Quality Improvement in Emergency Medical Services for Children (EMSC)

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INTRODUCTION

The mission of the Health Resources and Services Administration's (HRSA) Emergency Medical Services for Children (EMSC) Program is to expand and improve emergency medical services for children who need treatment for trauma or critical illness, with a guiding vision to improve survival and health outcomes among children and adolescents who experience medical emergencies or traumatic injuries. This mission extends across the nation to wherever children live, attend school, and play. For over 30 years, EMSC has worked to ensure that all children receive optimal and effective pediatric emergency care through funding various activities to identify and spread best practices in pediatric emergency care systems.

EMSC is employing Quality Improvement (QI) methods to spread pediatric readiness improvements within hospital and pre-hospital care and to document the impact of that readiness on the performance of the EMS system, the delivery of optimal clinical care, and the resulting health outcome for children treated.

The purpose of this paper is to describe for EMSC grantees and their partners how QI is an effective method for testing and spreading the delivery of optimal, effective pediatric emergency medicine. This paper will provide a brief overview of the QI approach, explore QI measures and the potential approaches to measurement in emergency care, discuss how EMSC actively applies QI to advance its mission, highlight successful examples of QI as applied to improving pediatric emergency care, and discuss opportunities for EMSC stakeholders to actively engage in existing and future QI efforts.

Brief Overview of the QI Approach

QI is a process in which stakeholders undertake systematic and continuous actions intended to lead to measurable improvements in healthcare services (processes) and health status (outcomes) (Health Resources and Services Administration, 2011). The movement reached prominence in the late 1990s and early 2000s through initiatives from the Institutes of Medicine, the Joint Commission, the National Quality Forum, and others. Essential elements of QI include restructuring systems of healthcare delivery, incentivizing competition between providers and organizations, identifying evidence-based processes to reduce unwanted variations, value-based care, and a strong emphasis on transparent data monitoring and evaluation (Marjoua & Bozic, 2012).

In 2011, HRSA published *Quality Improvement*, which included guidance on using QI within HRSA-funded programs. According to HRSA, there are four key principles of QI shown in **Figure 1** below.

Four Key Principles of Quality Improvement

1. QI work is **work on systems and processes**, taking the resources (inputs), activities (processes), and results (outputs or outcomes) of a healthcare system into account.
2. The measure of quality is the extent to which a **system meets patient needs and expectations**.
3. A **team approach is essential** when systems are complex, involve multiple disciplines and work areas, need creative solutions, and when effective solutions require commitment and buy-in from multiple stakeholders.
4. **Data is the touchstone of the work**, as a baseline, as a method of monitoring implementation, as a method of measuring improvements, and allowing for comparisons between sites, locations, patient groups, processes, and practices.

Figure 1. Four key principles of QI

QI collaboratives, where a team of stakeholders from various healthcare departments, hospitals, or organizations join together for a fixed period of time to address a specific aspect of providing care, are becoming more common. Research has found that this approach is promising, with reported improvements in both processes and outcomes related to healthcare.

One model of QI is the Breakthrough Series by the Institute for Healthcare Improvement (IHI), where QI collaboratives pass through a series of Plan-Do-Study-Act cycles to improve upon a particular area or issue in healthcare that has been identified as a focus (Institute for Healthcare Improvement, 2003). The Breakthrough model relies on a collaborative effort of subject matter, application, and clinical experts who help guide participating healthcare organizations and teams through a cyclical series of learning sessions, action periods, measurement and evaluation, and finally, summative publications (Institute for Healthcare Improvement, 2003). While many QI collaboratives are based on this model, the creation of a population registry of the patients receiving care is an additional element in collaboratives focused on pediatric health (Lannon & Peterson, 2013).

Collaborative Improvement and Innovation Networks (CoIINs) are another successful model of QI work implemented in maternal and child health. The Maternal and Child Health Bureau (MCHB) has conducted several successful CoIINs, including the Home Visiting, Infant Mortality, Early Childhood Comprehensive Systems Impact (ECCS Impact), Adolescent and Young Adult

Health (AYAH), and the Children's Healthy Weight CoIINs. Core elements of the CoIIN model include a focus on common aims, the development of common strategies through research and strategic planning, access to and use of "real time" data, shared measures to track progress, and common leveraging of resources (Ghandour et al., 2017). A process evaluation of the Infant Mortality CoIIN found that this model is a promising approach to strengthening partnerships among stakeholders at multiple levels and facilitates data sharing and peer-to-peer learning (Ghandour et al., 2017). The adoption of CoIINs demonstrates how the pediatric health space is moving toward increased use of QI collaboratives.

