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Pain Management in Pediatric Trauma

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Abstract

Purpose of Review Clinicians struggle to manage pain in pediatric patients, challenged by developmental constraints, nonlinear physiology, and uncertainty about pharmacological risks, all in the context of the decision pressure of trauma. This review describes means to mitigate these uncertainties.

Recent Findings In the past 5 years, focus of investigations has been on pediatric burn patients and using new technologies, such as virtual reality, to provide distraction during painful procedures. Further evidence demonstrates that the setting in which trauma patients receive initial pain control is important, as many children do not receive adequate analgesia in the prehospital setting.

Summary Pain management in trauma can be approached as special instances of validated principles applied to adults but requires knowledge of adjunct therapeutic options and special consideration of both patient and caregiver anxiety.

Keywords Pediatric · Trauma · Pain · Emergency medicine · Surgery · Anesthesia

Introduction

Adequate pain management in the pediatric population has often been challenging to clinicians. While the opioid epidemic has played an important role in forcing clinicians to pause before prescribing opioids, especially to vulnerable children, numerous challenges in the pediatric age group preceded the opioid crisis. Pain in children is exacerbated by fear, anxiety, and less developed coping mechanisms, on top of the developmental physiology in each age group. Children must be able to identify, quantify, and communicate the pain, which relies upon social and intellectual abilities. [1••] For the clinician and caregiver, assessing a child's pain requires astute observation if the child is unable to do so. Studies have shown that children who experience significant pain can have alterations in their nociceptive capabilities, contributing to long-term psychological dysfunction and chronic pain syndromes. [2••, 3, 4]

What we know from the current body of literature is that timely analgesic intervention is often delayed for pediatric trauma patients. In this article, we review literature from 2015 to 2020 with our updated recommendations on the principles of pain management, pharmacologic and non-pharmacologic interventions, and areas in which we must improve the quality of care we are providing children in the acute trauma setting.

Pain Assessment

Pain rating scales exist to assist clinicians in assessing patients in each age group. Infants and nonverbal children are rated by provider observation scales that factor in any vocal, facial, and motor responses, as well as behaviors such as consolability and level of interaction. Examples of these scales are the Revised Face, Legs, Activity, Cry, Consolability (r-FLACC), Non-Communicating Children's Pain Checklist-Postoperative Version (NCCPC-PV), Nursing Assessment of Pain Intensity (NAPI), Pediatric Pain Profile (PPP), and Individualized Numeric Rating Scale (INRS).

This article is part of the Topical Collection on *Pain Management in Trauma*

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While useful tools, these scales are not as accurate as self-reported pain and many are not validated in burn patients. [3, 5] The r-FLACC is commonly used by nurses for ongoing pain assessment in administering as-needed and nursing-controlled analgesics. Persistently elevated r-FLACC scores despite intervention may trigger alerting the clinician. Clinicians may use components of the r-FLACC in conjunction with vital signs, intake and output, and physical examination to determine pain as the source of an infant or nonverbal child's discomfort.

Visual scales are used for children ages 3 to 8. These are widely available and typically involve variations of smiley faces or other graphics that correlate with the standard numerical system (1–10). Fear and anxiety are a major inhibition to ascertaining pain levels in this age group, so extra measures must be taken to develop rapport with these children, child life specialists may be involved, and cues from the caregivers regarding the patient's baseline and pain tolerance can be utilized. In the acute trauma setting, it may not be possible to utilize the visual scale, so caregiver assessment is of great utility. Pre-adolescents may also use visual scales or the numerical rating system when appropriate. Typically, adolescents have the ability to qualify their pain and do not require a specific tool for assessment.

As mentioned above, there are special considerations in the trauma bay. In this acute setting, it is often difficult to obtain an accurate pain scale rating. After the primary and secondary surveys, consideration must be given to the location and severity of injuries as well as vital signs to guide empiric pain regimen until a more focused assessment can be performed.

