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QUALITY MANAGEMENT OF PREHOSPITAL PEDIATRIC RESPIRATORY DISTRESS AND AIRWAY PROGRAMS: AN NAEMSP POSITION STATEMENT AND RESOURCE DOCUMENT

Maria Mandt , Matthew Harris, John Lyng , Brian Moore , Toni Gross, Marianne Gausche-Hill , and J. Joelle Donofrio-Odmann 

ABSTRACT

The unique challenges of pediatric respiratory and airway emergencies require the development and maintenance of a prehospital quality management program that includes pediatric-focused medical oversight and clinical care expertise, data collection, operational considerations, focused education, and clinician competency evaluation. NAEMSP recommends:

- Medical director oversight must include a focus on pediatric airway and respiratory management and integrate pediatric-specific elements in guideline development, competency assessment, and skills maintenance efforts.

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- EMS agencies are encouraged to collaborate with medical professionals who have expertise in pediatric emergency care to provide support for quality management initiatives in pediatric respiratory distress and airway management.
- EMS agencies should define quality indicators for pediatric-specific elements in respiratory distress and airway management and benchmark performance based on regional and national standards.
- EMS agencies should implement both quantitative (objective) and qualitative (subjective) measures of performance to assess competency in pediatric respiratory distress and airway management.
- EMS agencies choosing to incorporate pediatric endotracheal intubation or supraglottic airway insertion must use pediatric-specific quality management benchmarks and perform focused review of advanced airway management.

Key words: pediatric airway management; pediatric respiratory emergencies; pediatric intubation; quality improvement; quality management

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INTRODUCTION

Respiratory distress is the most common reason for EMS clinician contact with pediatric patients, making delivery of appropriate respiratory and airway management a key to quality care in this population (1). While an increasing number of agencies include quality management in their operational initiatives, including a pediatric-focus to quality management can help ensure that the care provided consistently maximizes both patient outcome and patient safety. The 2018 NAEMSP position statement, *Defining Quality in EMS*, and its accompanying resource document provide clear objectives upon which to center the pediatric airway and respiratory quality management efforts detailed here (2). This document is intended to serve as a tool that can be used by medical directors, quality management teams, pediatric advisory committees, and pediatric emergency care coordinators (PECCs) to assist in the incorporation of orderly, actionable items into agency- and system-level quality management programs.

The Need for Quality Management in Pediatric Respiratory and Airway Emergencies

Historical methods of system “improvement” in EMS have relied upon top-down dictums to EMS clinicians, isolated education events, and reliance upon field practice to maintain skill proficiency for clinicians (3). The infrequency of pediatric encounters in EMS, coupled with the potentially catastrophic outcomes associated with error, prohibit our continued reliance upon these ineffectual and antiquated methods. As such, failure within systems to develop pediatric-focused quality management programs would likely stagnate a decrease in the complication rates currently reported during prehospital pediatric airway and respiratory distress management (4).

Challenges to Effective Pediatric Respiratory and Airway Quality Management. Multiple challenges to implementation exist when considering effective quality management strategies for pediatric respiratory and airway emergencies: the high-risk/low-frequency of such events, difficulty in maintaining skill competency, wide variations in clinical practice and equipment availability, and broad inconsistencies in documentation.

Pediatric transports represent only 10% of EMS episodes of care, making any pediatric encounter a low-frequency event for most EMS clinicians. Although respiratory distress is the most common complaint within the subset of pediatric encounters, a pediatric airway or respiratory emergency is significantly more rare overall, accounting for approximately 0.15% of all EMS encounters (5, 6). Further, as successful airway management is inversely related to patient age, quality management efforts are most informative when stratified by age (neonatal vs pediatric) (7). This, however, further increases the rarity with which an encounter occurs within each grouping. The coupling of a rare event with high acuity illustrates the need for a dedicated quality management program to quickly identify the correctable actions for the individual and the system.

