



# Pediatric Readiness in Emergency Medical Services Systems

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Ill and injured children have unique needs that can be magnified when the child's ailment is serious or life-threatening. This is especially true in the out-of-hospital environment. Providing high-quality out-of-hospital care to children requires an emergency medical services (EMS) system infrastructure designed to support the care of pediatric patients. As in the emergency department setting, it is important that all EMS agencies have the appropriate resources, including physician oversight, trained and competent staff, education, policies, medications, equipment, and supplies, to provide effective emergency care for children. Resource availability across EMS agencies is variable, making it essential that EMS medical directors, administrators, and personnel collaborate with outpatient and hospital-based pediatric experts, especially those in emergency departments, to optimize prehospital emergency care for children. The principles in the policy statement "Pediatric Readiness in Emergency Medical Services Systems" and this accompanying technical report establish a foundation on which to build optimal pediatric care within EMS systems and serve as a resource for clinical and administrative EMS leaders.

## DEFINITIONS

- **Emergency medical services (EMS):** An intricate and comprehensive system, which in a coordinated response, provides the arrangements of personnel, facilities, and equipment for the effective, coordinated, and timely delivery of health and safety services to provide emergency care.<sup>1,2</sup>
- **Out of hospital:** A term used in emergency medicine to mean "in the field," "in the community," "at the patient's home or workplace," or "prehospital." Assessments performed and treatments given out of

## abstract

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hospital often stabilize a patient or initiate critically needed care.<sup>3</sup>

## INTRODUCTION

Emergency care for children occurs along a continuum from primary prevention to prehospital, hospital-based acute care, and rehabilitation services. In 2009, the American Academy of Pediatrics (AAP), the American College of Emergency Physicians (ACEP), and the Emergency Nurses Association collaborated to produce a document focused on the emergency department (ED), "Guidelines for Care of Children in the Emergency Department,"<sup>4</sup> recently revised and published as "Pediatric Readiness in the Emergency Department."<sup>5</sup> Alongside the ED policy statement, the National Association of EMS Physicians (NAEMSP) and National Association of Emergency Medical Technicians (NAEMT) joined those organizations in authoring a policy statement<sup>6</sup> on pediatric readiness in EMS systems. This technical report supports these policies with evidence for the need for pediatric services to be embedded into the EMS segment of the continuum of emergency care for children. This report identifies areas where improvements can be made in EMS systems and provides resources and references for clinical and administrative EMS leaders to use to transform health care for pediatric patients. Recommendations for integrating pediatric-specific components into EMS systems are noted in Table 1.

## BACKGROUND

In 2011, the National Association of State EMS Officials (NASEMSO) published the results of the National EMS Assessment. At the time, 826 111 credentialed EMS professionals in 19 971 licensed EMS agencies cared for more than 35 million patients annually in the United States.<sup>7</sup> Children represented

only 10% of EMS encounters,<sup>8</sup> raising concerns that even well-trained EMS providers can face challenges in the maintenance of their cognitive knowledge and psychomotor skills given the range of acuity in pediatric patients they encounter.<sup>8-19</sup> These challenges underscore the importance of establishing activities in EMS agencies and systems to ensure pediatric readiness in the EMS environment.<sup>19-24</sup>

### Pediatric Readiness

In 2006, the Institute of Medicine (IOM), now called the National Academies of Sciences, Engineering, and Medicine, published a report titled, "Emergency Care for Children: Growing Pains," which described multiple deficiencies and gaps in the ability of our emergency care system to meet the needs of children.<sup>25</sup> For example, the IOM noted that the workforce providing emergency care must have the knowledge and skills to take care of children to minimize devastating health consequences. As evidence of deficiencies in this necessary knowledge and skill, the authors noted significant gaps in both clinical and administrative areas as well as a paucity of research on best practices, clinical outcomes, and patient safety for the prehospital care of children. The report had several recommendations including the need for the EMS industry to establish defined pediatric emergency care competencies and provide initial and continuing pediatric-specific education for providers.<sup>4-25</sup>

The 2013 National Pediatric Readiness Project assessment evaluated various foundational elements based on the joint policy statement "Guidelines for Care of Children in the ED." The fundamental elements of readiness included administration and coordination; physicians, nurses, and other health care providers; quality improvement (QI); patient safety; policies,

procedures, and protocols; support services; and equipment, supplies, and medications.<sup>4,26</sup> This study demonstrated that although pediatric readiness had improved in EDs, 80% still reported some barriers to implementing the recommendations in the guidelines. Studies examining pediatric readiness and a pediatric facility verification program found that activities in EDs that achieve higher scores of pediatric readiness are linked to improved outcomes such as a decreased pediatric mortality rate, timeliness of pain management and reduced radiation for fractures, and improved simulation care for pediatric sepsis.<sup>4,26-30</sup>

