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Joel A. Fein, William T. Zempsky, Joseph P. Cravero and THE COMMITTEE ON  
PEDIATRIC EMERGENCY MEDICINE AND SECTION ON ANESTHESIOLOGY  
AND PAIN MEDICINE

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## CLINICAL REPORT

# Relief of Pain and Anxiety in Pediatric Patients in Emergency Medical Systems

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EMERGENCY MEDICINE AND SECTION ON ANESTHESIOLOGY  
AND PAIN MEDICINE

### KEY WORDS

pain, stress, anxiety, analgesia, opiates, topical anesthesia

### ABBREVIATIONS

ED—emergency department

EMS—emergency medical services

IV—intravenous

NPO—nil per os

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## abstract

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Control of pain and stress for children is a vital component of emergency medical care. Timely administration of analgesia affects the entire emergency medical experience and can have a lasting effect on a child's and family's reaction to current and future medical care. A systematic approach to pain management and anxiolysis, including staff education and protocol development, can provide comfort to children in the emergency setting and improve staff and family satisfaction. *Pediatrics* 2012;130:e1391–e1405

## BACKGROUND

A systematic approach to pain management is required to ensure relief of pain and anxiety for children who enter into the emergency medical system, which includes all emergency medical services (EMS) agencies, interfacility critical care transport teams, and the emergency department (ED).<sup>1</sup> The administration of appropriate analgesia in children varies by age as well as by training of the ED team (which includes physicians, nurses, physician assistants, and nurse practitioners), however, and still lags behind analgesia provided for adults in similar situations.<sup>2</sup> Furthermore, neonates are at highest risk of receiving inadequate analgesia.<sup>3,4</sup>

Encouragingly, improvements in the recognition and treatment of pain in children have led to changes in the approach to pain management for acutely ill and injured pediatric patients.<sup>5</sup> Studies have shown an increase in opiate use in children with fractures.<sup>6–8</sup> Recent advances in the approach and support for pediatric analgesia and sedation, as well as new products and devices, have improved the overall climate of the ED for patients and families in search of the “ouchless” ED.<sup>5,9</sup> Increased parental education regarding pain and sedation, physician comfort and desire to enhance patient satisfaction, and a quest to satisfy accreditation regulations have appropriately driven this effort. System-wide approaches for pain management awareness and strategies work best if they are woven into the fabric of the emergency medical system through education and protocol development. The purpose of this report was to provide information to optimize the comfort and minimize the distress of children and families as they are cared for in the emergency setting.

## STATEMENT OF THE PROBLEM

Barriers to adequate pain control for children in the ED and in out-of-hospital emergency care settings include difficulty in assessing pain in

young patients, unfamiliarity with new products and techniques, fear of medication adverse effects, staffing limitations, and time constraints.<sup>10–15</sup> Children's pain is underestimated because of the underuse of appropriate assessment tools and the failure to account for the wide range of children's developmental stages. Analgesic agents typically used for pain in other settings might not be used in the ED because of concerns regarding masking of symptoms and prevention of appropriate diagnoses as well as misconceptions or personal biases by physicians or parents against using stigmatized medications like opiates. Topical anesthetics may be underused because of concerns regarding delay in definitive treatment, cost, or lack of availability. In addition to the child's developmental level, culture, ethnicity, and race affect pain management from both a patient and physician perspective. It is clear that cultural differences can contribute to how an individual or family manifests behavioral distress and anxiety<sup>16–19</sup>; however, no predictable patterns have emerged with regard to a consistent pain experience within ethnic groups.<sup>20</sup> Studies have noted that Hispanic and black individuals with long-bone fractures were less likely to receive analgesics than were non-Hispanic white individuals.<sup>21–23</sup> A review of the National Hospital Ambulatory Medical Care Survey from 1992 to 1997 demonstrated that among patients with fractures, black children covered by Medicaid were least likely to receive parenteral sedation and analgesia.<sup>24</sup> Opioid prescribing for painful conditions has increased for all patients, but white patients continue to be more likely to receive an opioid prescription than black, Hispanic, or Asian patients.<sup>25</sup>

Although few physicians still believe that children do not feel pain the same way adults do and that pain has no

untoward consequences,<sup>15</sup> there is a growing recognition of how even minor painful procedures, such as needle sticks, can affect a child's longer-term emotional well-being.<sup>26</sup> Inadequate sedation and pain control can worsen a child's reaction to subsequent, possibly even nonpainful procedures. Neonates who undergo procedures with inadequate analgesia have long-standing alterations in their response to and perceptions of painful experiences.<sup>27–32</sup> Inadequate pain control as well as invalidation of the child's pain during oncology procedures leads to significantly increased pain scores for subsequent painful procedures.<sup>33,34</sup> Posttraumatic stress symptoms can occur after procedures or stressful medical experiences that are not accompanied by appropriate pain control or sedation, and this can lead to adverse reactions to subsequent procedures.<sup>35–37</sup>

In the ED, children often present with a constellation of symptoms but no final diagnosis; they are usually unknown to the treating physician, have a wide range of medical or surgical problems, and are unlikely to be fasting on arrival.<sup>11</sup> These factors make their assessment and the selection of appropriate analgesic intervention more complicated. As well, the emergency setting can be a busy, fast-paced environment in which heightened patient and parental anxiety increases the perception of pain and makes its treatment more difficult.<sup>12</sup>

Optimal pain management requires a thorough understanding of pain assessment and management strategies.<sup>12,13</sup> Education in pain management is a recent emphasis for hospitals as well as regulatory agencies, such as The Joint Commission: "Each and every patient has a right to the assessment and management of pain."<sup>38,39</sup>

## NEW INFORMATION

### Setting the Stage for Relief of Pain and Anxiety

Physicians can begin to address pain and anxiety as soon as a child comes in contact with the EMS system. Prehospital EMS providers typically receive relatively little pain management instruction.<sup>40,41</sup> The development of pain assessment and management protocols specifically for prehospital EMS providers, along with educational initiatives, can improve pain management in the field.<sup>40,42–44</sup> Several adult studies and 1 pediatric trial show that analgesics, such as opiates and tramadol hydrochloride, can be used in prehospital protocols to decrease pain scores without causing respiratory depression.<sup>45–48</sup> Alternative delivery systems, such as transmucosal medications or inhaled nitrous oxide, could offer pain control without requiring intravenous (IV) access, providing advantages in the field as well as in the hospital setting.<sup>49–53</sup> Some EMS systems have implemented a "toolbox" of distraction equipment on units as an adjunct to providing pain relief in the anxious, uncomfortable child.

### Assessment and Management of Pain, Stress, and Anxiety in the ED

#### *The Environment*

It is clear that there is a relationship between anxiety and perceived pain in children and adults.<sup>54</sup> The creation of an appropriate environment is essential to minimize the pain and distress of a child's ED visit.<sup>12</sup> Ideally, each child should be placed in a private room. Even in a general ED, there can be a dedicated pediatric area that provides a child-friendly, calming environment.<sup>11</sup> Colorful walls, pictures on the ceiling, and a collection of toys and games will minimize fear induced by this strange setting.<sup>12</sup>

Stress management and emotional support are essential to providing a comfortable environment for the child and have been shown to reduce anxiety in older children as well as parental perception of pain in younger children.<sup>55</sup> Adequate preparation has been shown to decrease anxiety and increase a child's coping before a minor procedure or surgery.<sup>56–58</sup> Distraction can range from simple techniques, such as a bubble blower or pinwheel used by the child during a painful injection, to techniques that require more time and training, such as hypnosis.<sup>59–61</sup> Structural changes, such as outfitting each procedure room with equipment that can provide videos and music, and distraction stations equipped with bubble columns, light wands, and imagery projectors, can be helpful in engendering a feeling of safety and comfort in young children.<sup>62–67</sup> A child life specialist based in the ED has the ability to (1) decrease anxiety and pain perception using developmentally appropriate education and preparation to patients and families; (2) teach the child and staff simple distraction techniques, deep breathing, progressive relaxation, or guided imagery; (3) help the child to develop and execute coping plans during difficult events in the ED; (4) educate the child about the ED environment and his or her diagnosis; and (5) support family involvement in the child's care.<sup>68–70</sup> The child life specialist has an important role. He or she is one of a few professionals in the emergency setting who is not in a position to cause emotional or physical pain to the child<sup>71,72</sup>; however, nurses, physicians, and ancillary staff also share in this responsibility and can learn from and teach each other these techniques. Optimally, the treatment plan for each child should be communicated to the entire medical care team with specific regard to the environmental and behavioral management of anxiety in the emergency

medical setting. This includes teaching children what to expect during a procedure or during their visit, showing them specific medical supplies they will be using, offering them choices when appropriate, giving them a role or a job during a procedure or hospital visit, and using distractions. Creating a relaxing environment can help a child to feel more comfortable and less stressed.

Allowing (but not requiring) family presence during painful procedures also may be of benefit. Although there is no evidence that family presence decreases pain, their presence for procedures can decrease child distress.<sup>73–76</sup> Family presence does not usually increase anxiety of the child or decrease the procedure success rate of experienced physicians; however, it is important to monitor parental responses to limit the adverse effects on all parties.<sup>73,74,77</sup> In addition, involving the parent as a coach for the child during the procedure is useful in reducing anxiety and distress.<sup>78–82</sup>

### Pain Assessment in the ED

The Joint Commission standards include mandatory pain assessments for all hospital patients.<sup>39</sup> Pain is, by nature, a subjective experience and is influenced by social, psychological, and experiential factors. For example, patients who experience chronic pain may not report the same pain level or exhibit the same facial cues and vocalizations as those who are new to the pain experience. Pain assessment, which is obviously the first step toward appropriate treatment, can, therefore, be more complex than just obtaining a single pain score; it is also essential to pay attention to changes in pain scores in response to treatment. The current clinical standard for pain assessment is a self-report scale. Simple numerical scales, such as verbally grading pain from 0 to 10, are often

used in adults; although there is evidence that this technique may be accurate in older children with moderate to severe pain, it may be less accurate for those with abdominal pain.<sup>83,84</sup> Several well-validated scales exist for children as young as 3 years to report their own pain level.<sup>85–88</sup> The revised FACES pain scale, the Wong-Baker Faces scale, and the 10-cm Visual Analog Scale have been used successfully in many EDs caring for children.<sup>86,88–92</sup> Other dimensions can be added to the visual analog scale, such as height, width, and color, and are valid methods for assessment of acute pain in children.<sup>93</sup> For those who are unable to use self-report scales, behavioral scales can be combined with an evaluation of the patient's history and physical findings to assess the level of a child's pain.<sup>94–96</sup> Pain in a neonate can be evaluated using the Neonatal Infant Pain Scale,<sup>97</sup> and pain in infants, young children, and those with cognitive impairment can be assessed using the FLACC (face, legs, activity, crying and consolability) scale.<sup>98–104</sup> It must be noted that few, if any, scales have been validated in the prehospital setting.