Quality Improvement Measures

Regardless of the model chosen, using data for decision-making is an essential element of QI. There are three types of QI measures: Structural, Process, and Outcome, as described in **Figure 2** below.

Three Types of Quality Improvement Measures

Structural Measures: The resources and the capacity of a healthcare system to provide care (e.g., number of pediatric emergency medicine physicians, number of pediatric mental health beds).

Process Measures: The actions that a healthcare system takes to maintain or improve health (e.g., percentage of pediatric patients who are weighed in kilograms, percentage of pediatric patients with respiratory distress that receive inhaled corticosteroids).

Outcome Measures: The impact on the health status of a patient (e.g., 30-day survival to discharge for pediatric patients who experienced cardiac arrest).

Agency for Healthcare Research and Quality, 2017; Donabedian, 1966; El Sayed, 2012

Figure 2. Three types of QI measures

Domains and criteria for quality measures. In developing measures, the six domains of healthcare quality, defined initially by the Institute of Medicine in 2001 (now the National Academy of Medicine), should be one guide. These domains, shown in **Figure 3** below, are tested indicators of quality and can help ensure that measures address the needed elements for QI (Institute of Medicine & Committee on Quality of Healthcare in America, 2001).

Six Domains of Healthcare Quality

1. **Safe**: Avoiding injuries to patients.
2. **Effective**: Providing services based on scientific knowledge to those who will benefit.
3. **Patient-Centered**: Being respectful of patient preferences, needs, and values, and ensuring that these needs and values guide medical decisions.
4. **Timely**: Reducing waits and harmful delays.
5. **Efficient**: Avoiding waste of equipment, supplies, ideas, and energy.
6. **Equitable**: Providing care that does not vary in quality because of personal characteristics.

Figure 3. Six domains of healthcare quality

The National Quality Forum defines five criteria for determining what makes a good measure (National Quality Forum, n.d.), shown in **Figure 4** below.

Five Criteria for a Good Measure

1. The measure's impact on health is evidence-based, and the measure is **important** to making a change in healthcare quality or outcomes.
2. The measure produces **scientifically reliable and valid** results about quality of healthcare.
3. The collection of the data for the measure is **feasible** or the data is readily available in existing data sets.
4. The measure is **usable** by potential audiences, with transparent and credible information on how it can or will be used to further quality care.
5. The measure is superior to or can be **harmonized** with related or competing measures already in use.

Figure 4. Five criteria for a good measure

The next section describes how QI, and the relevant measures, are applied in the emergency care setting.

Potential Approaches to Measurement for Emergency Care

Many medical centers have utilized QI methodology for years to improve various components of the emergency care they provide to pediatric patients (Lannon & Peterson, 2013; Macias, 2013). However, consistent and widely agreed-upon measures in both the pre-hospital and hospital space are still developing. In the 2018 update of the American Academy of Pediatrics *Guidelines for Care of Children in the Emergency Department,* it is stated that QI plans should include pediatric-specific indicators, pediatric clinical-competency evaluations, and mechanisms to monitor and improve professional performance and clinical competencies (Remick et al., 2018). However, a recent review of 405 potential measures for pediatric emergency care found that more than half were measures of effectiveness and a sixth were measures of safety. Less than 10 percent of the measures addressed patient centeredness or equity (Alessandrini et al., 2011).

Existing Data Sources and Gaps

There are many existing data sources that can be used for QI measurement in emergency medical care. Some of these sources include:

- Vital statistics data, including birth and mortality data, maintained by the Centers for Disease Control and Prevention.
- National Emergency Medical Services Information System (NEMSIS), database of patient care information resulting from emergency 9-1-1 calls for assistance maintained by the National Highway Traffic Safety Administration's (NHTSA) Office of Emergency Medical Services (EMS).
- Healthcare Cost and Utilization Project (HCUP), longitudinal hospital care data maintained by AHRQ.
- National Trauma Data Bank, an aggregation of U.S. trauma registry data maintained by the American College of Surgeons.
- Medicaid, trauma, and hospitalization data maintained by state or local hospital systems and departments of public health.