Evidence from the National Pediatric Readiness Project supports that EDs are more prepared to care for children when guidelines are adhered to for the care of children in EDs.<sup>26,27</sup> Several of the elements of pediatric readiness assessed recommended a pediatric liaison in the EMS environment. EMS medicine has the potential to see similar benefits in readiness to care for children with established guidelines for the care of children in EMS systems.<sup>5,24</sup>

### The Impact of Population-Specific Oversight Practices on Improving Care

Attention to sufficient cognitive and psychomotor training, provider experience, and physician oversight aids EMS success. An example of success for a condition-specific population is advanced airway management, in which focused oversight has been shown to improve performance.<sup>31,32</sup> Researchers in Rochester, New York, studied the effect of a redesigned rapid sequence intubation program that was consistent with recommendations published by the NAEMSP.<sup>33</sup> They were able to demonstrate significant gains in cognitive performance, most notably proper

**TABLE 1** Integration of Pediatric Components Into EMS Systems

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Medical oversight
Ensure pediatric representation in EMS planning, operations, and oversight as outlined in the NAEMSP position statement “Physician Oversight of Pediatric Care in EMS”
Provide direct and indirect medical oversight that integrates pediatric-specific elements into the global EMS system
Operations
Include pediatric-specific guidance and expertise in the development and improvement of EMS operations
Have pediatric-specific equipment and supplies available and ensure that prehospital providers are competent in their use
Develop processes for evaluating pediatric-specific psychomotor and cognitive competencies of prehospital providers
Have policies that ensure the safe transport of children and families in emergency vehicles
Collaborate with outpatient and hospital-based pediatric experts, especially those in EDs
Facilitate destination determination of patients by weighing the risks and benefits of transport to a higher level of care
Collaborate with local EDs to promote basic pediatric readiness of all facilities
Include considerations for care of children and families in emergency preparedness planning and exercises, including family repatriation, in time of disasters
Provide situational awareness to caregivers by encouraging providers to designate a person to narrate and preempt actions to the bystander on the scene, using lay terms to communicate with patients and families, and allowing bystanders to maintain a line of sight with the child as long as they are not interfering with patient care
Education
Ensure that prehospital providers receive periodic pediatric-specific education
Ensure pediatric assessment and recognition of respiratory distress or failure, cardiac failure, and shock
Competency in neonatal and pediatric resuscitation
Ensure updated psychomotor skills and practice in pediatric airway management (focusing on basic airway management) and venous and intraosseous placement and access
Provide education tools to improve proper pain and wt assessment and pain management
Research, data management, and QI
Implement practices to reduce pediatric medication errors
Include pediatric-specific measures in QI and quality assurance processes
Submit data to a statewide database that is compliant with the most recent version of the NEMSIS and work with local hospitals to track pediatric patient-centered outcomes across the continuum of care

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Adapted from National Association of Emergency Medical Services Physicians. Physician oversight of pediatric care in emergency medical services. *Prehosp Emerg Care.* 2017;21(1):88 and Ayub EM, Sampayo EM, Shah MI, Doughty CB. Prehospital providers’ perceptions on providing patient and family centered care. *Prehosp Emerg Care.* 2017;21(2):233–241.

patient selection.<sup>33</sup> This serves as an example of the effect that recommendations from professional organizations can have on increasing EMS agency attention toward special populations or conditions and how adding close physician oversight can improve provider performance.

### **ADMINISTRATION AND COORDINATION FOR THE CARE OF CHILDREN IN EMS SYSTEMS**

Many publications have called for the coordination and integration of patient care throughout EMS systems. In 1993, the NASEMSO and NAEMSP published a position statement on physician oversight, emphasizing that quality patient care depends on a commitment to the development and operation of an integrated and comprehensive EMS system.<sup>34</sup> High-quality leadership is a critical element in developing such a high-functioning EMS agency or system, especially

with regard to physician oversight of EMS. In 2017, the NAEMSP provided clear descriptions of the role and duties of the EMS medical director, which were intended to help system administrators integrate medical direction throughout EMS systems.<sup>35</sup> The NAEMSP has published a position statement specifically outlining the critical elements of “Physician Oversight of Pediatric Care in EMS.”<sup>36</sup> In another policy statement that discussed the role of pediatricians in rural communities, the AAP described how pediatricians’ expertise can help close gaps in pediatric care for EDs and EMS agencies that have limited resources.<sup>37</sup> In the EMS Agenda 2050 document, which is a collaborative effort to create a plan for the next several decades, there is an emphasis on patient-centered care, as follows: “EMS medical oversight for specific patients and populations includes close collaboration with the physicians who make up the patients’ medical home,” including input from

various specialists such as pediatricians. Collaboration is an intrinsic component to system-wide EMS care tailored to the individual patient.<sup>38</sup>