General Principles of Pain Management

In a 2003 editorial issue of the *Journal of Pediatrics*, Berde and Wolfe highlighted the importance of distinguishing management of pain from management of anxiety. "Because pain and anxiety are frequently behaviorally indistinguishable, the combination is often referred to as distress." [6] This is most apparent in trauma scenarios where the fear and anxiety provoked by the unfamiliar hospital environment is compounded by the rapid nature of the trauma evaluation, and often with a delay in arrival of the caregiver to the bedside. So it follows that approaches to pain management should attend to both noxious pain and behavioral anxiety and fear. [7]

Three general rules should guide pain mitigation for any patient, regardless of age or size:

1. Acute distress should be addressed with *multimodal pharmacotherapy*. By countering the different layers of pain with multiple mechanisms, a synergy can be achieved thereby lowering the doses of drugs with not insignificant side effects. Oral analgesics are preferred as first-line treatment in those who can tolerate oral intake, and treatments for anticipated side effects are beneficial to improve tolerance, such as adding antihistamines for pruritus or anti-nausea medications. Adjuvant medications, such as anticonvulsants that alleviate neuropathic pain or anxiolytics that lessen behavioral disturbances, are part of a comprehensive approach. Nonpharmacologic therapies, such as cognitive-behavioral therapy and physical therapy, are also part of a multimodal approach to pain management.
2. Whenever safe and possible, prescribe *standing orders* of drugs like acetaminophen and ketorolac to maintain a baseline level of pain control. As-needed (PRN) orders are often skipped when the patient is sleeping or otherwise distracted, thereby falling behind on overall pain control.
3. While an effort should be made to *minimize opioids* as much as possible, it is a fine balance to not minimize them more than necessary. Hesitancy to prescribe opioids to children translates to a failure to relieve their pain and a clinical mistake. After initiation of pain regimen, frequent reassessment of the patient's pain is of paramount importance as is addressing sources of anxiety.

Specific considerations in the pediatric population involve parents and caregivers. What pain medications do they currently give the child that work, or what prior experience have they had with pain medications? Have they had an unpleasant experience with a side effect that now makes them hesitant about certain classes of drugs? How well does their child cope with stress, anxiety, and pain-provoking situations? Has the child had behavioral or psychiatric issues requiring pharmacologic or nonpharmacologic therapies? Are there any religious, spiritual, or social factors that may influence management?

A common point in many of the prospective studies of pediatric pain management is that preparation of the individuals is key to reducing both child and caregiver distress. Child life specialists readily available in the trauma bay to assist nursing staff in describing the scene to the patient and caregiver can provide immediate comfort. [8] These specialists are invaluable for involving caregivers in coaching children during diagnostic studies or interventions, which can ease caregiver anxiety that can directly affect child anxiety. In addition to the involvement of child life specialists, once patients are stabilized in the trauma bay, it can be beneficial to quickly move those without urgent or emergent interventional needs to a quiet room in the emergency department (ED).

Setting

The first care trauma patients receive is in the ambulance or prior to ED arrival. Multiple surveys and retrospective studies found that emergency medical service (EMS) providers infrequently assess the pain of children [9] and even less frequently administer analgesia. After implementation of a standardized recommendation for prehospital pain assessment and management, no significant changes were found with very low rates of pain assessment (18%) and opioid analgesia (5%) administration. However, when analgesia was provided, intranasal fentanyl was found to be the most frequently used drug due to the ease of administration and the short duration of action. [10] Similar results were found in the combat setting of pediatric patients encountered in Iraq and Afghanistan by US troops. [11] None of the previously mentioned pain scales has been validated in the prehospital setting, posing a challenge to changing practice. There is a clear need to improve and standardize prehospital pain assessment and management. [12] One promising development is the idea of a physician-led EMS team that could administer ketamine en route to the ED. [13]

Upon arrival to the ED, delivery of analgesia is often delayed by clinical examination and other priorities in the trauma bay. In a study of patients with supracondylar fractures post intervention, pain assessments were mandatory with nursing staff capable of administering mild to moderate pain medication without physician orders. Education material was provided to house officers, yet it was found that crowding of the ED still inhibited timely and effective analgesia. [14] Prompt administration of IV analgesics after an initial assessment of vital signs and addressing life-threatening injuries is recommended, typically beginning with 1 μg (mcg)/kilogram (kg)/dose of fentanyl due to its short onset and duration, allowing reassessment and optimization of pain regimen in a more controlled capacity.