### Pain Management in the ED

Pain assessment should occur routinely at the triage desk along with vital signs; however, reassessment during the ED stay is imperative to determine treatment effect.<sup>12,13,105</sup> In addition, physicians should take into account the possibility that combining multiple minor procedures may produce as much stress and discomfort as a single major procedure.<sup>106</sup>

#### *Controlling Pain Related to Needle Sticks and Other Minor Procedures*

Patients with less acute conditions also may require analgesia.<sup>107</sup> Protocols should be developed to facilitate the delivery of appropriate medications, such as acetaminophen, ibuprofen, or oral opiates, to these patients (Table 1).

**TABLE 1** Triage Oral Analgesic Administration Guidelines

Purpose
To provide analgesic therapy to patients presenting to triage with a complaint of pain
Procedure
1. Assess pain score using a validated tool
2. Immediately triage to a treatment room all patients with severe pain as assessed by triage nurse and consideration of pain score
3. For those not requiring immediate evaluation with pain score >3 (0–10 scale) or chief complaint consistent with pain, consider administration of oral analgesic
4. Assess recent analgesic use
Contraindications
1. Allergy to analgesic (consider alternative)
Medications
1. Ibuprofen (avoid if the patient has aspirin allergy, anticipated surgery, bleeding disorder, hemorrhage, or renal disease)
2. Acetaminophen (avoid if the patient has hepatic disease or dysfunction)
3. Oral oxycodone

Topical anesthetics can be placed proactively to control the pain associated with placement of IV catheters and other minor procedures. For example, in 1 inner-city pediatric ED, 90% of patients requiring IV access did not undergo this procedure until at least 60 minutes after triage.<sup>108</sup> A prediction model was developed whereby the patient's chief complaint and medical history, combined with an experienced triage nurse assessment, determined with some accuracy which patients had a high probability of requiring IV access.<sup>109</sup> These findings could be adapted to develop topical anesthetic protocols for painful procedures in other EDs, taking into account their patient volume, acuity, and flow characteristics (Table 2). Some topical anesthetics have been developed that produce anesthesia more rapidly than eutectic mixture of local anesthetics (EMLA; AstraZeneca, Wilmington, DE). A topical liposomal 4% lidocaine cream (LMX<sub>4</sub>; Ferndale Laboratories, Ferndale, MI) provides anesthesia in approximately 30 minutes.<sup>110,111</sup> Heat-activated systems have shortened the time required to as low as 10 to 20 minutes

**TABLE 2** Guidelines for Use of Topical Lidocaine in the ED

Topical anesthetics should be considered in any patient who has a high likelihood of undergoing a non-emergent invasive procedure on intact skin in the ED. These include the following:
• Intravenous line placement or venipuncture
• Lumbar puncture
• Abscess drainage
• Joint aspiration
Discussion with parents should bring up the following issues:
• Topical lidocaine does not provide complete pain relief
• Some patients may require a procedure before topical lidocaine reaches its full effectiveness (see below)
• Discuss with the parents how they feel the patient will tolerate the topical lidocaine application, in terms of anticipation of the procedure as well as sensory integration disorders
Contraindications:
• Emergent need for IV access
• Allergy to amide anesthetics
• Nonintact skin
• EMLA only: Recent sulfonamide antibiotic use (trimethoprim-sulfamethoxazole, erythromycin-sulfisoxazole); congenital or idiopathic methemoglobinemia
The topical anesthetic dose should be lower for patients <12 mo old or weighing <10 kg
Placement of topical lidocaine:
• Intravenous line placement
Topical lidocaine should be placed in at least 2 sites over veins amenable to placement of an IV line, preferably judged by the nurse placing the IV line.
Care should be taken to avoid mucous membrane contact or ingestion
• Lumbar puncture
Placement of topical lidocaine for lumbar puncture should be considered as soon as the decision is made to perform a lumbar puncture; accurate placement may require consultation with the clinician performing the procedure
Liposomal topical lidocaine reaches full effectiveness in 30 min, heated topical lidocaine in 20 min, EMLA reaches full effectiveness in 60 min.

for IV insertion pain relief.<sup>112</sup> Topical anesthetics also have been reported to improve procedural success rates, likely because of decreased movement leading to better accuracy.<sup>113,114</sup> When the procedure cannot be delayed or needs to take place in the prehospital setting, other techniques can be used; intradermal lidocaine injection as well

as intradermal saline with benzyl alcohol preservative decreases the pain of venous cannulation without affecting procedural success rate.<sup>115–119</sup> Needle-free injection systems using either powder or liquid jet injection reduce the onset time even more.<sup>106,120–123</sup> Vapocoolant sprays that have immediate onset of action have been found to be effective in reducing venipuncture pain in adults; however, they are less effective in children, likely because of their intolerance of the unpleasant cold feeling resulting from the required administration time.<sup>124,125</sup> Recent innovations include a vibrating device that, when applied to the proximal extremity over a cold pack, may decrease the pain of venipuncture and immunizations by taking advantage of the “gate” theory of pain. However, further study is required to determine the comparative efficacy of this technique.

Similar protocols should be developed for topical anesthetic placement for laceration repair at triage (Table 3). Laceration repair should be completed with an emphasis on minimizing pain and anxiety. Several topical anesthetic/vasoconstrictor combinations, such as lidocaine, epinephrine, and tetracaine, which can be made by the in-hospital pharmacy as a liquid or gel preparation, provide excellent wound anesthesia in 20 to 30 minutes.<sup>126,127</sup> EMLA cream also provides topical anesthesia for laceration repair, although it is not approved by the US Food and Drug Administration for this purpose.<sup>128,129</sup> Tissue adhesives, such as octyl cyanoacrylate, provide essentially painless closure for low-tension wounds.<sup>130,131</sup> Steri-Strips (3M, St Paul, MN) provide similar painless closure and are less expensive than currently available tissue adhesives.<sup>132</sup> Absorbable sutures should be considered for facial wounds that must be sutured to avoid the pain and anxiety produced by suture removal.<sup>133,134</sup>



**TABLE 3** Guidelines for Use of LET (a Topical Anesthetic for Open Wounds)

Eligibility
<ul style="list-style-type: none"> <li>• LET can be applied to simple lacerations and may be applied to complex or deeper lacerations that may require supplemental subcutaneous anesthetic administration.</li> </ul>
Contraindications
<ul style="list-style-type: none"> <li>• Allergy to amide anesthetics</li> <li>• Gross contamination of wound</li> </ul>
Procedure
<ul style="list-style-type: none"> <li>• LET should be placed according to standard ED procedure; time of placement should be documented on triage sheet</li> <li>• Dose: 3 mL for children &gt;17 kg; 0.175 mL/kg in children &lt;17 kg<sup>a</sup> <ol style="list-style-type: none"> <li>(1) Place LET on open wound and cover with occlusive dressing or place cotton ball soaked with LET solution into wound</li> <li>(2) Allow LET to soak into wound for 10–20 min or until wound edges appear blanched.</li> </ol> </li> </ul>

LET, lidocaine, epinephrine, and tetracaine.

<sup>a</sup> Based on maximum dose of 5 mg/kg of lidocaine.

Lidocaine can be used alone in urgent situations or after topical anesthetics have been applied. Lidocaine can be injected in an almost painless manner.<sup>115</sup> This technique includes buffering the anesthetic with bicarbonate, warming the lidocaine before injection, and injecting slowly with a small-gauge needle.<sup>135–139</sup> Lidocaine buffered with bicarbonate made in advance can be stocked in the ED and will remain stable for up to 30 days.<sup>140,141</sup>

The pain of intramuscular injection can be reduced using the shortest needle length possible to reach the intramuscular tissue, and applying concurrent manual pressure to the injection site.<sup>142–145</sup>

### Neonatal Pain Management in the ED

Simple changes in practice can minimize painful stimuli for infants. Protocols for topical anesthetic placement should include neonates. Topical anesthetics for procedures ranging from circumcision to venipuncture are safe in newborn infants and even preterm infants, with appropriate dosing and short administration times.<sup>146–148</sup>

Recent studies have suggested methods by which neonatal distress during painful procedures can be minimized. Sucrose has been found to decrease the response to noxious stimuli, such as heel sticks and injections, in neonates and has even been demonstrated to reduce subsequent crying episodes during routine care, such as diaper changes.<sup>149–161</sup> This effect seems to be strongest in the newborn infant and decreases gradually over the first 6 months of life. Nursing protocols that allow for the use of sucrose before painful procedures are in place at many hospitals (Table 4). A 12% to 25% sucrose solution that is made by the pharmacy or is available commercially can be used (Sweet-Ease, Children's Medical Ventures, Norwell, MA). The use of a pacifier alone or in conjunction with sucrose also has been shown to have analgesic effects in neonates undergoing routine venipuncture.<sup>162</sup> Skin-to-skin contact of an infant with his or her mother and breastfeeding during a procedure decrease pain behaviors associated with painful stimuli.<sup>163,164</sup>

Available evidence supports the use of local and topical anesthetic for lumbar puncture in neonates.<sup>165,166</sup> Protocols can allow for the timely placement of topical anesthetic, or injected buffered lidocaine can be used at the site of needle insertion before the procedure. Concerns over the increased difficulty of lumbar puncture after local anesthetic use have proved to be unfounded, and one study even demonstrated improved success with the use of topical anesthetic.<sup>113,165,167</sup>

Pain can be decreased in neonates by the elimination of heel sticks and intramuscular injections. Venipuncture seems to be less painful than heel lancing for obtaining blood for diagnostic testing.<sup>168</sup> When the intramuscular route is necessary, topical anesthetic should be used.<sup>169</sup> Use of distraction techniques discussed previously,

**TABLE 4** Guidelines for Use of Sucrose in the ED

Indications
<ul style="list-style-type: none"> <li>• Use as an adjunct for limiting the pain associated with procedures such as heel sticks, venipuncture, IV line insertion, arterial puncture, insertion of a Foley catheter, and lumbar puncture in neonates and infants younger than 6 mo</li> </ul>
Procedure
<ol style="list-style-type: none"> <li>1. Administer 2 mL of 25% sucrose solution by syringe into the infant's mouth (1 mL in each cheek) or allow infant to suck solution from a nipple (pacifier) no more than 2 min before the start of the painful procedure</li> <li>2. Sucrose seems to be more effective when given in combination with a pacifier; nonnutritive suck also contributes to calming the infant and decreasing pain-elicited distress</li> </ol>
Contraindications: None

ice, and less painful injection techniques can also be efficacious.<sup>170–173</sup> The use of lidocaine as the diluent for ceftriaxone can decrease the pain of intramuscular injection.<sup>174</sup>

### Does the Appropriate Use of Analgesics Make Evaluation More Difficult?

There is no evidence that pain management masks symptoms or clouds mental status, preventing adequate assessment and diagnosis. For patients with abdominal pain, several adult studies have shown that pain medications such as morphine can be used without affecting diagnostic accuracy.<sup>175–179</sup> Pediatric studies have demonstrated similar findings.<sup>179,180</sup> Clinical experience suggests that the use of pain medication makes children more comfortable and makes the examination of the patient's abdomen and diagnostic testing (such as ultrasonography) easier, thus aiding in diagnosis. In the child who has suffered multisystem trauma, small titrated doses of opiates can be used to provide pain relief without affecting the clinical examination or the ability to perform neurologic assessments.<sup>181,182</sup> The development of pain protocols can improve the management of children

who suffer major trauma.<sup>183</sup> Regional anesthesia should also be considered for patients who have injuries that are amenable to these techniques.<sup>184,185</sup> Additional studies evaluating these practices in pediatric patients are necessary but should not delay the development of protocols for the use of analgesics in patients with acute abdominal pain and multisystem trauma in the ED and even the prehospital setting.