### **Pediatric Leadership in EMS**

As previously noted, the 2006 IOM report stated the importance of having a pediatric emergency care coordinator (PECC) designated at the EMS agency level to facilitate continued pediatric emergency education; ensure QI for pediatric patients; enhance the availability of pediatric medications, equipment, and supplies; represent the pediatric perspective in the development of EMS protocols; and participate in pediatric research.<sup>25</sup> The 2017 NAEMSP position statement on the importance and oversight of pediatric care in EMS also discussed how PECC oversight could be incorporated into existing roles (eg, an agency’s EMS physician medical director) or established as a new role that is

collaborative within the EMS leadership team (eg, PECC or EMS system pediatric advisory committee).<sup>36</sup> The PECC could be incorporated into an EMS system as a single provider or team of providers. A person and/or team in this role would be expected to oversee the system-based care of pediatric patients and would promote the integration of pediatric elements into day-to-day services as well as local and/or regional disaster planning.<sup>25,36</sup> The PECC also can serve as a pediatric health care liaison among the EMS agency, community pediatricians, and medical home in addition to the local health care facilities. The recommended qualifications and responsibilities of an EMS PECC are noted in Table 2, which as previously noted, can be incorporated into an existing role already within the EMS agency or established as a stand-alone role.<sup>5,25,36</sup> The importance of a PECC within EMS agencies was further exemplified by the Emergency Medical Services for Children (EMSC) program adding this supportive role as a performance measure.<sup>39</sup> Analysis of pediatric readiness assessment data demonstrated that having a PECC in an ED increased the likelihood of a higher readiness score overall and improved pediatric QI processes.<sup>40</sup> A recent study showed interest among EMS agency administrators in integrating a PECC into their systems, and in addition, pediatric-specific psychomotor skills testing was more common in EMS agencies that respond to a higher pediatric call volume and have a PECC. The presence of a PECC can potentially increase provider confidence and safety for all pediatric prehospital patients regardless of volume and location.<sup>41</sup> Regardless of how this role is incorporated into the structure of EMS, it is important that each agency include pediatric-specific guidance and expertise in the development and improvement of their operations.

### **Pediatric Emergency Care Coordinator Learning Collaborative**

There is currently an initiative to strategize integrations of PECCs within EMS agencies, known as the Pediatric Emergency Care Coordinator Learning Collaborative. This initiative is being led by the Emergency Medical Services for Children Innovation and Improvement Center (EIIC). The purpose of this project is to form a cohort of EMSC state partnership grant recipients to participate in a learning collaborative that will demonstrate effective and replicable strategies for local EMS agencies with a PECC. Results from this project will inform and advance efforts within all 58 EMSC state partnership recipient sites to increase the adoption of PECCs within local EMS agencies.<sup>42</sup>

### **COMPETENCIES FOR PROVIDERS**

Considering the challenges associated with low patient volumes, a number of experts in the field have recommended mandated skills testing or ongoing education in pediatric emergency care programs such as Pediatric Advanced Life Support, Pediatric Education for Prehospital Professionals (PEPP), Advanced Pediatric Life Support, and the Emergency Nursing Pediatric Course.<sup>9–19,43–46</sup>

### **EMS Education**

EMS agencies have an important role in integrating pediatric-specific elements into all aspects of prehospital care, including oversight, education, protocol development, and performance improvement. Only 10% of the EMS patient volume involves pediatric patients,<sup>8</sup> underscoring the recognition that additional methods of exposure are needed to help EMS providers maintain clinically relevant cognitive and psychomotor competencies. One of these alternatives includes an annual educational and skill assessment of

provider competency in the following domains:

- pediatric assessment, including recognition of respiratory distress or failure, shock, and cardiac failure<sup>43,47–49</sup>;
- neonatal and pediatric cardiopulmonary resuscitation<sup>43–46</sup>;
- pediatric airway management with an emphasis on basic airway intervention skills<sup>10–14,17</sup>;
- pediatric vascular access, including intravenous access and intraosseous access;
- pain assessment and management, using age-appropriate pain scales; and
- pediatric weight assessment, equipment sizing, and medication dosing.<sup>48–51</sup>

### **Pediatric Clinical Care Within EMS: Pediatric Assessment**

Critical illness and injury do not always manifest in children in the same way as they do in adults. EMS agencies should ensure that providers have access to tools that can help them recognize critically ill or injured pediatric patients. Structured pediatric assessment tools, such as the Pediatric Assessment Triangle (PAT),<sup>47–49</sup> which is taught in the PEPP course,<sup>44</sup> allow EMS providers to develop a standardized approach to pediatric assessment. Evidence has shown that the PAT is a proven triage tool for EMS and has become a foundation for rapid pediatric assessment.<sup>46,49–51</sup> Such assessment tools have been incorporated into most standardized life support courses in the United States, including Pediatric Advanced Life Support, Advanced Pediatric Life Support, and the Emergency Nursing Pediatric Course.<sup>43–46</sup> The PAT includes an observational assessment of a child's respiratory status, circulatory status, and mental status and, when paired with measurement of a child's vital signs, can help