However, there are gaps in these data sources. For some national databases, finding

detailed data at the state, region, hospital, or hospital venue level may not be possible due to data restrictions and small sample sizes. Additionally, linkages based on research between the structural and process measures that reflect the actions undertaken by states, hospitals, and other QI stakeholders and the clinical measures contained in databases like HCUP and NEMSIS need to be developed. Other EMS-specific challenges include:

- Lack of uniformity in data collection.
- The broad range of conditions addressed by EMS (shock, trauma, mental health, cardiac arrest, respiratory distress, and others).
- The difficulty of directly linking health outcomes to pre-hospital care (El Sayed, 2012).

Ensuring quality in pediatric emergency care brings its own challenges, including communication issues with young children, unique physical and developmental characteristics of children, and the need for treatments and medication regimes tailored for children (Macias, 2013).

In the pre-hospital setting, the diverse array of EMS systems design, a smaller evidence base, and a lack of available data makes quality difficult to measure but stakeholders are developing innovative approaches such as focusing on high-impact clinical conditions and using disease- or condition-specific bundles of measures (NEMSAC, 2017, El Sayed, 2012).

In 2014 the National Association of State EMS Officials (NASEMSO), contracted by the NHTSA with co-funding from the HRSA EMSC Program, led the EMS Compass initiative to develop metrics for pre-hospital care (NEMSAC, 2017). This was a collaborative effort including a wide range of EMS stakeholders to develop initial pre-hospital measures. An initial set of more than 400 measures was submitted by the public, and the EMS Compass group compared those measures to existing data currently being collected by EMS systems to develop an initial list of candidate measures. These initial measures were released in 2016 after testing and validation in the field (National EMS Quality Alliance, 2018). The EMS Compass measures include indicators for hypoglycemia, medication error, pediatric respiratory distress, seizure, stroke, trauma, trauma pain, and vehicle operations safety.

In 2018, NHTSA continued its effort to support QI initiatives and funded the National EMS Quality Alliance (NEMSQA). The membership and stakeholders engaged in the NEMSQA are driving efforts for the continued development of EMS quality measures. Through these and other efforts, the evidence base for using QI in both pre-hospital and in-hospital emergency care continues to grow.

EMSC CONTRIBUTIONS THROUGH QI

Quality Improvement (QI) plays a vital role in the work of EMSC and its investments by ensuring the development, implementation, and evaluation of the most effective care for children in emergency care. EMSC makes investments in several areas with the overarching strategy to generate and spread evidence toward improving pediatric emergency care, as shown below.

How do EMSC Investments generate and spread evidence?

- **Pediatric Emergency Care Applied Research Network (PECARN)** is a multi-institutional network for pediatric emergency medicine research that establishes new evidence for optimal clinical care for children.
- **Targeted Issues grants** support innovative research in emergency settings to test and build the evidence base for optimal pediatric readiness and the delivery of emergency care.
- **State Partnership** grants spread improvements within state and local EMS systems, agencies and hospital emergency departments.
- **The EMSC Innovation and Improvement Center (EIIC)** translates evidence into applied system improvements and provides technical assistance and training to spread uptake of those best practices utilizing quality improvement science.
- **The EMSC Data Center** provides technical assistance in collection, analysis and use of quality measure data.

Every stakeholder in pediatric emergency care is needed to work toward continuous QI of the system: researchers who investigate best practice care; technical assistance providers who translate the research into actionable guidelines; state and local agencies who champion these guidelines and support providers to make necessary changes; and state and local emergency medicine providers, emergency medical services providers, and hospitals who apply that knowledge and feed health and process outcomes back to the research community. These relationships, and how they all contribute to the development and dissemination of knowledge, are shown in **Figure 5** below (based on Canadian Institutes of Health Research [CIHR] knowledge translation model in Sudsawad 2007).