Maintaining skill competency is a challenge for any clinician when tasks are performed infrequently. While primary airway management techniques such as bag-valve-mask (BVM) ventilation can be difficult to perform in the clinical setting, mastering and maintaining proficiency in invasive airway management poses an even greater challenge (5, 8–13). When considering components of airway management education within quality management, achieving true competency must be an intentional

goal, along with improving clinician confidence and self-perception of proficiency (14).

Reducing practice variability through the utilization of standardized clinical practice guidelines and appropriately sized pediatric equipment in the EMS setting not only impacts care quality, but also may contribute to an effective quality management program by allowing for internal and external benchmarking (15, 16). Unfortunately, wide variations remain across agencies in the development of standardized pediatric airway and respiratory management protocols and adoption of evidence-based recommendations (17, 18). Additionally, despite the existence of documents such as the multi-organizational position statement *Recommended Essential Equipment for Ground BLS and ALS ambulances*, and state-driven inspection programs, EMS clinicians still lack appropriate and consistently functional pediatric equipment in many locations (19). The combination of protocol and equipment inconsistencies make quality management efforts difficult and decreases the quality of field care provided to children.

Lastly, quality of care is difficult, if not impossible, to assess if the care provided is not well documented. Regardless of chief complaint, acquisition and documentation of a complete set of vital signs by EMS clinicians is significantly less likely in the pediatric patient. This is most notably identified in a study by Ramgopal et al. that evaluated charts in twenty regional EMS agencies and found that clinicians documented pulse oximetry values for only 62.5% of neonatal and 78.8% of infant cases of respiratory distress, compared to in >90% of all other age groups (20).

The intersection of these challenges form the basis of areas deserving focused attention in EMS quality management programs. Through physician medical director oversight with a focus on pediatric airway and respiratory management, expert collaboration, clearly defined quality indicators for pediatric-specific elements, and implementation of effective competency assessment strategies, barriers to pediatric care advancement can be overcome.

PHYSICIAN MEDICAL DIRECTOR OVERSIGHT

Medical Director Oversight Must Include a Focus on Pediatric Airway and Respiratory Management and Integrate Pediatric-Specific Elements in Guideline Development, Competency Assessment, and Skills Maintenance Efforts.

A host of position statements and documents have established the importance of physician oversight in EMS, including many papers that speak specifically to the importance of physician oversight of pediatric care

(21, 22). A leader dedicated to the continual evaluation and improvement of pediatric care sets the vision, direction, and tenor of the program, and is a critical member of the quality management team.

The foundation of physician oversight for pediatric respiratory emergencies and airway management rests upon a commitment to the development and routine review of pediatric guidelines or protocols (23). This practice helps to ensure that the agency's protocols contain the most up-to-date care recommendations and allows for rapid incorporation of emerging therapies. Such protocols should specifically address, at a minimum, the clinical approach to respiratory distress due to the most common pediatric etiologies, as well as those pertaining to respiratory and airway management in trauma, seizures, altered mental status, and toxicology.

Examples of documents that medical directors can use to help develop their agency or system's protocols include Cheng et al's 2020 evidence-based recommendations for out-of-hospital pediatric respiratory distress and the U.S. *National Model EMS Clinical Guidelines*. These comprehensive resources establish and routinely update pediatric-specific clinical guidelines and designate the foundation of skills required to maintain and demonstrate proficiency (17, 24). The medical director should evaluate these recommendations in the context of the agency's or region's population, operational abilities, and extent of local clinician scope of practice. Through use of national model guidelines, the physician medical director can more easily develop local treatment protocols that are unified broadly, allowing for agency-level data collection of performance measures with local significance and comparison to regional and national standards.