**TABLE 2** Responsibilities of an EMS PECC

Recommended Qualifications	Responsibilities
A clinical provider (physician, nurse, physician assistant, or nurse practitioner) with experience in EMS medicine and who works in an ED with active clinical practice in pediatric emergency medicine or a paramedic with some experience in pediatric prehospital or pediatric emergency medicine	Education
Strong interest in and desire to improve pediatric emergency care within the EMS system	To enhance pediatric proficiency for all EMS providers by facilitating both initial and continuing pediatric education for all providers
Experience in emergency medical care of children as demonstrated by training, clinical experience, and/or focused continuing education	To verify and promote EMS provider competency in providing pediatric emergency care through periodic training and evaluation of both cognitive and psychomotor competencies
Maintenance of competency in pediatric emergency care	To provide resuscitation skills training that includes concepts related to both trauma and medical care for neonates through adolescents
Provider may already be working within the EMS system	To promote opportunities for additional pediatric emergency care education and advancement within the EMS organization including, where available, collaboration with academic institutions
	Clinical care
	To actively provide pediatric-based input in the development and revision of EMS protocols
	To assess compliance with pediatric emergency care protocols and policies
	To observe and measure the quality of pediatric emergency care
	To equip the EMS agency to care for all children through the availability of pediatric-sized equipment and supplies, including medications required to treat common conditions in children
	To integrate pediatric needs into EMS disaster and emergency preparedness plans
	To serve as a liaison between hospitals, the local community, and EMS to establish local destination determination guidelines that ensure that pediatric patients are transported to appropriate regional facilities on the basis of the patient's clinical needs
	Research and QI
	To oversee pediatric QI, patient safety, injury and illness prevention, and clinical care initiatives
	To identify potential sources of funding for pediatric EMS research at local, state, or federal levels
	To integrate pediatric-specific quality metrics into the EMS agency that are either based on the national EMS Compass Initiative or are evidence based
	To establish a mechanism for electronic data collection that captures pediatric-relevant information in accordance with the most recent version of the NEMSIS data dictionary
	To analyze system efficacy and cost-effectiveness with respect to pediatric patient outcomes
	To identify local pediatric public health and operational issues in need of scientific evaluation and provide leadership to develop pediatric EMS research

a provider rapidly identify a child with significant illness or injury.<sup>47-49</sup>

The PEPP course and textbook is an additional EMS resource for pediatric assessment of abnormal respiratory and circulatory status and includes evaluating a child's lung sounds and work of breathing, noting the oxygen concentration and route of delivery required to improve oxygenation, and signs of perfusion such as skin color and capillary refill time.<sup>44</sup> Assessment of mental status can be achieved by

using the "alert-verbal-pain-unresponsive" (also known as AVPU) scale or the Glasgow Coma Scale.<sup>44</sup>

Age-related changes in ranges of normal pediatric vital signs can add to the challenges EMS providers face in recognition of critically ill or injured children.<sup>15</sup> Initial and ongoing assessment and documentation of pediatric vital signs include evaluation of respiratory rate, heart rate, blood pressure, temperature, pulse oximetry, mental status, weight,

and pain.<sup>43-49</sup> Current weight assessment tools in EMS include length-based tape<sup>52</sup> and age-based weight applications standardized in kilograms.<sup>45,50-52</sup> Pain assessment with age-appropriate tools and documentation before and after medication administration is consistent with evidence-based guidelines and defined EMS Compass quality metrics.<sup>53,54</sup> Understanding and recognizing critical departures from normal values can guide providers in detecting unstable

children early.<sup>15</sup> Processes for identifying abnormal vital signs and reporting them to receiving facilities as part of prearrival notification can enhance patient care and should be incorporated into EMS-based policies and clinical protocols.

In addition to these vital assessment findings, pediatric readiness also includes developing processes to include training on the recognition of child sex trafficking and interventions in cases of suspected child physical and/or sexual abuse and/or neglect.<sup>5,55</sup> Such processes should be incorporated into each EMS agency's pediatric-specific policies and protocols.