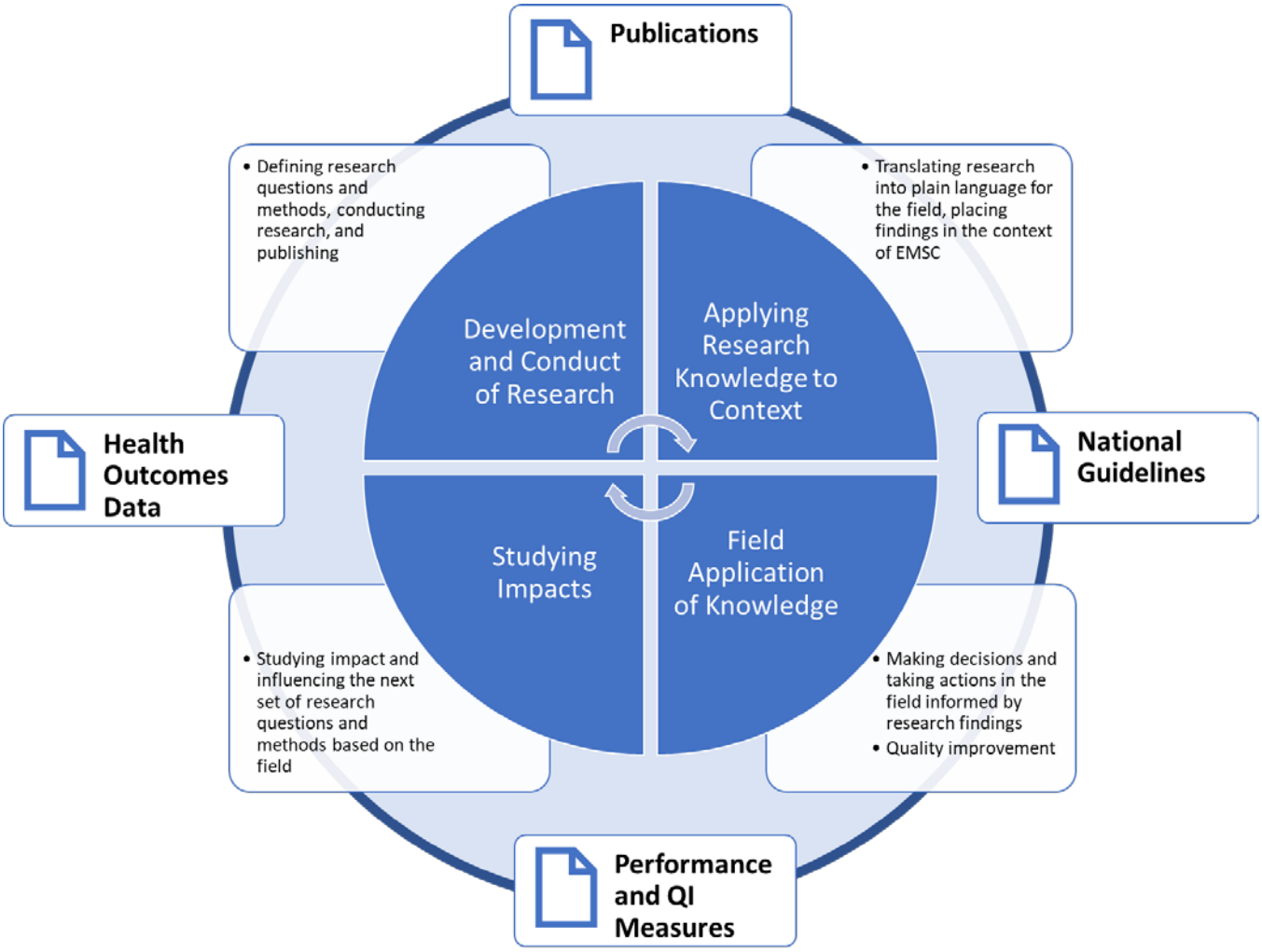


Figure 5. Cycle of knowledge translation and research

Specific Outcomes of EMSC-funded QI Activities

Through its investments, EMSC has supported important advancements in improving quality of care and health outcomes for children in the emergency care system. This summary, while not exhaustive, provides a look at QI activities and outcomes in traumatic brain injury (TBI), resuscitation, seizures, and anaphylaxis and cross-cutting areas.