The medical director may choose to limit or expand local scope of practice outside of national certification benchmarks for a variety of reasons, such as to accommodate the needs of the local patient population, to address the local comfort level with the risks associated with certain procedures, or due to an inability to adequately support the skills maintenance activities required to sustain certain skills. For example, though endotracheal intubation is described as part of the paramedic scope of practice in the national model, a local medical director and EMS agency may choose to restrict or prohibit this skill in pediatric patients if they determine that the skill would be performed too infrequently for the agency's clinicians to maintain competency in the skill, or because the local risk/benefit profile is unfavorable to patient safety or outcomes. State or regional bodies empowered with the task of regulating local EMS care may also direct the inclusion or exclusion of certain clinical interventions.

COLLABORATION IN PEDIATRIC SYSTEMS OF CARE

EMS Agencies Are Encouraged to Collaborate with Medical Professionals Who Have Expertise in Pediatric Emergency Care to Provide Support for Quality Management Initiatives in Pediatric Respiratory Distress and Airway Management.

A PECC or pediatric advisory committee working in conjunction with the EMS agency physician medical director may help ensure that the agency places appropriate focus on pediatric care as part of its normal operations (25, 26). As illustrated in the resource document to the NAEMSP position statement titled *Physician Oversight of Pediatric Care in Emergency Medical Systems*, a PECC or pediatric advisory committee facilitates the purposeful integration of pediatric policies, protocols, equipment and medication availability, and disaster planning into an agency's practice (22). Such efforts are critical to improving clinical management, documentation, and staff awareness of pediatric issues.

As described in the 2020 *Pediatric Readiness in Emergency Medical Services System Position Statement and Technical Report*, EMS medical directors must remain abreast of local systems of pediatric-focused care in order to develop and update pediatric destination guidelines (27). For children with respiratory and airway emergencies, this involves awareness of the pediatric capabilities of area emergency departments and hospitals, where pediatric critical care resources are available, and what the referral patterns are for regional pediatric tertiary care hospitals. EMS physician medical directors should also liaison with local and regional pediatric resources in order to maintain closed-loop communication regarding patient outcomes and sharing of evidence-based practice.

PEDIATRIC QUALITY INDICATORS

EMS Agencies Should Define Quality Indicators for Pediatric-Specific Elements in Respiratory Distress and Airway Management and Benchmark Performance Based on Regional and National Standards.

Meaningful measurements of progress can only be accomplished if the groups being analyzed are comparable. A lack of uniformity in the population will result in substantial variation in the data collected and conclusions that are drawn. From the changing

range of normal vital signs, to pulse oximetry ranges, to airway management techniques and recommendations, the time period from birth to adolescence is a dynamic growth process that results in vast changes in care. Each of these issues is well described in a paper by Di Cicco et al (28). As such, benchmarks and quality management plans must be categorized by age (29).

The landmark Institute of Medicine document, *Crossing the Quality Chasm: A New Health System for the 21st Century*, detailed the crucial components of a safe and effective health care system in 2001 (30). This document laid bare the dangers of siloed health care systems and their contribution to the wide gap between the research supporting clinical care advancements and the widespread, uniform implementation of that care. Since this 2001 publication, many local, regional, and national groups, including organizations such as the American Academy of Pediatrics, Pediatric Emergency Care Applied Research Network, and NAEMSP have published operational and clinical care recommendations for neonates and children. Many of these recommendations have helped established quality measures and benchmarks through organizations like the Ground Air Medical Quality Transport (GAMUT) initiative and the National EMS Quality Alliance (NEMSQA), though pediatric topics make up only a small proportion of the metrics evaluated (31, 32).

NEMSQA is an independent organization of EMS stakeholder organizations, initially funded in 2016 by the National Highway Transportation Safety Administration (NHTSA) Office of EMS to design, test, and evaluate EMS quality measures. Quality measure priorities are identified through call for measure concepts, enter a rigorous review and development process, and are subsequently opened for use in the EMS community.