## QI AND PERFORMANCE IMPROVEMENT

In 2006, the federal EMSC program established performance measures to evaluate the status of pediatric emergency care capabilities in each state and territory. The performance measures included benchmarks for EMS access to direct and indirect pediatric-specific medical oversight and suggested pediatric equipment guidelines for ground ambulances. This document also recommended hospital benchmarks to establish standardized systems for identifying facilities that are equipped to stabilize and manage children with medical or traumatic emergencies and to establish interfacility transfer guidelines and agreements among hospitals.<sup>39</sup>

A 2013 assessment of the EMSC performance measures revealed that approximately 90% of basic life support (BLS) and Advanced Life Support (ALS) agencies have direct pediatric-specific medical oversight. Indirect medical oversight, provided as written pediatric protocols, was available to 72% of BLS and 94% of ALS EMS agencies. In addition, both BLS and ALS agencies carried more than 90% of the nationally recommended pediatric equipment.<sup>39</sup>

After this assessment, the EMSC program worked with the National EMS for Children Data Analysis Resource Center to develop the next generation of "EMS for Children" performance measures, which were implemented for assessment in 2017<sup>39</sup>:

- submission of National Emergency Medical Services Information System (NEMSIS)-compliant version 3 data,
- pediatric emergency care coordination at the EMS agency level, and
- evaluation of psychomotor competencies using pediatric equipment.

## PEDIATRIC-SPECIFIC ELEMENTS OF EMS QI

EMS QI involves the continuous monitoring of EMS system performance by using measures to identify opportunities for improving patient care. Such improvements can include changes in policies, addition or revision of clinical protocols, and ensuring access to appropriate resources and health care facilities.

Pediatric EMS QI includes several important elements, starting with the integration of pediatric-relevant content into prearrival dispatch instructions. Other components are the inclusion of pediatric data elements into prehospital patient care charts and data-reporting technology and collaboration with pediatric content-matter experts in off-line protocol development. Of critical importance are the development of relationships and a communication process between EMS and hospitals to facilitate the exchange of QI information including patient outcomes and case reviews and to include both EMS and hospitals in system data analysis.<sup>5,56</sup> The EIIC is spearheading a QI collaborative to assist state programs in accelerating their progress in improving the pediatric readiness of EDs through

new interventions. The EIIC hopes to demonstrate how leveraging QI science and the expertise of multiple professional societies and federal organizations can improve and transform health care outcomes for children in the United States.<sup>57</sup> Evaluation of EMS as part of the trauma QI program is a requirement for trauma centers by state designation, the American College of Surgeons verification process, or both. Integration of prehospital care and children's hospital transport services in the QI process is also an essential component of the American College of Surgeons Optimal Resources for Children's Surgical Care Verification Program.<sup>58</sup>

Pediatric-specific EMS QI programs should consider the following clinical areas for inclusion in both concurrent reporting and peer review with medical oversight and in a written plan that incorporates quality metrics that use NEMSIS-based data elements:

- neonatal assessment, resuscitation, and transport;
- respiratory distress and failure, including airway management;
- cardiovascular assessment and management;
- trauma, including burns and head injury;
- child abuse and neglect;
- pain assessment and management;
- hypoglycemia and hyperglycemia assessment and management;
- seizure assessment and management;
- environmental exposure hypothermia and hyperthermia; and
- toxicology assessment and management.

In 2014, NASEMSO launched an initiative known as EMS Compass. This initiative was funded through a cooperative agreement with the National Highway Traffic Safety

Administration with the focused goal of helping EMS systems (local, regional, and state) measure EMS care delivery and improve the quality of care at all 3 levels.<sup>54</sup> The quality metrics proposed by this program are linked to NEMSIS data variables to allow individual EMS agencies to assess quality and benchmark their care against other EMS agencies. As pediatric-relevant quality metrics are developed through EMS Compass, it is important to integrate them into local QI processes at the EMS agency level. The first pediatric-specific quality metrics focus on pediatric respiratory assessment, the administration of  $\beta$ -agonists for asthma, and the documentation of weight in kilograms with the use of various methods and applications, such as length-based tape. To ensure sustainability of the initial work of the EMS Compass initiative, the Joint National Emergency Medical Services Leadership Forum is working with the National Highway Traffic Safety Administration to create the National EMS Quality Alliance.<sup>59</sup>

## **POLICIES, PROCEDURES, AND PROTOCOLS**

Use of prehospital guidelines will assist EMS entities in achieving recommendations from the IOM that “EMS systems should implement evidence-based approaches to reduce errors in emergency and trauma care for children.”<sup>25</sup> Integration of these guidelines into operational practice requires the involvement of EMS medical directors and administrators, EMS educators, state health entities, emergency physicians, pediatricians, and nurses who are involved in the prehospital care of children.<sup>5,36,56</sup>

### **Pediatric Refusals**

Refusal of medical aid is a challenging element of EMS care for patients of any age and can be especially difficult when the refusal of aid involves pediatric patients. A NAEMSP and ACEP joint position statement

recommends that each EMS agency and system include key elements in their policies surrounding refusal of medical aid and that such policies specifically address the issue of nontransport of minors. It also recommends that nontransport occur only in the presence of online medical direction or detailed off-line protocols.<sup>60</sup> These specific guidelines are useful tools to help EMS systems prepare for the special needs of their pediatric population.