Traumatic brain injury. Concussions and other head injuries are common childhood afflictions but the treatments for mild injury and serious injury are very different. Inappropriate treatment for either can lead to unnecessary poor health outcomes. QI initiatives have resulted in reduced use of Computed Tomography (CT) scans and better concussion management for pediatric patients.

Radiation from CT scans can be hazardous for children and has been proven to cause malignancies. QI tools, such as clinical scores, decision tools, and guidelines, can be used to ensure CT scans are used only when necessary (Macias & Sahouria, 2011). A seminal study in the use of CT in children with head injuries was supported by PECARN and a Targeted Issues (TI) grant and the guidelines from this study have become the standard in most trauma centers. In this study, scans and clinical results from more than 42,000 children were examined to develop a set of validated prediction rules to identify children at low risk of clinically important TBI who do not need to receive a CT scan (Kupperman et al., 2009). The application of these prediction rules in pediatric and general emergency departments has resulted in a modest and safe decrease in CT use for children at low risk of clinically important TBI without increasing the rate of missed injuries in multiple studies (Atabaki et al., 2017; Dayan et al., 2017). This study demonstrates that QI is an effective strategy for spreading change in clinical pediatric emergency care.

Resuscitation skills. Although these cases are serious, paramedics rarely encounter seriously ill or injured pediatric patients and do not get many chances to practice resuscitation skills with these patients. Paramedics from five EMS agencies in Michigan, funded by EMSC, participated in the Pediatric

Continuous QI Model Project where continuous paramedic education and patient simulation was provided to prevent skill atrophy. This proved to be a valid way to measure pediatric patient resuscitation skills and identify skills to be targeted in continuing education (Lammers, Byrwa, Fales & Hale, 2008). Another TI grant at the Children's National Medical Center successfully developed, tested, and disseminated a checklist designed to reduce errors in simulated pediatric trauma resuscitation (Carter, Waterhouse, Kovler, Fritzeen & Burd, 2013; Kelleher, Carter, Waterhouse, Parsons, Fritzeen & Burd, 2014).

Seizures and anaphylaxis. Two recent TI grants addressed the treatment of seizures and anaphylaxis. In the first, the Illinois EMSC program conducted a statewide ED QI collaborative looking at the adherence of emergency departments to practice guidelines for managing simple febrile seizure in pediatric patients. This study found that while guidelines for lumbar puncture were being followed, guidelines for laboratory workups were not (Carapetian et al., 2015). Similarly, in another study, the implementation of a bundled, multifaceted educational intervention for paramedics transporting children for anaphylaxis or seizures improved adherence to the updated evidence-based pediatric pre-hospital protocols (Marino et al., 2018).

Pediatric readiness. The EMSC Innovation and Improvement Center (EIIC) is a leader in EMSC QI collaboratives. Currently, the EIIC is leading the Pediatric Readiness Quality Collaborative (PRQC), a program to help state programs, including state partnership grantees and one State Partnership Regionalization of Care (SPROC) grantee, ensure that their hospitals have the appropriate resources and staff to provide effective emergency care for children. The goal of this program is to demonstrate how the use of QI science and local QI efforts targeting pediatric readiness can lead to improved outcomes for children. PRQC is working with sites that represent five percent of all pediatric ED visits in the United States. This QI collaborative employs a grassroots approach to pediatric recognition and focuses on the provider level, providing them with resources, education, and support needed to implement local QI efforts. Particular attention is paid to breaking down the barriers to becoming pediatric ready reported in past assessments: cost of training personnel, lack of QI efforts, and lack of resources. PRQC is made up of 20 teams of training sites, who will provide training and support, and affiliate sites, who with training will implement local QI efforts to foster pediatric readiness. Throughout its span, PRQC will conduct QI processes on four “intervention bundles” with clinical processes and policies that have theoretical benefit in improving health outcomes:

- Abnormal vital signs.
- Disaster planning.
- Inter-facility transfers.
- Weight in kilograms.