### *Analgesia in the ED and EMS Setting*

Optimal pain management requires expeditious pain assessment and rapid administration of systemic opioid pain medication to patients in severe pain. This may occur through various routes of administration, including transmucosal or IV routes. The IV route allows for rapid relief of pain and drug titration; the intramuscular route is less preferred, because it does not allow for medication titration and is painful at the time of delivery and for days afterward. Adjunctive pain medications, such as nonsteroidal antiinflammatory drugs, can be used judiciously in children with pain; antiplatelet activity and gastrointestinal tract and renal toxicity are rare but recognized adverse effects. Oral opiates and nonsteroidal antiinflammatory drugs are appropriate for mild to moderate pain if the patient has no contraindications to receiving oral medications. Alternative routes of medication administration, including oral, intranasal, transdermal, and inhaled routes, should be used when appropriate and may offer rapid relief of pain.<sup>186</sup> Studies of transmucosal, aerosolized, and inhaled fentanyl show analgesic action commensurate with IV opioids.<sup>187–189</sup> Transmucosal administration may be appropriate and useful in the prehospital setting as well.<sup>190</sup> Intranasal delivery, despite demonstrating more rapid onset of action, also may be less tolerated because of burning of the

nasal mucosa during administration.<sup>54,191</sup> Drug delivery into the central nervous system is greatly enhanced with the use of an atomizer that distributes the medication more evenly to the mucous membranes.<sup>192–194</sup> Because adverse events are still possible when this mode of opiate administration is used, care should be taken when using adjunctive medications, such as benzodiazepines. In addition, if there is no IV access, it is prudent to prepare for alternative methods of administration for reversal agents. Pain medication should be provided in the ED as well as on discharge, even for those with mild to moderate pain. Patients and families should get specific instructions regarding dose and duration of use. Clear, written instructions should be provided for families regarding the after care of children who have received procedural sedation. Pain medication should be recommended on an around-the-clock basis for anyone in whom moderate pain is anticipated.

The use of sedative hypnotic medication may be required to reduce pain and distress for children undergoing procedures in the ED. Unfortunately, pain and anxiety are often difficult to differentiate in infants and toddlers and even in school-aged children. Although many procedures can be performed relatively painlessly with the use of a topical or local anesthetic, this does not obviate the use of pharmacologic agents to decrease the anxiety and stress in children undergoing procedures in the ED, especially when the child needs to remain still to ensure the success of the procedure. When the procedure is expected to be painful, the agents used should have analgesic properties as well. Emergency physicians are increasingly using short-acting medications such as propofol, alone or in combination with ketamine, for procedural sedation in children.<sup>195,196</sup>

Published reports involving adult patients and recently published experiences with children demonstrate that, when applied using careful protocols and in a setting of experienced sedation teams, propofol, either alone or in combination with ketamine, can be used safely and effectively for sedation in children.<sup>195,197–205</sup> Benzodiazepines, particularly rapidly effective but relatively short-acting ones, such as midazolam, are also helpful in the prehospital and ED settings. Nitrous oxide is a potent analgesic that does not require venous access and is available in some EDs.<sup>49–53</sup> Nitrous oxide should be used in conjunction with appropriate sedation guidelines and avoided in patients with pneumothorax, bowel obstruction, intracranial injury, and cardiovascular compromise.<sup>52,53</sup> Nitrous oxide has many potential applications, including anxiolysis for procedures such as IV catheter insertion and laceration repair; pain control for burn débridement, and fracture and dislocation reduction; care should be taken if opiates are used concurrently so as not to reduce respiratory drive.<sup>206</sup> The most important part of providing safe sedation for children is the establishment of appropriate sedation systems and sedation training programs with credentialing guidelines for sedation providers that specifically address the core competencies required for the care of pediatric patients.<sup>207,208</sup>

### *Pain Considerations for Children With Developmental Disabilities*

Children with developmental disabilities, particularly those with severe neurologic involvement, provide additional challenges to parents and EMS and ED personnel in management of acute pain and its associated anxiety. For many children, previous painful experiences in similar settings add to stress of the acute incident. Learning about the child's anticipated response

and previous experiences from parents, primary care physicians, and specialists informs the emergency physician and staff of useful supportive technique.<sup>209–211</sup> Parental understanding and awareness of subtle indirect behaviors or emotional shifts are often critical adjuncts in the assessment process of the child's sense of comfort and well-being. Child life specialists, as previously mentioned, are knowledgeable of distinct coping strategies to assist children with developmental disabilities and children who are more sensitive to sights and sounds. Myths of pain insensitivity or indifference must be actively avoided.<sup>212–214</sup> Pain modulation can vary widely, related to neurotransmitter function differences within the brain or along the injured spinal cord, thereby altering the perception and response to pain in children with previous injuries.<sup>213–215</sup> Cognitive impairments can affect both understanding and coping mechanisms, making self-report particularly challenging in young people with motor and/or cognitive differences. Maladaptive behaviors, heightened anxiety, and uncommon coping styles can add further complexity to the assessment process. The Non-communicating Children's Pain Checklist–Revised offers a validated visual method for staff members to assess and reassess children 3 to 18 years of age.<sup>216–218</sup> In addition, the Individual Numeric Rating Scale has been shown to be effective in children with developmental disabilities. In general, the approaches to medication use for pain and anxiety should hold true for children with developmental disabilities; some children, however, show altered sensitivity to medications and may be taking medications that interact with common pain medications.<sup>219</sup>

### *Sedation Policies and Protocols in the ED*

Physicians, physician assistants, and nurse practitioners who administer

sedation and analgesia should have proven training and skills and ongoing education in the management of pediatric airways and resuscitation, especially in the use of face mask ventilation and laryngeal mask airways. Emergency physicians and other nonanesthesiologist physicians with appropriate training have demonstrated the ability to safely and effectively provide moderate and deep sedation and dissociative anesthesia, allowing for the timely performance of procedures and rapid relief of pain and anxiety.<sup>202,207,208,220,221</sup> A recent large prospective study of 131 751 elective pediatric sedation encounters demonstrated no differences in serious adverse outcomes (ie, death, ICU admissions, aspiration events) between those performed by anesthesiologists and those performed by other pediatric medical subspecialists practicing in highly organized sedation systems.<sup>222</sup> Although the reported incidence of serious complications is low, it is imperative to develop ongoing policies that establish informed consent and close monitoring of these patients. A critical component of any sedation protocol is to require a trained observer to be solely responsible for monitoring the patient while the procedure is being performed.<sup>223,224</sup> Techniques such as noninvasive end-tidal carbon dioxide monitoring allow for more consistent detection of bradypnea, hypopnea, and apnea in sedated children and are being recognized increasingly as an essential part of the sedation armamentarium<sup>225,226</sup>; however, this is not a replacement for direct visualization of respiratory effort. Current guidelines from the American Academy of Pediatrics, American Society of Anesthesiologists, and American College of Emergency Physicians recommend a structured evaluation of children that allows risk stratification before beginning sedation, thereby reducing the risk of complications in the

pediatric age group.<sup>223,227–235</sup> This evaluation should include issues such as preexisting medical conditions, focused airway examination, and consideration of nil per os (NPO) status. NPO guidelines for children receiving sedation in the ED are controversial. Many children who have received procedural sedation for emergencies have not fasted in accordance with published guidelines for elective procedures, and this variation was not associated with adverse outcomes.<sup>236–239</sup> Current data are insufficient to determine the length of time that constitutes safety with regard to NPO status.<sup>237–243</sup> Recently published guidelines recommend that the physician consider the urgency of the procedure, targeted depth of sedation, risk level of the patient, and timing of most recent solid food intake to determine the safety profile for each patient.<sup>244</sup>

Discharge criteria also are critically important for children undergoing sedation in the ED. Patients who receive sedatives with long half-lives, such as chloral hydrate or pentobarbital, are at particular risk of adverse events after discharge, either during transportation or in their homes after the procedure.<sup>224</sup> Strict adherence to criteria that require a child to be “back to baseline” in terms of consciousness, or adaptation of newer “maintenance of wakefulness” criteria, are critical to optimize safety surrounding the sedation process.<sup>245</sup>

### *Quality Improvement Programs*

Any ED that provides treatment of children should have a quality improvement program that reviews, at regular intervals, sedation and pain management practices in pediatric patients. Transport team and pre-hospital EMS providers are essential partners in this ongoing review and should consider establishing internal review policies as well. Many hospitals use a multidisciplinary committee to



help interpret the data emanating from these reviews and then suggest system-wide protocol and educational initiatives. Indicators that should be evaluated include the use of validated pain scores; appropriate analgesics for specific disease states (whether severe or mild to moderate pain); topical anesthetics and other non-noxious routes of analgesia and sedation; monitoring for adverse outcomes; and the use of discharge instructions that outline the indications, dose, and duration of analgesic to be used.<sup>246–248</sup> Discharge instruction also should include any possible adverse effects of sedative/analgesic medications used in the ED. Adverse events that lead to respiratory depression or other life-threatening conditions should be fully reviewed by a committee charged with understanding if systemic care issues or provider-specific issues were root causes of these outcomes.