### **Existing Guidelines for Policies, Procedures, and Protocols**

Local or statewide EMS policies, procedures, and protocols lay the foundation for providing optimal care to ill and injured pediatric patients in the prehospital setting. The development of policies, procedures, and protocols that are evidence based, when possible, and inclusive of EMS system stakeholders at the local, regional, and state levels will make EMS care more effective for children.

Implementation of procedures that integrate QI activities and include education within the system has the potential to enhance care. Suggested prehospital pediatric policies, procedures, and protocols could include, but are not limited to, the following:

- appropriate level of care (BLS, ALS, or critical care);
- appropriate mode of transport (ground, rotor wing, or fixed wing);
- pediatric field triage and facility destination decision-making;
- refusal of medical aid (nontransport decision-making and documentation);
- prehospital determination of death and withholding of resuscitation;
- physician medical direction;
- dispatch prearrival instructions for children and families;
- children with special health care needs;

- child maltreatment, including recognition and criteria and processes for mandated reporting;
- evidence-based guidelines for clinical care and, when not available, vetted consensus-based guidelines, such as the NASEMSO Model EMS Clinical Guidelines<sup>61</sup>;
- development of new guidelines based on the pediatric community’s health care needs by using rigorous methods for guideline development;
- children and disaster management planning<sup>62-67</sup>; and
- key support services.

## **PATIENT AND MEDICATION SAFETY**

Unlike adults, for whom a “one-dose-fits-most” approach can be an effective method of dosing medications, dosage of medications for pediatric patients requires an accurate assessment of a child’s weight to avoid significant over- and underdosing.<sup>45,50-52</sup> Estimation of children’s weight by using a specific pediatric validated tool for weight and documenting the weight in kilograms in the EMS record can enhance safety.<sup>45,50-52</sup> Medication dosages are based on weight in kilograms, and adjuncts, such as smartphone applications that provide decision support for precalculated doses, can minimize dosing errors.<sup>50-52</sup> Online medical direction from a physician with pediatric expertise can provide important guidance when EMS personnel have reached the limit of what is specified in their agency’s protocols. A method to identify, prevent, and report medication errors, including a policy for timely reporting and tracking of adverse events, can enhance safety.<sup>68</sup> Including pediatric weight measurement tools, use of weight-based dosing tools, education in the use of those tools, and developing QI projects surrounding the accuracy of pediatric-based medication dosing

are necessary components of pediatric readiness that should be incorporated in the activities of each EMS agency.<sup>45,50–52,68–70</sup>

### **Patient- and Family-Centered Care in EMS**

Policies and/or protocols that promote family presence, participation in care, and safe transport of children have been recommended by the NAEMT.<sup>71</sup> Methods for the identification of the child receiving treatment and transport during a disaster that includes contact information for a responsible adult can enhance the ability of EMS systems and/or hospitals to reunify children with adult caregivers. Planning for the reunification of children and families is often an overlooked element of disaster planning but is an important consideration in disaster response plans for both EMS and receiving facilities.<sup>67,72</sup>

Part of providing patient- and family-centered care also involves using effective communication strategies and technology. In a qualitative study of EMS providers who participated in simulated resuscitations of pediatric patients, providers identified several strategies to promote patient- and family-centered care. These included providing emotional support to caregivers, maintaining a calm demeanor, empowering families to feel involved, designating a person to narrate and preemptively describe interventions in lay terms, summarizing between interventions, allowing a line of sight between the caregiver and child, and allowing the bystander the opportunity to return if temporarily removed for interfering with patient care.<sup>72</sup>

The diversity of languages that EMS providers encounter continues to grow, and methods for accessing language services can enhance the ability of EMS personnel to communicate with

non-English-speaking patients and family members. Organizations such as the NAEMT have recommended that EMS agencies adopt procedures to ensure effective communication in culturally diverse communities.<sup>71</sup>

Policies on advanced directives for withholding or terminating prehospital resuscitation efforts in children are also an important consideration for local protocols and should be considered as part of an EMS agency's pediatric readiness activities. State protocols for the declaration of death in the field and termination of resuscitation vary widely and often differ between adults and children. For childhood victims of out-of-hospital cardiac arrest attributable to blunt trauma, there is evidence that children and adults have similar outcomes, although the current recommendations for termination of resuscitation in children are more conservative, recommending at least 30 minutes of resuscitation efforts compared with 15 minutes in adults. The recommendations in children also advocate for a family-centered approach under guidance from medical control, especially in remote areas that are far from a hospital.<sup>73–77</sup>

Guidance for prehospital providers on how to disclose that a child is dead of any cause, next steps in the care of the family, and prevention of secondary trauma in themselves are all challenges of encountering pediatric death in the field.<sup>75</sup>