In the inpatient setting, we found one retrospective study evaluating femur and humeral fracture patients that demonstrated inconsistent use of non-opioid analgesic adjuncts while opioids were used in the majority of these patients in the ED, inpatient, and postoperative settings. [15] As previously mentioned, once trauma patients are stabilized and transferred to an inpatient bed, scheduled acetaminophen and ketorolac with PRN opioids or patient- or nursing-controlled analgesia (PCA/NCA) should be started. Based upon the age of the child and the mechanism of trauma, the next important step is assessing the need for adjunct anxiolytics and anticonvulsants. A low dose of lorazepam (0.02 mg (mg)/kg/dose) can be effective in consoling an infant who has sustained extensive injury when pain medication does not seem to be alleviating symptoms and other etiologies of discomfort have been addressed.

Pharmacologic Therapy

Multiple prior studies have demonstrated an analgesic effect of oral sucrose for painful procedures in neonates and infants. The mechanism of action and optimal dosing has not been established, but repeat dosing has been used with success for procedures such as circumcision. As a first-line agent, oral sucrose has utility for mild pain and intravenous (IV) access during a trauma workup. It is then common to follow a stepwise protocol wherein topical anesthetics are applied, followed by acetaminophen or nonsteroidal anti-inflammatory drugs (NSAIDs) for mild pain, increasing to opioids for more severe pain, ultimately considering regional nerve blockade and sedation. [16]

Opioids

For moderate to severe and refractory pain, opioids can provide effective relief. Most commonly used and well-studied in the pediatric population is morphine, which has multiple routes of administration—oral, sublingual, subcutaneous, rectal, IV, and intrathecal. A common prohibitive side effect of morphine is pruritus, secondary to its effect on histamine release. For milder forms, diphenhydramine or other antihistamines can successfully alleviate this, but for more severe reactions, switching to an alternative may be required. Hydromorphone is an acceptable alternative that is better tolerated by some, while fentanyl is uniquely useful for pediatric patients due to its shorter onset and duration in the IV form. Transdermal fentanyl is also available but is more useful for chronic pain than in the acute setting. Nalbuphine is an IV opioid used at some institutions due to its safety profile with limited respiratory depression. This is due to its mixed agonist/antagonist mechanism of action on kappa and mu receptors, respectively. In addition, nalbuphine is useful to treat opioid-induced urinary retention in the pediatric population, both anecdotally and in a recently published study. [17]

While PCA is beneficial to adults with a Glasgow Coma Scale (GCS) 15 and severe, acute pain, it is limited in utility for children until adolescence when they are reliable in their self-reported pain assessments. NCA may be an alternative, but again, requires reliable assessment using observational pain scales that may not be as accurate as self-reported pain.

Other oral opioid options that are safely used in children include oxycodone and hydrocodone, which are potent and long-acting compared to morphine. Hydrocodone is usually administered as a combination pill with acetaminophen providing additional baseline analgesia; however, care must be taken to avoid acetaminophen toxicity if acetaminophen is also prescribed independently for mild pain. Separate prescription with a combination of scheduled acetaminophen

(1000 mg every 6 h) and oxycodone (2.5 to 10 mg every 3 to 4 h, based upon age and weight), avoids potential toxicity concerns and reduces opioid use for milder pain.

Less commonly used opioids include methadone, codeine, and tramadol. Methadone is a long-acting opioid that is available in pill or elixir form, but the cumulative effects can lead to toxicity after the initial dose. Methadone is typically reserved for critically ill patients who have been on continuous opioid infusions during prolonged stays in the intensive care unit (ICU), requiring a regimented weaning protocol. Codeine and tramadol are metabolized in an unpredictable pattern in children and are not recommended in the pediatric population. A serious adverse effect of opioids is respiratory depression, so all patients who are prescribed opioids should have naloxone ordered and available in the event of inadvertent opioid overdose.