### Implementation

A systematic approach to pain management in the EMS requires an implementation strategy, promoted and advocated by leadership, that includes the following: (1) a comprehensive evaluation of current pain and distress management practices; (2) an educational and credentialing program regarding pain assessment and management techniques for all clinical staff, preferably overseen by a hospital-wide sedation committee<sup>249</sup>; (3) development of protocols to allow the universal and efficient application of pain management strategies and medications; and (4) a quality improvement process to evaluate the ongoing success of the program.<sup>11,13</sup> EMS agencies should establish policies and protocols that make available pertinent provider education and ensure quality improvement processes are in place for pediatric pain management protocols appropriate for their practice setting.

## CONCLUSIONS

Management of a child's distress during illness or after an injury is an important yet complex aspect of emergency medical care for children. Physicians and prehospital EMS providers should be aware of all the available analgesic and sedative options. Adequate pain assessment is essential for pain relief and should begin on entry into the EMS and continue through discharge of the child from the ED. Multiple modalities are now available that allow pain and anxiety control for all age groups. Future research should concentrate on pharmacologic, nonpharmacologic, and device-related technology that can assist in reducing the pain and distress associated with medical procedures.

## SUMMARY OF KEY POINTS

1. Training and education in pediatric pain assessment and management should be provided to all participants in the EMS for children; EMS medical directors should formally include pediatric pain management measures within the protocols provided to EMS providers.
2. Incorporation of child life specialists and others trained in nonpharmacologic stress reduction can alleviate the anxiety and perceived pain related to pediatric procedures.
3. Family presence during painful procedures can be a viable and useful practice in the acute care setting.
4. Pain assessment for children should begin at admission to EMS, including prehospital management, and continue until discharge from the ED. When discharged, patients should receive detailed instructions regarding analgesic administration.
5. Administration of analgesics and anesthetics should be painless or as pain free as possible.
6. Neonates and young infants should receive adequate pain prophylaxis for procedures and pain relief as appropriate.
7. Administration of pain medication has been demonstrated to preserve the ability to assess patients with abdominal pain and should not be withheld.
8. Sedation or dissociative anesthesia should be provided appropriately for patients undergoing painful or stressful procedures in the ED.
9. Pain management and sedation, including deep sedation and dissociative anesthesia, are fully within the monitoring and management capabilities of appropriately trained emergency medicine and pediatric emergency medicine physicians. Each emergency department that provides sedation and analgesia to children should include sedation competencies in recertification procedures and develop protocols, policies, and quality improvement programs as part of the systematic approach to pain management in the EMS.

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**REFERENCES**

- Augarten A, Zaslansky R, Matok Pharm I, et al. The impact of educational intervention programs on pain management in a pediatric emergency department. *Biomed Pharmacother*. 2006;60(7):299–302
- Probst BD, Lyons E, Leonard D, Esposito TJ. Factors affecting emergency department assessment and management of pain in children. *Pediatr Emerg Care*. 2005;21(5):298–305
- Batton DG, Barrington KJ, Wallman C; American Academy of Pediatrics, Committee on Fetus and Newborn; Section on Surgery, Section of Anesthesiology and Pain Medicine; Canadian Paediatric Society Fetus and Newborn Committee. Prevention and management of pain in the neonate: an update. *Pediatrics*. 2006;118(5):2231–2241
- Lewis LM, Lasater LC, Brooks CB. Are emergency physicians too stingy with analgesics? *South Med J*. 1994;87(1):7–9
- Bhargava R, Young KD. Procedural pain management patterns in academic pediatric emergency departments. *Acad Emerg Med*. 2007;14(5):479–482
- Selbst SM, Clark M. Analgesic use in the emergency department. *Ann Emerg Med*. 1990;19(9):1010–1013
- Petrack EM, Christopher NC, Kriwinsky J. Pain management in the emergency department: patterns of analgesic utilization. *Pediatrics*. 1997;99(5):711–714
- Alexander J, Manno M. Underuse of analgesia in very young pediatric patients with isolated painful injuries. *Ann Emerg Med*. 2003;41(5):617–622
- Schechter NL, Blankson V, Pachter LM, Sullivan CM, Costa L. The ouchless place: no pain, children's gain. *Pediatrics*. 1997;99(6):890–894
- McGrath PJ, Frager G. Psychological barriers to optimal pain management in infants and children. *Clin J Pain*. 1996;12(2):135–141
- Craig KD, Lilley CM, Gilbert CA. Social barriers to optimal pain management in infants and children. *Clin J Pain*. 1996;12(3):232–242
- Zempsky W. Developing the painless emergency department: a systematic approach to change. *Clin Pediatr Emerg Med*. 2000;1(4):253–259
- Ducharme J. Acute pain and pain control: state of the art. *Ann Emerg Med*. 2000;35(6):592–603
- Kelly A-M. A process approach to improving pain management in the emergency department: development and evaluation. *J Accid Emerg Med*. 2000;17(3):185–187
- American Academy of Pediatrics. Committee on Psychosocial Aspects of Child and Family Health; Task Force on Pain in Infants, Children, and Adolescents. The assessment and management of acute pain in infants, children, and adolescents. *Pediatrics*. 2001;108(3):793–797
- Lipton JA, Marbach JJ. Ethnicity and the pain experience. *Soc Sci Med*. 1984;19(12):1279–1298
- Wolff B. Ethnocultural factors influencing pain and illness behavior. *Clin J Pain*. 1985;1(1):23–30
- Martinelli A. Pain and ethnicity: how people of different cultures experience pain. *AORN J*. 1987;46(2):273–274, 276, 278
- Bernstein B, Pachter L. Cultural considerations in children's pain. In: Schechter N, Berde C, Yaster M, eds. *Pain in Infants, Children, and Adolescents*. Philadelphia: Lippincott, Williams and Wilkins; 2003:142–156
- Jones M, Qazi M, Young KD. Ethnic differences in parent preference to be present for painful medical procedures. *Pediatrics*. 2005;116(2). Available at: [www.pediatrics.org/cgi/content/full/116/2/e191](http://www.pediatrics.org/cgi/content/full/116/2/e191)
- Anderson KO, Green CR, Payne R. Racial and ethnic disparities in pain: causes and consequences of unequal care. *J Pain*. 2009;10(12):1187–1204
- Todd KH, Samaroo N, Hoffman JR. Ethnicity as a risk factor for inadequate emergency department analgesia. *JAMA*. 1993;269(12):1537–1539
- Todd KH, Deaton C, D'Adamo AP, Goe L. Ethnicity and analgesic practice. *Ann Emerg Med*. 2000;35(1):11–16
- Hostetler MA, Avinger P, Szilagyi PG. Parenteral analgesic and sedative use among ED patients in the United States: combined results from the National Hospital Ambulatory Medical Care Survey (NHAMCS) 1992–1997. *Am J Emerg Med*. 2002;20(3):139–143

25. Pletcher MJ, Kertesz SG, Kohn MA, Gonzales R. Trends in opioid prescribing by race/ethnicity for patients seeking care in US emergency departments. *JAMA*. 2008;299(1):70–78
26. Young KD. Pediatric procedural pain. *Ann Emerg Med*. 2005;45(2):160–171
27. Kennedy RM, Luhmann J, Zempsky WT. Clinical implications of unmanaged needle-insertion pain and distress in children. *Pediatrics*. 2008;122(suppl 3):S130–S133
28. Walco GA. Needle pain in children: contextual factors. *Pediatrics*. 2008;122(suppl 3):S125–S129
29. Taddio A, Katz J, Illersich AL, Koren G. Effect of neonatal circumcision on pain response during subsequent routine vaccination. *Lancet*. 1997;349(9052):599–603
30. Taddio A, Goldbach M, Ipp M, Stevens B, Koren G. Effect of neonatal circumcision on pain responses during vaccination in boys. *Lancet*. 1995;345(8945):291–292
31. Grunau RE, Whitfield MF, Petrie J. Children's judgements about pain at age 8-10 years: do extremely low birthweight (< or = 1000 g) children differ from full birthweight peers? *J Child Psychol Psychiatry*. 1998;39(4):587–594
32. Johnston CC, Stevens BJ. Experience in a neonatal intensive care unit affects pain response. *Pediatrics*. 1996;98(5):925–930
33. Cline RJW, Harper FWK, Penner LA, Peterson AM, Taub JW, Albrecht TL. Parent communication and child pain and distress during painful pediatric cancer treatments. *Soc Sci Med*. 2006;63(4):883–898
34. Weisman SJ, Bernstein B, Schechter NL. Consequences of inadequate analgesia during painful procedures in children. *Arch Pediatr Adolesc Med*. 1998;152(2):147–149
35. Blount R, Zempsky W, Jaaniste T, et al. Management of pediatric pain and distress due to medical procedures. In: Roberts M, Steele R, eds. *Handbook of Pediatric Psychology*. 4th ed. New York, NY: Gilford Press; 2009:171–188
36. Wintgens A, Boileau B, Robaey P. Post-traumatic stress symptoms and medical procedures in children. *Can J Psychiatry*. 1997;42(6):611–616
37. Kain ZN, Mayes LC, Wang SM, Hofstadter MB. Postoperative behavioral outcomes in children: effects of sedative premedication. *Anesthesiology*. 1999;90(3):758–765
38. Twycross A. Education about pain: a neglected area? *Nurse Educ Today*. 2000;20(3):244–253
39. Joint Commission on Accreditation of Healthcare Organizations. *Comprehensive Accreditation Manual for Hospitals*. Oakbrook Terrace, IL: Joint Commission on Accreditation of Healthcare Organizations; 2001
40. Ricard-Hibon A, Chollet C, Saada S, Lorient B, Marty J. A quality control program for acute pain management in out-of-hospital critical care medicine. *Ann Emerg Med*. 1999;34(6):738–744
41. Dieckmann R, Brownstein D, Gausche-Hill M, eds. *Pediatric Education for Pre-hospital Professionals*. Sudbury, MA: Jones and Bartlett; 2000
42. Rogovik AL, Goldman RD. Prehospital use of analgesics at home or en route to the hospital in children with extremity injuries. *Am J Emerg Med*. 2007;25(4):400–405
43. Jennings PA, Cameron P, Bernard S. Measuring acute pain in the prehospital setting. *Emerg Med J*. 2009;26(8):552–555
44. Baskett PJF. Acute pain management in the field. *Ann Emerg Med*. 1999;34(6):784–785
45. Ward ME, Radburn J, Morant S. Evaluation of intravenous tramadol for use in the prehospital situation by ambulance paramedics. *Prehosp Disaster Med*. 1997;12(2):158–162
46. Vergnion M, Degesves S, Garcet L, Magotteaux V. Tramadol, an alternative to morphine for treating posttraumatic pain in the prehospital situation. *Anesth Analg*. 2001;92(6):1543–1546
47. Bruns BM, Dieckmann R, Shagoury C, Dingerson A, Swartzell C. Safety of prehospital therapy with morphine sulfate. *Am J Emerg Med*. 1992;10(1):53–57
48. DeVellis P, Thomas SH, Wedel SK, Stein JP, Vinci RJ. Prehospital fentanyl analgesia in air-transported pediatric trauma patients. *Pediatr Emerg Care*. 1998;14(5):321–323
49. National Association of Emergency Medical Services Physicians. Use of nitrous oxide:oxygen mixtures in prehospital emergency care. *Prehosp Disaster Med*. 1990;5(3):273–274
50. Baskett PJ. Nitrous oxide in pre-hospital care. *Acta Anaesthesiol Scand*. 1994;38(8):775–776
51. Burton JH, Auble TE, Fuchs SM. Effectiveness of 50% nitrous oxide/50% oxygen during laceration repair in children. *Acad Emerg Med*. 1998;5(2):112–117
52. Luhmann JD, Kennedy RM, Jaffe DM, McAllister JD. Continuous-flow delivery of nitrous oxide and oxygen: a safe and cost-effective technique for inhalation analgesia and sedation of pediatric patients. *Pediatr Emerg Care*. 1999;15(6):388–392
53. Luhmann JD, Kennedy RM, Porter FL, Miller JP, Jaffe DM. A randomized clinical trial of continuous-flow nitrous oxide and midazolam for sedation of young children during laceration repair. *Ann Emerg Med*. 2001;37(1):20–27
54. Koppal R, Ardash E, Uday A, Anilkumar G. Comparison of the midazolam transnasal atomizer and oral midazolam for sedative premedication in paediatric cases. *J Clin Diagn Res*. 2011;5(5):932–934
55. Sinha M, Christopher NC, Fenn R, Reeves L. Evaluation of nonpharmacologic methods of pain and anxiety management for laceration repair in the pediatric emergency department. *Pediatrics*. 2006;117(4):1162–1168
56. Kolk AM, van Hoof R, Fiedeldij Dop MJ. Preparing children for venipuncture. The effect of an integrated intervention on distress before and during venipuncture. *Child Care Health Dev*. 2000;26(3):251–260
57. Lewis Claar R, Walker LS, Barnard JA. Children's knowledge, anticipatory anxiety, procedural distress, and recall of esophagogastroduodenoscopy. *J Pediatr Gastroenterol Nutr*. 2002;34(1):68–72
58. Kain ZN, Caldwell-Andrews AA. Pre-operative psychological preparation of the child for surgery: an update. *Anesthesiol Clin North America*. 2005;23(4):597–614, vii
59. Katz ER, Kellerman J, Ellenberg L. Hypnosis in the reduction of acute pain and distress in children with cancer. *J Pediatr Psychol*. 1987;12(3):379–394
60. Rogovik AL, Goldman RD. Hypnosis for treatment of pain in children. *Can Fam Physician*. 2007;53(5):823–825
61. Butler LD, Symons BK, Henderson SL, Shortliffe LD, Spiegel D. Hypnosis reduces distress and duration of an invasive medical procedure for children. *Pediatrics*. 2005;115(1). Available at: [www.pediatrics.org/cgi/content/full/115/1/e77](http://www.pediatrics.org/cgi/content/full/115/1/e77)
62. Klassen JA, Liang Y, Tjosvold L, Klassen TP, Hartling L. Music for pain and anxiety in children undergoing medical procedures: a systematic review of randomized controlled trials. *Ambul Pediatr*. 2008;8(2):117–128
63. French GM, Painter EC, Coury DL. Blowing away shot pain: a technique for pain management during immunization. *Pediatrics*. 1994;93(3):384–388
64. Fowler-Kerry S, Lander JR. Management of injection pain in children. *Pain*. 1987;30(2):169–175
65. Megel ME, Houser CW, Gleaves LS. Children's responses to immunizations: lullabies as a distraction. *Issues Compr Pediatr Nurs*. 1998;21(3):129–145
66. Fratianne RB, Prensner JD, Huston MJ, Super DM, Yowler CJ, Standley JM. The