### **Pediatric Safe Transport**

Safe transport for children has been a significant problem that is now being recognized. Given the unique features of children, including their smaller size and different anatomic proportions, the National Highway Traffic Safety Administration published guidelines for the safe

transport of children in ground ambulances, including specific guidance regarding requirements for pediatric-passenger restraint.<sup>78</sup> Previously, there were no federal standards or protocols for the best method of pediatric transport in ambulances. It is estimated that up to 1000 ambulance crashes involve pediatric patients per year, with approximately 4 fatalities occurring per year.<sup>79</sup> In addition, in a collision at 35 mph, an unrestrained 15-kg child is exposed to the same forces as in falling from a fourth-story window.<sup>79</sup> The NASEMSO released interim guidance in 2017 on the safe transport of children by EMS, and this organization specifically highlighted the need for further research to establish a Society of Automotive Engineers standard for pediatric restraint recommendations through crash testing of different types of equipment.<sup>80</sup> The interim guidance emphasized that safe transport for children should be considered standard of care equivalent to EMS airway, breathing, and circulation maintenance. The guidance strongly states that all EMS agencies should have pediatric safe transport policies and procedures for evidence-based and appropriately sized and positioned child-restraint systems. Children should not be transported in ambulances unrestrained (eg, held in laps and/or arms).<sup>80</sup>

### **Children With Special Health Care Needs**

Children with special health care needs are defined as “children who have or are at increased risk for a chronic physical, developmental, behavioral, or emotional condition and who also require health and related services of a type or amount beyond that required by children generally.”<sup>81</sup> Given that the number of children with special health care needs or dependence on health technologies has been steadily increasing, EMS systems have always



faced the need to provide quality prehospital care to children with special needs. A report from Utah found that these children were more likely to receive ALS and prehospital clinical interventions than children who are not technology dependent.<sup>82</sup> Up to 78% of ED encounters for children with special health care needs are also more likely to use EMS for interfacility transport.<sup>83</sup>

It is important to have access to key information to care for patients, especially those with special needs. Professional organizations such as the ACEP and AAP have recommended that families maintain an emergency information form (EIF).<sup>84</sup> Paper and electronic versions of the form are available from both organizations' Web sites. The development of electronic, remotely accessible health-information exchanges available to EMS providers in real time may someday reduce the need for paper copies of EIFs. Until then, EMS-applicable patient-specific care plans, EIFs, and off-line guidelines are each important elements of pediatric prehospital readiness programs. In addition to key information and medical history for this population, it is equally important to ensure specific training for pediatric technology such as ventilators, tracheostomies, and gastrostomy tubes.<sup>84</sup>

### **Health Disparities in Pediatric Prehospital Care**

Significant health disparities exist in pediatric prehospital care. EMS personnel are often the initial contact for many children who do not have insurance or access to emergency care. EMS serves as a health care safety net for this population. Rural areas are a setting in which EMS can act as a primary source of health care. Rural EMS systems face operational and clinical challenges in meeting the prehospital needs of their communities and more specifically the vulnerable population of children.

These challenges include geographic isolation, lack of qualified physicians to serve as medical directors, insufficient staffing of EMS providers, substandard road conditions, inadequate landing areas for air transport, and radio communication dead zones.<sup>85-87</sup>

In addition, the health disparity gap is widened for pediatric minority populations such as African American, American Indian, Alaskan native, and Hispanic children. Children of minority populations experience myriad disparities in prehospital care, medical care, access to health care, and use of health care services. Some of these health disparities include suboptimal health status; higher levels of obesity, asthma, and behavioral problems; lack of mental health services and medical insurance; transportation barriers to care; and increased frequency of ED visits. Language and cultural differences can lead to barriers to care in the prehospital environment. African American children and children in urban residences are more likely to arrive at the ED by EMS.<sup>86,87</sup> In a recently published abstract, pediatric patients with severe asthma who were transported by regional EMS agencies were predominantly older, of male sex, and African American.<sup>88</sup> In addition, in a recent study assessing statewide EMS management of pediatric asthma, 49% of the patients were African American, and there was a geographic disparity of EMS asthma encounters involving African American children living in rural areas.<sup>89</sup> American Indian and Alaskan native children are disproportionately burdened by injuries and diseases and often live in rural areas geographically far from hospitals.<sup>90-92</sup> A study focusing on prehospital care for rural American Indian children concluded that Indian Health Service EMS agencies do not have the infrastructure to treat pediatric patients during day-to-day

operations as well as disaster situations. Indian Health Service agencies were markedly overwhelmed and unable to provide pediatric continued medical education.<sup>93</sup> Mobile integrated health (MIH) and community paramedicine is a way for EMS systems to provide patient-centered and integrated health care with social services, subsequently improving the overall health of the community. MIH programs improve and enhance care by sending EMS personnel to patients' home to aide in chronic disease management (eg, asthma) and education, follow-up, and rehabilitation care as well as preventive care.<sup>94</sup> A PECC can serve as a pediatric liaison within an EMS MIH system to provide much needed health care to children in minority and rural populations where they live. Integration of PECCs within EMS systems could help to overcome health care barriers and obstacles for these patients and serve as a possible solution to help coordinate pediatric emergency care for these particularly vulnerable populations.