Facility recognition. The Facility Recognition Collaborative (FRC), led by the EIIC from July 2016 to December 2017, was a QI collaborative to help states in the development of Pediatric Medical Recognition Programs. Pediatric Medical Recognition Programs designate and verify hospitals that are trained, equipped, and ready to care for children with medical emergencies. In this project, state improvement teams benefited by interacting with QI specialists and experts in both pediatric readiness and facility recognition. Pediatric Medical Recognition Programs are associated with an increase in the pediatric readiness score, which is a measure of an emergency department's readiness to care for children in an emergency with the minimum policies, procedures, and supplies needed (Gausche-Hill et al., 2015; Snow, 2017). Beyond pediatric readiness, state teams received support in navigating state-specific political and fiscal constraints around starting a facility recognition program and in the development to assist with promoting facility recognition to hospital and state leadership.

The FRC resulted in four new state-level Pediatric Medical Recognition Programs, with five more in development. The infographic on the following page shows the spread of the FRC across the United States as participating states accelerate their progress in improving the pediatric readiness of emergency departments and developing programs to recognize emergency departments in each state that are ready to care for children with medical emergencies.

STRENGTHENING CAPACITY TO PROVIDE EMERGENCY MEDICAL CARE FOR CHILDREN

Pediatric Facility Recognition

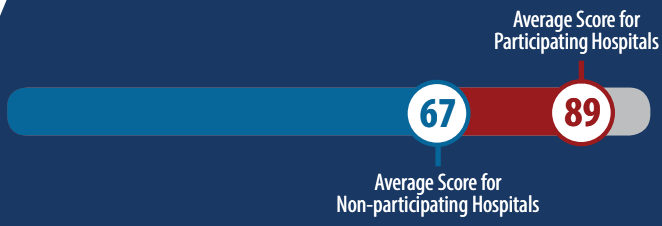
An Emergency Medical Services for Children Program Initiative

The initiative supports states in creating formal Pediatric Medical Recognition programs that ensure hospitals have:

- Appropriate protocols for treatment of children
- Guidelines for administration and coordination of pediatric care
- Pediatric patient safety protocols
- Pediatric-specific considerations in disaster preparedness plans
- Pediatric trained personnel (physicians, nurses and other staff)
- Pediatric-appropriate equipment, supplies and medications on hand
- Policies that ensure immediate transfer to pediatric facilities when medically necessary

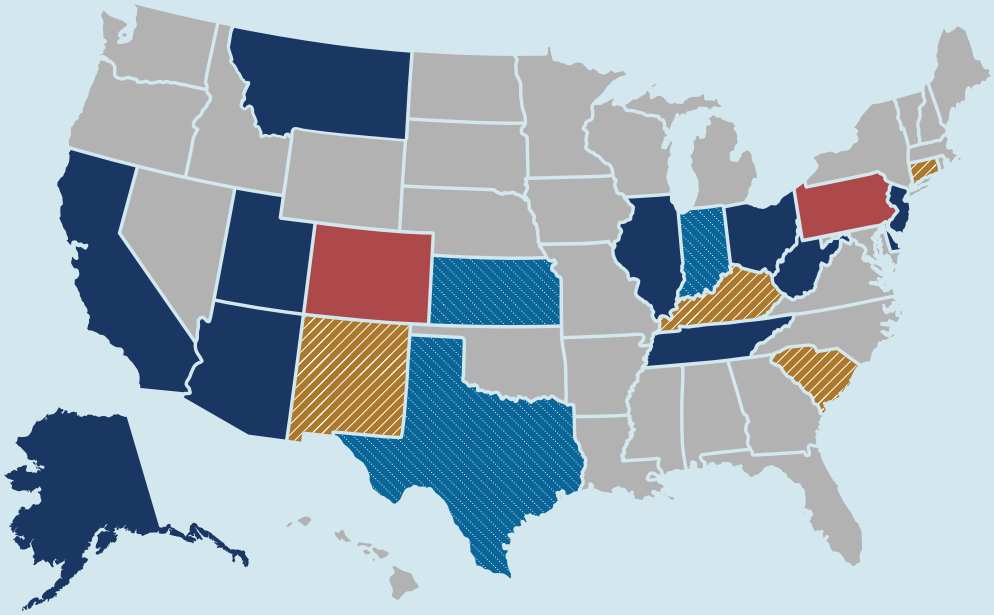
Pediatric Readiness Score

The Pediatric Readiness Score measures whether hospitals are likely to be ready to care for kids on a scale from 0 to 100. Hospital emergency departments participating in state-level pediatric medical recognition programs scored an 89 on average compared to an average score of 67 for non-participating hospitals.