- effect of music-based imagery and musical alternate engagement on the burn debridement process. *J Burn Care Rehabil.* 2001;22(1):47–53
67. Favara-Scacco C, Smirne G, Schilirò G, Di Cataldo A. Art therapy as support for children with leukemia during painful procedures. *Med Pediatr Oncol.* 2001;36(4):474–480
  68. Krebel MS, Clayton C, Graham C. Child life programs in the pediatric emergency department. *Pediatr Emerg Care.* 1996;12(1):13–15
  69. Alcock DS, Feldman W, Goodman JT, McGrath PJ, Park JM. Evaluation of child life intervention in emergency department suturing. *Pediatr Emerg Care.* 1985;1(3):111–115
  70. American Academy of Pediatrics, Committee on Hospital Care. Child life services. *Pediatrics.* 2000;106(5):1156–1159
  71. Rothenberg MB. The unique role of the child life worker in children's health care settings. *Child Health Care.* 1982;10(4):121–124
  72. Rae WA, Worchel FF, Upchurch J, Sanner JH, Daniel CA. The psychosocial impact of play on hospitalized children. *J Pediatr Psychol.* 1989;14(4):617–627
  73. Bauchner H, Waring C, Vinci R. Parental presence during procedures in an emergency room: results from 50 observations. *Pediatrics.* 1991;87(4):544–548
  74. Wolfram RW, Turner ED, Philput C. Effects of parental presence during young children's venipuncture. *Pediatr Emerg Care.* 1997;13(5):325–328
  75. Boudreaux ED, Francis JL, Loyacano T. Family presence during invasive procedures and resuscitations in the emergency department: a critical review and suggestions for future research. *Ann Emerg Med.* 2002;40(2):193–205
  76. Emergency Nurses Association. *Emergency Nurses Association Position Statement: Family Presence at the Bedside During Invasive Procedures and Resuscitation in the Emergency Department.* Des Plaines, IL: Emergency Nurses Association; 2010
  77. Smith RW, Shah V, Goldman RD, Taddio A. Caregivers' responses to pain in their children in the emergency department. *Arch Pediatr Adolesc Med.* 2007;161(6):578–582
  78. Cohen LL. Behavioral approaches to anxiety and pain management for pediatric venous access. *Pediatrics.* 2008;122(suppl 3):S134–S139
  79. Crenshaw DA. An interpersonal neurobiological-informed treatment model for childhood traumatic grief. *Omega (Westport).* 2006;2007;54(4):319–335
  80. Kleiber C, Craft-Rosenberg M, Harper DC. Parents as distraction coaches during i.v. insertion: a randomized study. *J Pain Symptom Manage.* 2001;22(4):851–861
  81. Dingeman RS, Mitchell EA, Meyer EC, Curley MAQ. Parent presence during complex invasive procedures and cardiopulmonary resuscitation: a systematic review of the literature. *Pediatrics.* 2007;120(4):842–854
  82. Moreland P. Family presence during invasive procedures and resuscitation in the emergency department: a review of the literature. *J Emerg Nurs.* 2005;31(1):58–72, quiz 119
  83. Bailey B, Bergeron S, Gravel J, Daoust R. Comparison of four pain scales in children with acute abdominal pain in a pediatric emergency department. *Ann Emerg Med.* 2007;50(4):379–383, 383.e1–383.e2
  84. von Baeyer CL, Spagrud LJ, McCormick JC, Choo E, Neville K, Connelly MA. Three new datasets supporting use of the Numerical Rating Scale (NRS-11) for children's self-reports of pain intensity. *Pain.* 2009;143(3):223–227
  85. Cohen LL, Lemanek K, Blount RL, et al. Evidence-based assessment of pediatric pain. *J Pediatr Psychol.* 2008;33(9):939–955, discussion 956–957
  86. Jacob E. Pain assessment and management in children. In: Wong D, Hockenberry MJ, Wilson D, eds. *Wong's Nursing Care of Infants and Children.* 9th ed. St. Louis, MO: Mosby; 2011:179–202
  87. Beyer JE, Aradine CR. Content validity of an instrument to measure young children's perceptions of the intensity of their pain. *J Pediatr Nurs.* 1986;1(6):386–395
  88. Scott J, Huskisson EC. Graphic representation of pain. *Pain.* 1976;2(2):175–184
  89. Hicks CL, von Baeyer CL, Spafford PA, van Korlaar I, Goodenough B. The Faces Pain Scale-Revised: toward a common metric in pediatric pain measurement. *Pain.* 2001;93(2):173–183
  90. Belville RG, Seupaul RA. Pain measurement in pediatric emergency care: a review of the faces pain scale-revised. *Pediatr Emerg Care.* 2005;21(2):90–93
  91. Stinson JN, Kavanagh T, Yamada J, Gill N, Stevens B. Systematic review of the psychometric properties, interpretability and feasibility of self-report pain intensity measures for use in clinical trials in children and adolescents. *Pain.* 2006;125(1-2):143–157
  92. McGrath PJ, Walco GA, Turk DC, et al; PedIMMPACT. Core outcome domains and measures for pediatric acute and chronic/recurrent pain clinical trials: PedIMMPACT recommendations. *J Pain.* 2008;9(9):771–783
  93. Bulloch B, Tenenbein M. Validation of 2 pain scales for use in the pediatric emergency department. *Pediatrics.* 2002;110(3):e33
  94. McGrath P, Johnson G, Goodman J, Schillinger J, Dunn J, Chapman J. CHEOPS: a behavioral scale for rating postoperative pain in children. *Adv Pain Res Ther.* 1985;9:395–402
  95. Grunau RVE, Craig KD. Pain expression in neonates: facial action and cry. *Pain.* 1987;28(3):395–410
  96. McGrath P. Behavioral measures of pain. In: Finley G, McGrath P, eds. *Measurement of Pain in Infants and Children.* Seattle, WA: IASP Press; 1998:83–102
  97. Lawrence J, Alcock D, McGrath P, Kay J, MacMurray SB, Dulberg C. The development of a tool to assess neonatal pain. *Neonatal Netw.* 1993;12(6):59–66
  98. Merkel SI, Voepel-Lewis T, Shayevitz JR, Malviya S. The FLACC: a behavioral scale for scoring postoperative pain in young children. *Pediatr Nurs.* 1997;23(3):293–297
  99. Malviya S, Voepel-Lewis T, Tait AR, Merkel S, Tremper K, Naughton N. Depth of sedation in children undergoing computed tomography: validity and reliability of the University of Michigan Sedation Scale (UMSS). *Br J Anaesth.* 2002;88(2):241–245
  100. Merkel S, Voepel-Lewis T, Malviya S. Pain assessment in infants and young children: the FLACC scale. *Am J Nurs.* 2002;102(10):55–58
  101. Munro HM, Walton SR, Malviya S, et al. Low-dose ketorolac improves analgesia and reduces morphine requirements following posterior spinal fusion in adolescents. *Can J Anaesth.* 2002;49(5):461–466
  102. Riegger LQ, Voepel-Lewis T, Kulik TJ, et al. Albumin versus crystalloid prime solution for cardiopulmonary bypass in young children. *Crit Care Med.* 2002;30(12):2649–2654
  103. Tait AR, Voepel-Lewis T, Robinson A, Malviya S. Priorities for disclosure of the elements of informed consent for research: a comparison between parents and investigators. *Paediatr Anaesth.* 2002;12(4):332–336
  104. Voepel-Lewis T, Merkel S, Tait AR, Trzcinka A, Malviya S. The reliability and validity of the Face, Legs, Activity, Cry, Consolability observational tool as a measure of pain in children with cognitive impairment. *Anesth Analg.* 2002;95(5):1224–1229
  105. Drendel AL, Brousseau DC, Gorelick MH. Pain assessment for pediatric patients in the emergency department. *Pediatrics.* 2006;117(5):1511–1518