Multimodal Analgesia

Acetaminophen and NSAIDs are generally well tolerated with multiple available routes of administration. For mild pain and moderate pain, oral, or rectal acetaminophen can be very effective. IV acetaminophen is an option for those who cannot take it enterally, but it is limited in use at many institutions due to its higher cost. Ibuprofen is the most common NSAID used, which is administered orally. Precautions must be taken to avoid the development of ulcers, and it should not be used in children with renal impairment. Aspirin is an NSAID that must be avoided in young children due to the risk of Reye syndrome. Ketorolac is an IV NSAID that can provide relief of moderate pain. NSAIDs may be advantageous over acetaminophen for patients with an inflammatory component to their pain. While there have been concerns over the use of NSAIDs in the perioperative setting due to the risk of bleeding and renal and GI toxicity, there have been limited pediatric studies to recommend for or against its use. [18] Common dosing strategies include scheduled ketorolac at 15 mg/kg/dose every 6 h replaced by 600 to 800 mg ibuprofen every 8 h when the child is tolerating oral intake.

Adjuvant oral medications that treat visceral and neuropathic pain are important adjuncts. Tricyclic antidepressants and anticonvulsants, such as gabapentin, are helpful in treating neuropathic pain. Gabapentin is especially beneficial for neurologically impaired children, though it has not been well studied for pediatric burn patients who suffer from neuropathic pain. [5] While glucocorticoids are not commonly thought of as analgesics, they can reduce hepatic distension and cerebral edema, which both may cause visceral pain.

Anxiolytics are important adjuncts in pharmacologic pain management. The literature is lacking with regards to pharmacologic anxiolysis in pediatric trauma patients. There are two general categories—sedatives and benzodiazepines. Clonidine is an alpha-2 agonist that may have anxiolytic and analgesic effects. [5] Dexmedetomidine has a similar mechanism of action as clonidine and is more commonly used as a sedative. More recently, intranasal dexmedetomidine has been studied in comparison to intranasal administration of ketamine for magnetic resonance imaging, with equivalent sedative and anxiolytic effects. [19] Intranasal dexmedetomidine is commonly used for short, minor procedures in the ED with excellent results. Ketamine has become a "wonder drug" for pediatric patients in the emergency setting. As both a sedative and analgesic, ketamine provides the necessary comfort to pediatric trauma patients requiring fracture reduction, laceration repair, and other procedures performed in the ED or trauma bay. Close monitoring of oxygenation is required due to risk of respiratory depression, but it is generally well tolerated in children. Notably, ketamine has historically been contraindicated in trauma patients with closed head injuries or open ocular injuries due to the side effect of increased intracranial and intraocular pressure. However, evidence for this has been low quality with more recent studies in adults demonstrating possible decreased intracranial pressure. [20] Studies are limited in the pediatric literature for a closed head injury, and caution is advised. Benzodiazepines are commonly used anxiolytics in adults, but concerns exist for dependence and adverse effects when benzodiazepines are combined with opioids in children. Midazolam is most frequently used in pediatric studies, primarily as a procedural sedative agent. [21] Lorazepam has not been well studied, but as mentioned previously, is a medication we use at low doses with great caution for its synergistic effect of respiratory depression in those on opioids. As we will discuss below, nonpharmacologic measures to alleviate anxiety are gaining increasing popularity, eliminating concern for the adverse effects associated with pharmacologic interventions.

Topical, local, and regional anesthesia are extremely useful in reducing opioid and non-opioid drug needs, as well as reducing the need for prolonged sedation, especially with lacerations and extremity trauma. Topical anesthesia is better tolerated in the pediatric population than injected local anesthetic, so it is a preferred route in the trauma bay and ED. For simple laceration repairs, a combination of 4% lidocaine, 0.1% epinephrine, and 0.5% tetracaine (LET) can be applied and with sufficient anesthetic effect in 30 min. This may also be used prior to locally infiltrative lidocaine, to reduce the pain from the injection. Other techniques that may reduce pain from injected local anesthetic include injecting slowly and perpendicular to the skin, beginning peripherally at the wound edges, starting with small-bore needles, using bicarbonate as a buffer, and warming the injectate. [22] Buffering lidocaine is the most essential pain reduction intervention. Standard preparations of lidocaine are acidic with pH values as low as 5. By adding 1 part 1 mEq/mL sodium bicarbonate to 5–10 parts of 1% lidocaine, the pH is neutralized to that similar to body tissue thus decreasing the burning sensation. The shelf life of buffered lidocaine is reduced to 1 week, but can make a significant difference in patient tolerance.

