort between referring and accepting physicians to determine mode (air versus ground), appropriate level of provider, and necessary equipment. The referring institution must copy all records and include copies of all radiologic images. The referring facility must also obtain consent for transfer.31 Medical necessity and risks must be explained to the parent or legal guardian. This requirement may be waived if an emergent transfer is necessary for patient health and safety.

After acceptance, the referring facility must continue to manage the patient until arrival of the transport team. The referring facility must keep the accepting facility updated on changes in the patient’s condition, as well as important diagnostic study results. The accepting facility continues to serve as a consultant. The referring facility is not obligated to follow accepting facility advice, and acceptance is not contingent on the referring facility carrying out diagnostic or therapeutic interventions. Joint responsibility and collegial management are necessary to ensure optimal patient safety.

On arrival, the referring clinicians should greet the transport team and provide further clinical updates. The transport team should be pleasant, professional, and avoid any insinuations of suboptimal management. Although collaborative management is always paramount, as long as the transport team is in the referring hospital, ultimate responsibility rests with the referring physician. Legally, the transporting team assumes full control of medical decision-making when they leave the referring facility.

SUMMARY

Interfacility transport of critically ill neonatal and pediatric patients has rapidly progressed, from moving children to tertiary children’s hospitals from community emergency departments, to specialized teams bringing cutting-edge care, goal-directed therapies, and critical care interventions and monitoring in mobile ICUs to the bedside in the community. The deployment of specialized pediatric teams has been associated with improved outcomes and safety compared with nonspecialized teams. Although the personnel composition of specialized teams varies based on local and regional resources, the common thread is the dedicated expertise in pediatric emergency medicine and neonatal and/or pediatric critical care of the team members. The neonatal/pediatric transport community, led by the AAP SOTM, is actively defining pediatric quality indicators, benchmarking outcomes, and developing training recommendations for interfacility transport teams, with the overall goal of improving the care of infants and children.
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