106. Sacchetti A, Baren J, Carraccio C. Total procedural requirements as indication for emergency department sedation. *Pediatr Emerg Care*. 2010;26(3):209–211
107. Michaelowski T, Zempsky W, Schechter N. Pain in low-severity emergency department visits: frequency and management [abstract]. *Ann Emerg Med*. 2001;38:S21
108. Fein JA, Callahan JM, Boardman CR. Intravenous catheterization in the ED: is there a role for topical anesthesia? *Am J Emerg Med*. 1999;17(6):624–625
109. Fein JA, Callahan JM, Boardman CR, Gorelick MH. Predicting the need for topical anesthetic in the pediatric emergency department. *Pediatrics*. 1999;104(2):e19
110. Kleiber C, Sorenson M, Whiteside K, Gronstal BA, Tannous R. Topical anesthetics for intravenous insertion in children: a randomized equivalency study. *Pediatrics*. 2002;110(4):758–761
111. Eichenfield LF, Funk A, Fallon-Friedlander S, Cunningham BB. A clinical study to evaluate the efficacy of ELA-Max (4% liposomal lidocaine) as compared with eutectic mixture of local anesthetics cream for pain reduction of venipuncture in children. *Pediatrics*. 2002;109(6):1093–1099
112. Curry SE, Finkel JC. Use of the Synera patch for local anesthesia before vascular access procedures: a randomized, double-blind, placebo-controlled study. *Pain Med*. 2007;8(6):497–502
113. Baxter AL, Fisher RG, Burke BL, Goldblatt SS, Isaacman DJ, Lawson ML. Local anesthetic and stylet styles: factors associated with resident lumbar puncture success. *Pediatrics*. 2006;117(3):876–881
114. Taddio A, Soin HK, Schuh S, Koren G, Scolnik D. Liposomal lidocaine to improve procedural success rates and reduce procedural pain among children: a randomized controlled trial. *CMAJ*. 2005;172(13):1691–1695
115. Klein EJ, Shugerman RP, Leigh-Taylor K, Schneider C, Portscheller D, Koepsell T. Buffered lidocaine: analgesia for intravenous line placement in children. *Pediatrics*. 1995;95(5):709–712
116. Sacchetti AD, Carraccio C. Subcutaneous lidocaine does not affect the success rate of intravenous access in children less than 24 months of age. *Acad Emerg Med*. 1996;3(11):1016–1019
117. Fein JA, Boardman CR, Stevenson S, Selbst SM. Saline with benzyl alcohol as intradermal anesthesia for intravenous line placement in children. *Pediatr Emerg Care*. 1998;14(2):119–122
118. Luhmann J, Hurt S, Shootman M, Kennedy R. A comparison of buffered lidocaine versus ELA-Max before peripheral intravenous catheter insertions in children. *Pediatrics*. 2004;113(3 pt 1). Available at: [www.pediatrics.org/cgi/content/full/113/3/e217](http://www.pediatrics.org/cgi/content/full/113/3/e217)
119. Brown D. Local anesthesia for vein cannulation: a comparison of two solutions. *J Infus Nurs*. 2004;27(2):85–88
120. Zempsky WT, Robbins B, Richards PT, Leong MS, Schechter NL. A novel needle-free powder lidocaine delivery system for rapid local analgesia. *J Pediatr*. 2008;152(3):405–411
121. Zempsky WT, Bean-Lijewski J, Kauffman RE, et al. Needle-free powder lidocaine delivery system provides rapid effective analgesia for venipuncture or cannulation pain in children: randomized, double-blind Comparison of Venipuncture and Venous Cannulation Pain After Fast-Onset Needle-Free Powder Lidocaine or Placebo Treatment trial. *Pediatrics*. 2008;121(5):979–987
122. Lysakowski C, Dumont L, Tramèr MR, Tassonyi E. A needle-free jet-injection system with lidocaine for peripheral intravenous cannula insertion: a randomized controlled trial with cost-effectiveness analysis. *Anesth Analg*. 2003;96(1):215–219
123. Jimenez N, Bradford H, Seidel KD, Sousa M, Lynn AM. A comparison of a needle-free injection system for local anesthesia versus EMLA for intravenous catheter insertion in the pediatric patient. *Anesth Analg*. 2006;102(2):411–414
124. Cohen Reis E, Holubkov R. Vapocoolant spray is equally effective as EMLA cream in reducing immunization pain in school-aged children. *Pediatrics*. 1997;100(6):E5
125. Ramsook C, Kozinetz C, Moro-Sutherland D. The efficacy of ethyl chloride as a local anesthetic for venipuncture in an emergency room setting. Paper presented at: 39th Annual Meeting of the Ambulatory Pediatric Association; May 3, 1999; San Francisco, CA
126. Schilling CG, Bank DE, Borchert BA, Klatzko MD, Uden DL. Tetracaine, epinephrine (adrenalin), and cocaine (TAC) versus lidocaine, epinephrine, and tetracaine (LET) for anesthesia of lacerations in children. *Ann Emerg Med*. 1995;25(2):203–208
127. Ernst AA, Marvez E, Nick TG, Chin E, Wood E, Gonzaba WT. Lidocaine adrenaline tetracaine gel versus tetracaine adrenaline cocaine gel for topical anesthesia in linear scalp and facial lacerations in children aged 5 to 17 years. *Pediatrics*. 1995;95(2):255–258
128. Zempsky WT, Karasic RB. EMLA versus TAC for topical anesthesia of extremity wounds in children. *Ann Emerg Med*. 1997;30(2):163–166
129. Singer AJ, Stark MJ. LET versus EMLA for pretreating lacerations: a randomized trial. *Acad Emerg Med*. 2001;8(3):223–230
130. Simon HK, McLario DJ, Bruns TB, Zempsky WT, Wood RJ, Sullivan KM. Long-term appearance of lacerations repaired using a tissue adhesive. *Pediatrics*. 1997;99(2):193–195
131. Quinn J, Wells G, Sutcliffe T, et al. A randomized trial comparing octylcyanoacrylate tissue adhesive and sutures in the management of lacerations. *JAMA*. 1997;277(19):1527–1530
132. Zempsky WT, Parrotti D, Grem C, Nichols J. Randomized controlled comparison of cosmetic outcomes of simple facial lacerations closed with Steri Strip Skin Closures or Dermabond tissue adhesive. *Pediatr Emerg Care*. 2004;20(8):519–524
133. Holger JS, Wandersee SC, Hale DB. Cosmetic outcomes of facial lacerations repaired with tissue-adhesive, absorbable, and nonabsorbable sutures. *Am J Emerg Med*. 2004;22(4):254–257
134. Karounis H, Gouin S, Eisman H, Chalut D, Pelletier H, Williams B. A randomized, controlled trial comparing long-term cosmetic outcomes of traumatic pediatric lacerations repaired with absorbable plain gut versus nonabsorbable nylon sutures. *Acad Emerg Med*. 2004;11(7):730–735
135. Bartfield JM, Gennis P, Barbera J, Breuer B, Gallagher EJ. Buffered versus plain lidocaine as a local anesthetic for simple laceration repair. *Ann Emerg Med*. 1990;19(12):1387–1389
136. Davidson JA, Boom SJ. Warming lignocaine to reduce pain associated with injection. *BMJ*. 1992;305(6854):617–618
137. Krause RS, Moscati R, Filice M, Lerner EB, Hughes D. The effect of injection speed on the pain of lidocaine infiltration. *Acad Emerg Med*. 1997;4(11):1032–1035
138. Scarfone RJ, Jasani M, Gracely EJ. Pain of local anesthetics: rate of administration and buffering. *Ann Emerg Med*. 1998;31(1):36–40
139. Bartfield JM, Sokaris SJ, Raccio-Robak N. Local anesthesia for lacerations: pain of infiltration inside vs outside the wound. *Acad Emerg Med*. 1998;5(2):100–104
140. Bartfield JM, Homer PJ, Ford DT, Sternklar P. Buffered lidocaine as a local anesthetic: an investigation of shelf life. *Ann Emerg Med*. 1992;21(1):16–19
141. Meyer G, Henneman PL, Fu P. Buffered lidocaine. *Ann Emerg Med*. 1991;20(2):218–219
142. Cook IF, Murtagh J. Needle length required for intramuscular vaccination of infants