### **Mental Health and Pediatric Prehospital Care**

Mental health disorders are one of the most common diseases of childhood. Children with mental health disorders are at increased risk for substance use, residing in juvenile detention, and suicide and homicide. There continues to be an increasing number of children with mental health disorders seen in the ED and a decreasing number of available mental health facilities.<sup>95</sup> As a result, there is growing evidence revealing increased use of EMS services for children with mental health disorders to obtain care related to these disorders.<sup>95</sup> In a study of a statewide EMS system, a large proportion of pediatric patients with behavior-related disorders within mental health disorders was associated with an increase in EMS resource use because of limited behavioral

health infrastructure.<sup>96</sup> Interventions are key to training EMS providers on the recognition and management of pediatric mental health disorders.

## INTERACTION WITH SYSTEMS OF CARE

### Trauma

Trauma accounts for approximately 20% of pediatric EMS encounters.<sup>97</sup>

The care of the pediatric trauma patient in the prehospital setting involves rapid assessment of hemodynamic status; focused and measured assessment and management of airway patency, oxygenation, and ventilation; evaluation of pain and provision of analgesia; consideration of cervical spine injury and provision of appropriate spinal motion restriction; and making appropriate destination determination decisions.<sup>98-100</sup>

Verification or state designation of a trauma center does not mean that the facility has also achieved a high degree of overall pediatric readiness.<sup>101</sup> In regions where both trauma center and pediatric facility designation programs exist, a trauma center does not equate to pediatric readiness, further highlighting the potential benefits of regionalizing pediatric care.<sup>101</sup> Pediatric readiness in EMS systems will therefore need to include an assessment of appropriate destination facilities with respect to pediatric-focused protocols, equipment, and training to optimally manage the pediatric trauma patient.<sup>5</sup> Most children's hospitals that are also pediatric trauma centers will have the requisite resources for the care of the injured child, and EMS providers who use a destination determination triage tool such as the one developed by the Centers for Disease Control and Prevention will triage children to a pediatric trauma center if one is available.<sup>102</sup> Coordination with the regional trauma system as well as any pediatric facility verification program, where it exists, will be critical.<sup>102,103</sup>

## Mass Casualties and Disasters

Few position statements regarding mass casualty events address infants and children. The NAEMSP has position statements on both the role of EMS in disaster response and mass gathering medical care,<sup>64,65</sup> with neither document specifically addressing children. In a survey of EMS agencies, only 13% had pediatric-specific mass casualty incident plans.<sup>66</sup> Several organizations have worked or are now working to develop resources for EMS agencies to incorporate children into their disaster preparedness plans, including educational resources.<sup>67-69</sup> These resources can be leveraged by EMS agencies to prepare for the care of children and families during disasters as part of their prehospital pediatric readiness activities.

## EQUIPMENT, SUPPLIES, AND MEDICATIONS

Even with the best leadership and well-trained providers, without appropriate equipment, optimal care cannot be provided to pediatric patients in the field. The policy statement "Equipment for Ground Ambulances" addresses this issue and serves as a standard for the minimum equipment and supplies needed for both ALS and BLS ground ambulances in the United States.<sup>104</sup>

## CONCLUSIONS

Numerous publications have indicated the need for improved integrated pediatric care within the prehospital setting.<sup>4,5,25,26,36</sup> EMS systems can adopt policies, practices, and procedures that guide provider prehospital pediatric emergency care. Pediatric-specific components that will aid in improving care include pediatric-specific education, equipment, QI, data collection and management, and research. Designation of a PECC, EMS provider access to pediatric direct and indirect medical direction, and safe transport

of pediatric patients are particularly important components of a well-integrated pediatric prehospital care system.

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**ABBREVIATIONS**

AAP: American Academy of Pediatrics  
ACEP: American College of Emergency Physicians  
ALS: Advanced Life Support  
BLS: basic life support  
ED: emergency department  
EIF: emergency information form  
EHC: Emergency Medical Services for Children Innovation and Improvement Center  
EMS: emergency medical services  
EMSC: Emergency Medical Services for Children  
IOM: Institute of Medicine  
MIH: mobile integrated health

NAEMSP: National Association of EMS Physicians  
NAEMT: National Association of Emergency Medical Technicians  
NAEMSO: National Association of State EMS Officials  
NEMSIS: National Emergency Medical Services Information System  
PAT: Pediatric Assessment Triangle  
PECC: pediatric emergency care coordinator  
PEPP: Pediatric Education for Prehospital Professionals  
QI: quality improvement

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