Remick, K. et al. (2016). Pediatric readiness and facility verification. Annals of Emergency Medicine, 67(3): 320-328.e1. doi.org/10.1016/j.annemergmed.2015.07.500

The State of Pediatric Medical Recognition in the United States



KEY

- Established medical recognition programs
- New Medical Recognition Programs
- Medical Recognition Programs Pilots
- Medical Recognition Programs Coming Soon
- None

From 2006 to 2019, the number of states that established a pediatric medical recognition program has more than doubled from 5 to 13.

For more information, visit: https://emscimprovement.center/collaboratives/facility-recognition-collaborative/

CONCLUSION AND CALL TO ACTION

Every stakeholder in pediatric emergency care is needed to work toward continuous Quality Improvement (QI) of the system. EMSC grantees and their partners can participate in several ways, including joining QI collaboratives, performing investigator-initiated research to generate evidence, working toward developing and implementing performance measurement in their state, and disseminating evidence to all stakeholders and the broader field.

Participating in QI Collaboratives

Participating in QI collaboratives is a direct way to support QI both for an individual institute and for the field as a whole. EMSC-supported QI collaboratives, such as the Pediatric Readiness Quality Collaborative (PRQC) and the Prehospital Pediatric Emergency Care Coordinator Learning Collaborative (PECCLC), are currently underway, but future collaboratives are being planned on a variety of pediatric emergency medicine topics. Opportunities for state partners, hospitals, and hospital systems to participate in QI collaboratives will come from EMSC and the Maternal and Child Health Bureau, EIIC, and clinical research partners.

Integrating QI into EMSC Research Priorities

QI is increasingly integrated into the research priorities of EMSC investments. The Targeted Issues (TI) grants, focused on filling knowledge gaps in pediatric emergency research, have supported several successful QI projects over the past several years. Through these grants, EMSC has consistently laid the groundwork for practices to integrate pediatrics into emergency medicine system in both the pre-hospital and hospital world. Current QI-focused research TI projects include a web-based Pediatric Resuscitation Quality Self-Assessment Toolkit and a family-centered care (FCC) QI package at the Children's Hospital of Pennsylvania; a QI program focused on pediatric protocols and procedures for sepsis, respiratory distress, and trauma at the University of North Carolina, Chapel Hill; and a QI program examining drug dosing for pediatric patients at the Western Michigan University School of Medicine (EIIC 2016).

PECARN supports QI in multiple ways, including conducting direct research into quality of care, developing measures for quality of care, conducting comparative effectiveness research, and supporting knowledge translation through the dissemination of findings (Macias, 2013). The EMSC's Data Center also works within PECARN to conduct multi-center studies and serve as a central resource for network data including data collection and management, quality assurance, statistical analysis and coordination of selected PECARN activities. The Data Center also has a vital role in knowledge transfer, supporting QI dissemination to the larger field.

To support this work, researchers can continue QI within their institutions and hospitals; promote studies that speak to improving processes and care for children; continue partnerships

with specialties and subspecialties to consider emergency room data and post-visit outcomes together; and ensure that the research gets to practice and to patients.

Disseminating Evidence to Stakeholders and the Broader Field

It is vital for EMSC-funded initiatives to be able to demonstrate their effectiveness in improving the quality of care for children and youth to the broader field. Being able to demonstrate stronger EMSC systems, improved clinical care, and positive impacts on children's health outcomes engages clinical providers and helps secure buy-in from state EMS authorities, clinical providers, and other EMSC stakeholders. Disseminating this evidence to EMS and emergency care system stakeholders and the larger field of emergency medicine can take several forms, including encouraging hospital medical and administrative staff to participate in education on QI, circulating research findings, and communicating support for QI methods and projects.

Conclusion

EMSC and its investments can be leaders in employing QI methodologies to improve quality of care for children and build the evidence base for pediatric readiness in hospital and pre-hospital care. Being able to demonstrate improvements in system performance, delivery of optimal clinical care, and the resulting health outcomes after treatment can help ensure ongoing buy-in to this vital work. Finally, and most important, improving quality of care for children fulfills the ultimate mission of EMSC: the reduction in mortality or morbidity of children resulting from physical trauma and medical emergencies.

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