- and toddlers. An ultrasonographic study. *Aust Fam Physician*. 2002;31(3):295–297
143. Groswasser J, Kahn A, Bouche B, Hanquinet S, Perlmutter N, Hessel L. Needle length and injection technique for efficient intramuscular vaccine delivery in infants and children evaluated through an ultrasonographic determination of subcutaneous and muscle layer thickness. *Pediatrics*. 1997;100(3 pt 1):400–403
  144. Barnhill BJ, Holbert MD, Jackson NM, Erickson RS. Using pressure to decrease the pain of intramuscular injections. *J Pain Symptom Manage*. 1996;12(1):52–58
  145. Chung JW, Ng WM, Wong TK. An experimental study on the use of manual pressure to reduce pain in intramuscular injections. *J Clin Nurs*. 2002;11(4):457–461
  146. Taddio A, Ohlsson A, Einarson TR, Stevens B, Koren G. A systematic review of lidocaine-prilocaine cream (EMLA) in the treatment of acute pain in neonates. *Pediatrics*. 1998;101(2). Available at: [www.pediatrics.org/cgi/content/full/101/2/e1](http://www.pediatrics.org/cgi/content/full/101/2/e1)
  147. Essink-Tebbes CM, Wuis EW, Liem KD, van Dongen RT, Hekster YA. Safety of lidocaine-prilocaine cream application four times a day in premature neonates: a pilot study. *Eur J Pediatr*. 1999;158(5):421–423
  148. Brisman M, Ljung BM, Otterbom I, Larsson LE, Andréasson SE. Methaemoglobin formation after the use of EMLA cream in term neonates. *Acta Paediatr*. 1998;87(11):1191–1194
  149. Taddio A, Shah V, Katz J. Reduced infant response to a routine care procedure after sucrose analgesia. *Pediatrics*. 2009;123(3). Available at: [www.pediatrics.org/cgi/content/full/123/3/e425](http://www.pediatrics.org/cgi/content/full/123/3/e425)
  150. Hatfield LA, Gusic ME, Dyer A-M, Polomano RC. Analgesic properties of oral sucrose during routine immunizations at 2 and 4 months of age. *Pediatrics*. 2008;121(2). Available at: [www.pediatrics.org/cgi/content/full/121/2/e327](http://www.pediatrics.org/cgi/content/full/121/2/e327)
  151. Blass E, Fitzgerald E, Kehoe P. Interactions between sucrose, pain and isolation distress. *Pharmacol Biochem Behav*. 1987;26(3):483–489
  152. Barr RG, Young SN, Wright JH, et al. “Sucrose analgesia” and diphtheria-tetanus-pertussis immunizations at 2 and 4 months. *J Dev Behav Pediatr*. 1995;16(4):220–225
  153. Lewindon PJ, Harkness L, Lewindon N. Randomised controlled trial of sucrose by mouth for the relief of infant crying after immunisation. *Arch Dis Child*. 1998;78(5):453–456
  154. Stevens B, Taddio A, Ohlsson A, Einarson T. The efficacy of sucrose for relieving procedural pain in neonates—a systematic review and meta-analysis. *Acta Paediatr*. 1997;86(8):837–842
  155. Harrison D, Bueno M, Yamada J, Adams-Webber T, Stevens B. Analgesic effects of sweet-tasting solutions for infants: current state of equipoise. *Pediatrics*. 2010;126(5):894–902
  156. Harrison D, Stevens B, Bueno M, et al. Efficacy of sweet solutions for analgesia in infants between 1 and 12 months of age: a systematic review. *Arch Dis Child*. 2010;95(6):406–413
  157. Harrison D, Yamada J, Stevens B. Strategies for the prevention and management of neonatal and infant pain. *Curr Pain Headache Rep*. 2010;14(2):113–123
  158. Stevens B, Johnston C, Taddio A, Gibbins S, Yamada J. The premature infant pain profile: evaluation 13 years after development. *Clin J Pain*. 2010;26(9):813–830
  159. Stevens B, McGrath P, Ballantyne M, et al. Influence of risk of neurological impairment and procedure invasiveness on health professionals’ management of procedural pain in neonates. *Eur J Pain*. 2010;14(7):735–741
  160. Stevens B, Yamada J, Ohlsson A. Sucrose for analgesia in newborn infants undergoing painful procedures. *Cochrane Database Syst Rev*. 2010;(1):CD001069
  161. Yamada J, Stevens B, Sidani S, Watt-Watson J, de Silva N. Content validity of a process evaluation checklist to measure intervention implementation fidelity of the EPIC intervention. *Worldviews Evid Based Nurs*. 2010;7(3):158–164
  162. Carbajal R, Chauvet X, Couderc S, Olivier-Martin M. Randomised trial of analgesic effects of sucrose, glucose, and pacifiers in term neonates. *BMJ*. 1999;319(7222):1393–1397
  163. Gray L, Miller LW, Philipp BL, Blass EM. Breastfeeding is analgesic in healthy newborns. *Pediatrics*. 2002;109(4):590–593
  164. Gray L, Watt L, Blass EM. Skin-to-skin contact is analgesic in healthy newborns. *Pediatrics*. 2000;105(1). Available at: [www.pediatrics.org/cgi/content/full/e14](http://www.pediatrics.org/cgi/content/full/e14)
  165. Pinheiro JM, Furdon S, Ochoa LF. Role of local anesthesia during lumbar puncture in neonates. *Pediatrics*. 1993;91(2):379–382
  166. Kaur G, Gupta P, Kumar A. A randomized trial of eutectic mixture of local anesthetics during lumbar puncture in newborns. *Arch Pediatr Adolesc Med*. 2003;157(11):1065–1070
  167. Carraccio C, Feinberg P, Hart LS, Quinn M, King J, Lichenstein R. Lidocaine for lumbar punctures. A help not a hindrance. *Arch Pediatr Adolesc Med*. 1996;150(10):1044–1046
  168. Larsson BA, Tannfeldt G, Lagercrantz H, Olsson GL. Venipuncture is more effective and less painful than heel lancing for blood tests in neonates. *Pediatrics*. 1998;101(5):882–886
  169. Uhari M. A eutectic mixture of lidocaine and prilocaine for alleviating vaccination pain in infants. *Pediatrics*. 1993;92(5):719–721
  170. Ipp MM, Gold R, Goldbach M, et al. Adverse reactions to diphtheria, tetanus, pertussis-polio vaccination at 18 months of age: effect of injection site and needle length. *Pediatrics*. 1989;83(5):679–682
  171. Holmes HS. Options for painless local anesthesia. *Postgrad Med*. 1991;89(3):71–72
  172. Keen MF. Comparison of intramuscular injection techniques to reduce site discomfort and lesions. *Nurs Res*. 1986;35(4):207–210
  173. Main KM, Jørgensen JT, Hertel NT, Jensen S, Jakobsen L. Automatic needle insertion diminishes pain during growth hormone injection. *Acta Paediatr*. 1995;84(3):331–334
  174. Schichor A, Bernstein B, Weinerman H, Fitzgerald J, Yordan E, Schechter N. Lidocaine as a diluent for ceftriaxone in the treatment of gonorrhea. Does it reduce the pain of the injection? *Arch Pediatr Adolesc Med*. 1994;148(1):72–75
  175. LoVecchio F, Oster N, Sturmman K, Nelson LS, Flashner S, Finger R. The use of analgesics in patients with acute abdominal pain. *J Emerg Med*. 1997;15(6):775–779
  176. Pace S, Burke TF. Intravenous morphine for early pain relief in patients with acute abdominal pain. *Acad Emerg Med*. 1996;3(12):1086–1092
  177. Attard AR, Corlett MJ, Kidner NJ, Leslie AP, Fraser IA. Safety of early pain relief for acute abdominal pain. *BMJ*. 1992;305(6853):554–556
  178. Green R, Bulloch B, Kabani A, Hancock BJ, Tenenbein M. Early analgesia for children with acute abdominal pain. *Pediatrics*. 2005;116(4):978–983
  179. Kim MK, Strait RT, Sato TT, Hennes HM. A randomized clinical trial of analgesia in children with acute abdominal pain. *Acad Emerg Med*. 2002;9(4):281–287
  180. Bailey B, Bergeron S, Gravel J, Bussi eres J-F, Bensoussan A. Efficacy and impact of intravenous morphine before surgical consultation in children with right lower quadrant pain suggestive of appendicitis: a randomized controlled trial. *Ann Emerg Med*. 2007;50(4):371–378

