Pediatric Medication Safety in the Emergency Department

Lee Benjamin, MD, FACEP, FAAP; Karen Frush, MD, FAAP; Kathy Shaw, MD, MSCE, FAAP; Joan E. Shook, MD, MBA, FAAP; Sally K. Snow, BSN, RN, FAEN

AMERICAN ACADEMY OF PEDIATRICS
Committee on Pediatric Emergency Medicine

AMERICAN COLLEGE OF EMERGENCY PHYSICIANS
Pediatric Emergency Medicine Committee

EMERGENCY NURSES ASSOCIATION
Pediatric Emergency Medicine Committee

Policy Statement
Organizational Principles to Guide and Define the Child Health Care System and Improve the Health of All Children

ABBREVIATIONS: ADE, adverse drug event; ASHP, American Society of Health-System Pharmacists; CPOE, computerized physician order entry; ED, emergency department.

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ABSTRACT

Pediatric patients cared for in emergency departments (EDs) are at high risk of medication errors for a variety of reasons. A multidisciplinary panel was convened by the Emergency Medical Services for Children program and the American Academy of Pediatrics Committee on Pediatric Emergency Medicine to initiate a discussion on medication safety in the ED. Top opportunities identified to improve medication safety include using kilogram-only weight-based dosing, optimizing computerized physician order entry using clinical decision support, developing a standard formulary for pediatric patients while limiting variability of medication concentrations, using pharmacist support within EDs, enhancing training of medical professionals, systematizing the dispensing and administration of medications within the ED, and addressing challenges for home medication administration before discharge.

BACKGROUND

Despite a national focus on patient safety since the publication of the Institute of Medicine (National Academy of Medicine) report *To Err is Human* in 1999, medical errors remain a leading cause of morbidity and mortality across the United States.[1] Medication errors are by far the most common type of medical error occurring in hospitalized patients,[2] and the medication error rate in pediatric patients has been found to be as much as 3 times that in adult patients.[3,4] Because many medication errors and adverse drug events (ADEs) are preventable,[1] strategies to improve medication safety are an essential component of an overall approach to providing quality care to children.

The pediatric emergency care setting is recognized as a high-risk environment for medication errors because of a number of factors, including medically complex patients with multiple medications who are unknown to emergency department (ED) staff, a lack of standard pediatric drug dosing and formulations,[5] weight-based dosing,[6,7] verbal orders, a hectic environment with frequent interruptions,[8] lack of clinical pharmacists on the ED care team,[9,10] inpatient boarding status,[11] use of information technology systems that lack pediatric safety features,[12] and numerous transitions in care. In addition, the majority of pediatric patients seeking care in EDs are not treated in pediatric hospitals but rather in community hospitals, which may treat a low number of pediatric patients.[13] Studies also outline the problem of medication errors in children in the out-of-hospital setting. A study of 8 Michigan emergency medical services agencies demonstrated errors for

commonly used medications, with up to one third of medications being dosed incorrectly.[14] Medication error rates reported from single institutions with dedicated pediatric EDs range from 10% to 31%,[15,16] and a study by Shaw et al[6] from a pediatric tertiary care center network showed that medication errors accounted for almost 20% of all incident reports, with 13% of the medication errors causing patient harm.[6] Another study examined medication errors in children at 4 rural EDs in northern California and found an error rate of 39%, with 16% of these errors having the potential to cause harm.[17] The following discussion adds to the broad topic of medication safety by introducing specific opportunities unique to pediatric patients within EDs to facilitate local intervention on the basis of institutional experience and resources.

STRATEGIES FOR IMPROVEMENT

A multidisciplinary expert panel was convened by the Emergency Medical Services for Children program and the American Academy of Pediatrics, through its Committee on Pediatric Emergency Medicine, to discuss challenges related to pediatric medication safety in the emergency setting. The panel included emergency care providers, nurses, pharmacists, electronic health record industry representatives, patient safety organization leaders, hospital accreditation organizations, and parents of children with ADEs. The panel outlined numerous opportunities for improvement, including raising awareness of risks for emergency care providers, trainees, children, and their families; developing policies and processes that support improved pediatric medication safety; and implementing best practices to reduce pediatric ADEs. Specific strategies discussed by the panel, as well as recent advances in improving pediatric medication safety, are described.

Decreasing Pediatric Medication Prescribing Errors in the ED

Computerized physician order entry. Historically, the majority of pediatric medication errors were associated with the ordering phase of the medication process. Specific risks related to pediatric weight-based dosing include not using the appropriate weight,[6] performing medication calculations based on pounds instead of the recognized standard of kilograms,[6] and making inappropriate calculations, including 10-fold dosing errors.[18-20] Childhood obesity introduces further opportunity for dosing error. In addition to the lack of science to guide medication dosing in obese patients,[21] frequent underdosing[22] is reported, and currently available resuscitation tools are commonly imprecise.[23] Furthermore, there are limited opportunities for prescription monitoring or double-checking in the ED setting, and many times calculations are performed in the clinical area without input from a pharmacist.[9] The implementation of computerized physician order entry (CPOE) and clinical decision support (CDS) with electronic prescribing has reduced many of these errors because most CPOE systems obviate the need for simple dose calculation. However, CPOE systems have not fully eliminated medication errors. Commercial or independently developed CPOE systems may fail to address critical unique pediatric dosing requirements.[12,24] Kilogram-only scales are recommended for obtaining weights, yet conversion to pounds either by the operator or electronic health record may introduce opportunity for error into the system. In addition, providers may overide CDS despite its proven success in reducing errors.[16,25] Prescribers frequently choose to ignore or override CDS prescribing alerts, with reported override rates as high as 96%.[26] Allowing free-text justification to override alerts for nonformulary drugs may introduce errors. The development of an override algorithm can help reduce user variability.[27] As the use of CPOE increases, one can expect that millions of medication errors will be prevented.[28] For EDs that do not use CPOE, preprinted medication order forms have been shown to significantly reduce medication errors in a variety of settings and serve as a low-cost substitute for CPOE.[29-32]

Standardized formulary. The Institute of Medicine (National Academy of Medicine) recommends development of medication dosage guidelines, formulations, labeling, and administration techniques for the pediatric emergency care setting.[5] Unfortunately, there are currently no universally accepted, pediatric-specific standards in regard to dose suggestion and limits, and dosing guidelines and alerts found in CPOE are commonly provided by third-party vendors that supply platforms to both children's and general hospitals. The development of a standard pediatric formulary, independent from an adult-focused system, can reduce opportunities for error by specifying limited concentrations and standard dosage of high-risk and frequently used medications, such as resuscitation medications, vasoactive infusions, narcotics, and antibiotics, as well as look-alike and sound-alike medications.[33] A standard formulary will allow consistent education during initial training and continuing medical education for emergency care providers, creating a consistent measure of provider competency. At least one large hospital organization has successfully implemented this type of change.[34] In addition, the American Society of Health-System Pharmacists (ASHP) is working with the Food and Drug Administration to develop and implement national standardized concentrations for both intravenous and oral liquid medications.[35]