The GAMUT QI collaborative is a critical care transport-based data analytics platform (i.e., registry) that establishes transport-based performance measures and aggregates data submitted by participating programs on the performance measures established. Benchmark scores and best practices are subsequently established when performance levels attained by top programs account for at least 10% of the population (32). Efforts such as these allow for a living cycle of quality management that involves continual evaluation, data collection, and reassessment to drive practice change. However, an enhanced focus on pediatric respiratory and airway management to drive practice and protocol development is still required. Until national benchmarking goals can be established, agency quality management teams should use evidence-based guidelines to

drive prioritized measure topics, collect discrete and reliable data, and establish internal trends. Benchmarking performance metrics should use NEMSIS-compliant data variables and should ideally include metrics for bronchiolitis, croup/upper airway, and asthma. Sample metrics include frequency of documentation of complete vital signs and lung sounds, and correct treatment provided based on the EMS clinician impression and local protocol (e.g., albuterol for an acute asthma exacerbation or nebulized epinephrine for moderate to severe croup) (33, 34).

PEDIATRIC MEASURES OF PERFORMANCE

EMS Agencies Should Implement Both Quantitative (Objective) and Qualitative (Subjective) Measures of Performance to Assess Competency in Pediatric Respiratory Distress and Airway Management.

The quality management team is integral to the development and delivery of appropriate, effective initial and continuing EMS clinician education and competency assessments in pediatric airway and respiratory management (35). Comprehensive airway management skills remain difficult to both attain and maintain. Historically, many agencies have viewed evaluation of EMS clinician airway skills through the *quantitative* lense (e.g., how many times did a clinician attempt an intervention during a timeframe, and how many attempts were successful). However, a focus solely upon quantitative measures ignores the need for a *qualitative* evaluation of an EMS clinician's skill set, such as early symptom recognition and the decision-making skills required to mitigate risk to the patient. As such, in addition to minimum quantitative requirements for psychomotor skill performance, we recommend implementing a qualitative assessment of an EMS clinician's ability to perform both the cognitive and procedural tasks involved in pediatric airway and respiratory management (Table 1).

There are limited data regarding how well EMS clinicians recognize and correctly treat pediatric respiratory distress. An effective quality management program must include an evaluation of the availability and efficacy of education focused on achieving critical tasks within pediatric respiratory and airway management. A companion manuscript to this resource document, *Pediatric Respiratory Distress and Airway Management Training and Education*, discusses this concept further (14). Additionally, we recommend that quality

TABLE 1. Sample pediatric respiratory qualitative evaluations.

Identify the type of respiratory distress, upper (e.g., croup) versus lower (e.g. bronchiolitis) and select the correct treatment
Select the correctly sized equipment and correct medication with proper dosing for specific respiratory etiologies (e.g., croup, asthma, anaphylaxis)
Identify respiratory arrest and intervene with appropriate management
Select the correctly sized equipment and perform effective bag-mask-ventilation in all ages and sizes, from neonates to adults
Pair an individual patient's degree of airway/ventilation compromise with the effectiveness and invasiveness of available mitigating interventions based on the individual clinician's competency to perform the intervention(s) successfully (i.e., prepare to perform the intervention(s), execute the intervention(s), and provide post-intervention care)

management teams assess an EMS clinician's ability to locate and demonstrate competency in the use of pediatric-specific items within the agency's supply bags and vehicles. This recommendation is supported by a performance measure created through the U.S. National EMS for Children Program, *EMSC performance measure 03: Use of Pediatric-Specific Equipment*, which recommends that 90% of EMS agencies "have a process that requires EMS clinicians to physically demonstrate the correct use of pediatric-specific equipment" by 2026 (36).

A critical component of competency assessment occurs through a detailed case review of every pediatric airway and respiratory management encounter. Such a review begins with an analysis of EMS documentation to identify a clinician's qualitative decision points throughout a patient's treatment course. Examples of critical components include: the presence or absence of relevant clinical and physiologic factors prompting a decision to intervene, the intervention chosen (e.g. repositioning, suctioning, BVM), the patient's response to the intervention, and any complications that may have occurred during and after the intervention.