181. Hedderich R, Ness TJ. Analgesia for trauma and burns. *Crit Care Clin*. 1999;15(1):167–184
182. Joseph MH, Brill J, Zeltzer LK. Pediatric pain relief in trauma. *Pediatr Rev*. 1999;20(3):75–83, quiz 84
183. Zohar ZRN, Eitan AMD, Halperin PMD, et al. Pain relief in major trauma patients: an Israeli perspective. *J Trauma*. 2001;51(4):767–772
184. Fletcher AK, Rigby AS, Heyes FLP. Three-in-one femoral nerve block as analgesia for fractured neck of femur in the emergency department: a randomized, controlled trial. *Ann Emerg Med*. 2003;41(2):227–233
185. Blasier RD, White R. Intravenous regional anesthesia for management of children's extremity fractures in the emergency department. *Pediatr Emerg Care*. 1996;12(6):404–406
186. Wolfe TR, Braude DA. Intranasal medication delivery for children: a brief review and update. *Pediatrics*. 2010;126(3):532–537
187. Borland M, Jacobs I, King B, O'Brien D. A randomized controlled trial comparing intranasal fentanyl to intravenous morphine for managing acute pain in children in the emergency department. *Ann Emerg Med*. 2007;49(3):335–340
188. Miner JR, Kletti C, Herold M, Hubbard D, Biros MH. Randomized clinical trial of nebulized fentanyl citrate versus i.v. fentanyl citrate in children presenting to the emergency department with acute pain. *Acad Emerg Med*. 2007;14(10):895–898
189. Furyk JS, Grabowski WJ, Black LH. Nebulized fentanyl versus intravenous morphine in children with suspected limb fractures in the emergency department: a randomized controlled trial. *Emerg Med Australas*. 2009;21(3):203–209
190. Theroux MC, West DW, Corrdry DH, et al. Efficacy of intranasal midazolam in facilitating suturing of lacerations in preschool children in the emergency department. *Pediatrics*. 1993;91(3):624–627
191. Kogan A, Katz J, Efrat R, Eidelman LA. Premedication with midazolam in young children: a comparison of four routes of administration. *Paediatr Anaesth*. 2002;12(8):685–689
192. Henry RJ, Ruano N, Casto D, Wolf RH. A pharmacokinetic study of midazolam in dogs: nasal drop vs. atomizer administration. *Pediatr Dent*. 1998;20(5):321–326
193. Klein EJ, Brown JC, Kobayashi A, Osincup D, Seidel K. A randomized clinical trial comparing oral, aerosolized intranasal, and aerosolized buccal midazolam. *Ann Emerg Med*. 2011;58(4):323–329
194. Primosch R, Bender F. Factors associated with administration route when using midazolam for pediatric conscious sedation. *ASDC J Dent Child*. 2001;68(4):233–238, 228
195. Bassett KE, Anderson JL, Pribble GG, Guenther E. Propofol for procedural sedation in children in the emergency department. *Ann Emerg Med*. 2003;42(6):773–782
196. Miner JR, Burton JH. Clinical practice advisory: emergency department procedural sedation with propofol. *Ann Emerg Med*. 2007;50(2):182–187, 187.e1
197. Hohl CM, Sadatsafavi M, Nosyk B, Anis AH. Safety and clinical effectiveness of midazolam versus propofol for procedural sedation in the emergency department: a systematic review. *Acad Emerg Med*. 2008;15(1):1–8
198. Pershad J, Wan J, Anghelescu DL. Comparison of propofol with pentobarbital/midazolam/fentanyl sedation for magnetic resonance imaging of the brain in children. *Pediatrics*. 2007;120(3). Available at: [www.pediatrics.org/cgi/content/full/120/3/e629](http://www.pediatrics.org/cgi/content/full/120/3/e629)
199. Rothermel LK. Newer pharmacologic agents for procedural sedation of children in the emergency department: etomidate and propofol. *Curr Opin Pediatr*. 2003;15(2):200–203
200. Havel CJ, Jr; Strait RT, Hennes H. A clinical trial of propofol vs midazolam for procedural sedation in a pediatric emergency department. *Acad Emerg Med*. 1999;6(10):989–997
201. Andolfatto G, Willman E. A prospective case series of single-syringe ketamine-propofol (Ketofol) for emergency department procedural sedation and analgesia in adults. *Acad Emerg Med*. 2011;18(3):237–245
202. Mallory MD, Baxter AL, Yanosky DJ, Cravero JP. Emergency physician-administered propofol sedation: a report on 25,433 sedations from the pediatric sedation research consortium. *Ann Emerg Med*. 2011;57(5):462.e1–468.e1
203. Green SM, Andolfatto G, Krauss B. Ketofol for procedural sedation? Pro and con. *Ann Emerg Med*. 2011;57(5):444–448
204. da Silva PS, de Aguiar VE, Waisberg DR, Passos RM, Park MV. Use of ketofol for procedural sedation and analgesia in children with hematological diseases. *Pediatr Int*. 2011;53(1):62–67
205. Nejati A, Moharari RS, Ashraf H, Labaf A, Golshani K. Ketamine/propofol versus midazolam/fentanyl for procedural sedation and analgesia in the emergency department: a randomized, prospective, double-blind trial. *Acad Emerg Med*. 2011;18(8):800–806
206. Litman RS, Berkowitz RJ, Ward DS. Levels of consciousness and ventilatory parameters in young children during sedation with oral midazolam and nitrous oxide. *Arch Pediatr Adolesc Med*. 1996;150(7):671–675
207. Cravero JP, Beach ML, Blike GT, Gallagher SM, Hertzog JH; Pediatric Sedation Research Consortium. The incidence and nature of adverse events during pediatric sedation/anesthesia with propofol for procedures outside the operating room: a report from the Pediatric Sedation Research Consortium. *Anesth Analg*. 2009;108(3):795–804
208. Cravero JP. Risk and safety of pediatric sedation/anesthesia for procedures outside the operating room. *Curr Opin Anaesthesiol*. 2009;22(4):509–513
209. Champagne T, Stromberg N. Sensory approaches in inpatient psychiatric settings: innovative alternatives to seclusion & restraint. *J Psychosoc Nurs Ment Health Serv*. 2004;42(9):34–44
210. Cooley WC, McAllister JW. Building medical homes: improvement strategies in primary care for children with special health care needs. *Pediatrics*. 2004;113(5 suppl):1499–1506
211. Raphael JL, Zhang Y, Liu H, Tapia CD, Giardino AP. Association of medical home care and disparities in emergency care utilization among children with special health care needs. *Acad Pediatr*. 2009;9(4):242–248
212. Biersdorff KK. Incidence of significantly altered pain experience among individuals with developmental disabilities. *Am J Ment Retard*. 1994;98(5):619–631
213. Oberlander T. Pain assessment and management in infants and young children with developmental disabilities. *Infants Young Child*. 2001;14(2):33–47
214. Oberlander TF, O'Donnell ME. Beliefs about pain among professionals working with children with significant neurologic impairment. *Dev Med Child Neurol*. 2001;43(2):138–140
215. Schneider F, Habel U, Holthusen H, et al. Subjective ratings of pain correlate with subcortical-limbic blood flow: an fMRI study. *Neuropsychobiology*. 2001;43(3):175–185
216. Breau LM, Burkitt C. Assessing pain in children with intellectual disabilities. *Pain Res Manag*. 2009;14(2):116–120
217. Lotan M, Ljunggren EA, Johnsen TB, Defrin ZR, Pick CG, Strand LI. A modified version of the non-communicating children pain checklist-revised, adapted to adults with intellectual and developmental disabilities:

- sensitivity to pain and internal consistency. *J Pain*. 2009;10(4):398–407
218. Malviya S, Voepel-Lewis T, Burke C, Merkel S, Tait AR. The revised FLACC observational pain tool: improved reliability and validity for pain assessment in children with cognitive impairment. *Paediatr Anaesth*. 2006;16(3):258–265
  219. Solodiuk JC, Scott-Sutherland J, Meyers M, et al. Validation of the Individualized Numeric Rating Scale (INRS): a pain assessment tool for nonverbal children with intellectual disability. *Pain*. 2010;150(2):231–236
  220. Green SM. Propofol in emergency medicine: further evidence of safety. *Emerg Med Australas*. 2007;19(5):389–393
  221. Miner JR, Burton JH. Clinical practice advisory: emergency department procedural sedation with propofol. *Ann Emerg Med*. 2007;50(2):182–187, 187.e1
  222. Couloures KG, Beach M, Cravero JP, Monroe KK, Hertzog JH. Impact of provider specialty on pediatric procedural sedation complication rates. *Pediatrics*. 2011;127(5). Available at: [www.pediatrics.org/cgi/content/full/127/5/e1154](http://www.pediatrics.org/cgi/content/full/127/5/e1154)
  223. American Society of Anesthesiologists Task Force on Sedation and Analgesia by Non-Anesthesiologists. Practice guidelines for sedation and analgesia by non-anesthesiologists. *Anesthesiology*. 2002;96(4):1004–1017
  224. Coté CJ, Notterman DA, Karl HW, Weinberg JA, McCloskey C. Adverse sedation events in pediatrics: a critical incident analysis of contributing factors. *Pediatrics*. 2000;105(4 pt 1):805–814
  225. Krauss B, Hess DR. Capnography for procedural sedation and analgesia in the emergency department. *Ann Emerg Med*. 2007;50(2):172–181
  226. Anderson JL, Junkins E, Pribble C, Guenther E. Capnography and depth of sedation during propofol sedation in children. *Ann Emerg Med*. 2007;49(1):9–13
  227. Coté CJ, Wilson S; American Academy of Pediatrics; American Academy of Pediatric Dentistry; Work Group on Sedation. Guidelines for monitoring and management of pediatric patients during and after sedation for diagnostic and therapeutic procedures: an update. *Pediatrics*. 2006;118(6):2587–2602
  228. Mace SE, Brown LA, Francis L, et al. Clinical policy: critical issues in the sedation of pediatric patients in the emergency department. *Ann Emerg Med*. 2008;51(4):378–399, 399.e1–399.e7
  229. Green SM, Krauss B. Clinical practice guideline for emergency department ketamine dissociative sedation in children. *Ann Emerg Med*. 2004;44(5):460–471
  230. Cravero JP, Blike GT, Beach M, et al; Pediatric Sedation Research Consortium. Incidence and nature of adverse events during pediatric sedation/anesthesia for procedures outside the operating room: report from the Pediatric Sedation Research Consortium. *Pediatrics*. 2006;118(3):1087–1096
  231. Krauss B, Green SM. Procedural sedation and analgesia in children. *Lancet*. 2006;367(9512):766–780
  232. Krauss B. Managing acute pain and anxiety in children undergoing procedures in the emergency department. *Emerg Med (Fremantle)*. 2001;13(3):293–304
  233. Kennedy RM, Luhmann JD. The “ouchless emergency department”. Getting closer: advances in decreasing distress during painful procedures in the emergency department. *Pediatr Clin North Am*. 1999;46(6):1215–1247, vii–viii
  234. Jagoda AS, Campbell M, Karas JS, et al; American College of Emergency Physicians. Clinical policy for procedural sedation and analgesia in the emergency department. *Ann Emerg Med*. 1998;31(5):663–677
  235. Hoffman GM, Nowakowski R, Troshynski TJ, Berens RJ, Weisman SJ. Risk reduction in pediatric procedural sedation by application of an American Academy of Pediatrics/American Society of Anesthesiologists process model. *Pediatrics*. 2002;109(2):236–243
  236. McDevit D, Perry H, Tucker J, Zempsky W. Sedation in the pediatric emergency department: a survey of emergency department directors’ adherence to sedation guidelines [abstract 106]. *Ann Emerg Med*. 2000;36(suppl):S28
  237. Roback M, Wathen J, Bajaj L. Effect of NPO time on adverse events in pediatric procedural sedation and analgesia [abstract 620]. *Pediatr Res*. 2003;53:109A
  238. Phrampus E, Pitetti R, Singh S. Duration of fasting and occurrence of adverse events during procedural sedation in a pediatric emergency department [abstract 612]. *Pediatr Res*. 2003;53:109A
  239. Agrawal D, Manzi SF, Gupta R, Krauss B. Preprocedural fasting state and adverse events in children undergoing procedural sedation and analgesia in a pediatric emergency department. *Ann Emerg Med*. 2003;42(5):636–646
  240. Peña BMG, Krauss B. Adverse events of procedural sedation and analgesia in a pediatric emergency department. *Ann Emerg Med*. 1999;34(4 pt 1):483–491
  241. Green SM, Kuppermann N, Rothrock SG, Hummel CB, Ho M. Predictors of adverse events with intramuscular ketamine sedation in children. *Ann Emerg Med*. 2000;35(1):35–42
  242. Green SM, Krauss B. Pulmonary aspiration risk during emergency department procedural sedation—an examination of the role of fasting and sedation depth. *Acad Emerg Med*. 2002;9(1):35–42
  243. American Society of Anesthesiologists Committee. Practice guidelines for pre-operative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: application to healthy patients undergoing elective procedures: an updated report by the American Society of Anesthesiologists Committee on Standards and Practice Parameters. *Anesthesiology*. 2011;114(3):495–511
  244. Green SM, Roback MG, Miner JR, Burton JH, Krauss B. Fasting and emergency department procedural sedation and analgesia: a consensus-based clinical practice advisory. *Ann Emerg Med*. 2007;49(4):454–461
  245. Malviya S, Voepel-Lewis T, Ludomirsky A, Marshall J, Tait AR. Can we improve the assessment of discharge readiness? A comparative study of observational and objective measures of depth of sedation in children. *Anesthesiology*. 2004;100(2):218–224
  246. Miaskowski C. Monitoring and improving pain management practices. A quality improvement approach. *Crit Care Nurs Clin North Am*. 2001;13(2):311–317
  247. Gordon DB, Pellino TA, Miaskowski C, et al. A 10-year review of quality improvement monitoring in pain management: recommendations for standardized outcome measures. *Pain Manag Nurs*. 2002;3(4):116–130
  248. American Pain Society Quality of Care Committee. Quality improvement guidelines for the treatment of acute pain and cancer pain. *JAMA*. 1995;274(23):1874–1880
  249. Krauss B, Green SM. Training and credentialing in procedural sedation and analgesia in children: lessons from the United States model. *Paediatr Anaesth*. 2008;18(1):30–35



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