We believe it is crucial that pediatric respiratory and airway management case reviews be performed by the medical director and quality management team in close proximity to the event, and that both system and individual elements of care are assessed. Infrequent events such as these are more effectively reviewed on a "rolling" or case-by-case basis, rather than a periodic "en bloc" approach. Cushman et al. noted that paramedics receiving proximate and focused reviews also demonstrated gains in use of a stepwise approach to pediatric respiratory and airway emergencies, beginning with noninvasive interventions (23). Not only does delivery of effective, timely feedback improve EMS clinician competency, but it also has been shown to be critical in improving the quality of pediatric care provided (37, 38). Additionally, constructive feedback should be provided not only to the involved clinicians, but also shared with the system as a whole; for example, through education initiatives. Root cause analysis

may identify opportunities for system-based and individual clinician-focused improvement(s) (39).

PEDIATRIC ADVANCED AIRWAY MANAGEMENT

EMS Agencies Choosing to Incorporate Pediatric Endotracheal Intubation or Supraglottic Airway Insertion Must Use Pediatric-Specific Quality Management Benchmarks and Perform Focused Review of Advanced Airway Management.

As discussed in the companion document to this manuscript, *Pediatric Respiratory Distress and Airway Management Interventions*, endotracheal intubation is of uncertain benefit to children and recent literature illustrates that it can be harmful when inappropriately or unnecessarily performed (4, 40–43). It is incumbent upon the EMS agency medical director to remain abreast of current literature and published recommendations, and to maintain an outcome-based focus when devising agency protocols. The overarching goal of all pediatric respiratory and airway management protocols should be utilization of the least-invasive means possible to prevent or mitigate progression from respiratory distress to respiratory failure.

Pediatric endotracheal intubation is an extremely high-risk, low-frequency skill that should only be included in an agency's scope of practice if the agency can commit the necessary resources to establish and maintain a system of quality management dedicated to this specific intervention. Such a program should extensively and continuously evaluate every case of pediatric endotracheal intubation and supraglottic airway insertion. In addition to the components of case review detailed above, review of advanced airway modalities must extend to the use, appropriateness, and effectivity of the noninvasive interventions deployed prior to the use of invasive methods. Clear documentation of the number of advanced airway attempts and direct patient response to each attempt should be examined. A comprehensive understanding of the episode of care

should also include the patient's clinical outcome and relevant hospital-based data.

If pediatric endotracheal intubation is part of an agency's approved clinician scope of practice, we recommend conducting competency maintenance activities on a quarterly basis. These sessions should include not only psychomotor practice, but also educational content to improve topic-focused knowledge and understanding, and cognitive decision-making processes. When developing competency evaluation and maintenance programs, it is important to view airway and respiratory management as a cognitive process, rather than as a group of discrete psychomotor skills. Ultimately, multiple teaching methods and training modalities should be used to establish and maintain clinician competency, as when these are coupled with a robust quality management program, improvements in EMS clinician airway skill performance can be realized (44).

CONCLUSION

Although pediatric respiratory and airway emergencies represent a common reason for contact with EMS clinicians, such cases still represent low-frequency, high-risk events in the EMS setting. Management of pediatric respiratory and airway emergencies deserves the attention of a focused quality management program to help ensure that the EMS care provided is appropriate and strives to achieve optimal patient-based outcomes. By implementing the quality management practices discussed in this paper, agencies can ensure that their practices and processes effectively address areas specific to the EMS-based care of pediatric patients with respiratory and airway emergencies. Though every EMS agency should undertake these pediatric airway- and respiratory-focused quality management activities, agencies choosing to include pediatric endotracheal intubation and/or supraglottic airway insertion within their EMS clinician scope of practice must dedicate quality management programs focused directly on these high-risk interventions.

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