For more extensive lacerations and fractures, regional blocks provide long-lasting anesthesia focused at the site of injury. There are many regional block locations that include digital blocks, Bier blocks (localized IV blocks in an extremity), facial nerve blocks, and dorsal penile blocks. [23•] When using these anesthetics, appropriate dosing must be calculated per patient's body weight to avoid toxicity. In addition, anaphylaxis and methemoglobinemia are rare complications that are associated with these drugs.

Nonpharmacologic Therapy

A multimodal approach to pain management is critical to the success of treating acute pain and preventing the development of chronic pain or maladaptive behavior. The broad categories of nonpharmacologic therapies are those that provide a physical relief, those that address behaviors, and cognitive therapies.

For neonates, breastfeeding, suckling a pacifier, swaddling, and skin-to-skin contact all provide tactile stimulation. [24] Sensorial saturation is a specific approach in which taste, touch, and vocal stimulation are used in coordination. Oral sugar, gentle massage, and caregivers talking to the baby are thought to provide direct inhibition of descending and spinal neural pathways. [25]

In older children, gentle massage, heat and cold stimulation, and even acupuncture provide physical analgesia. Behavioral management can consist of simple exercises, relaxation techniques, music or art therapy, and positive reinforcement. More formal techniques like biofeedback and desensitization require a gradual approach that may not be feasible in the trauma setting.

The latest developments in nonpharmacological approaches to pain management in children are under the umbrella of cognitive therapy. Medical play is a term used to describe the action of allowing children to interact with medical equipment or even act out clinical scenarios in a playful manner, in preparation for an examination or intervention. Hypnosis can be used in the acute setting as a unique way to distract the child from the procedure being performed. [26] Distraction in combination with the advances in technology has been the most innovative approach to pain management in the pediatric trauma setting. Providing toys, bubbles, or party favors or even having the child count was previously the mainstay of distraction. However, there has been a shift towards the use of computer tablets and video games for successful distraction in all age groups. [27] While not yet widely used, virtual reality is proving to be a very effective tool for distraction in trauma and burn patients (Fig. 1). [28] Challenges do exist to implement virtual reality in the acute care setting. Training staff in use of the technology, the extensive setup that is required, having available individuals to provide technical support, and cost can all be prohibitive. [5] Child life specialists are invaluable resources who implement the majority of these distraction methods, assisting with clinical management from the trauma bay to inpatient care.

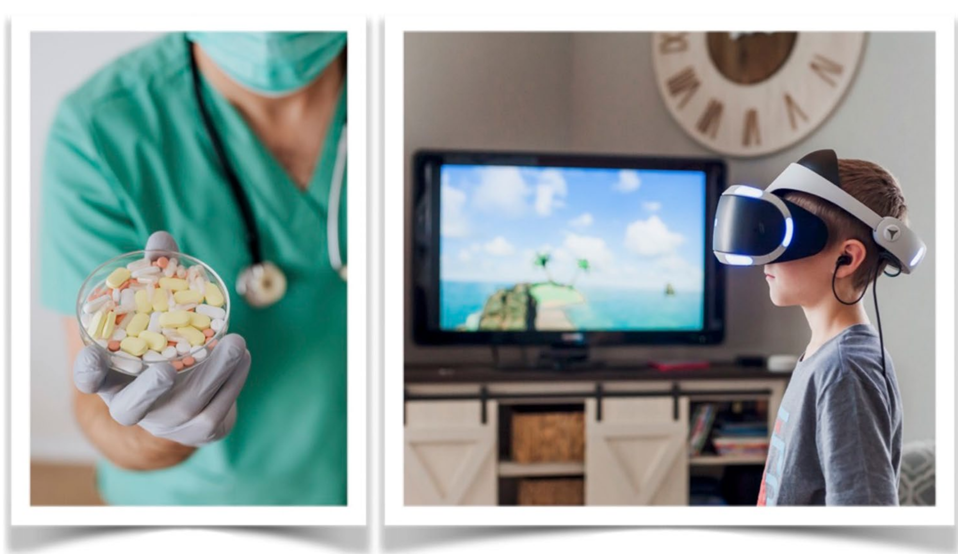

Fig. 1 New technology has provided innovative solutions to avoid over-medicating children in managing acute pain after trauma. Virtual reality as a method of distraction is the newest management approach gaining traction over the past 5 years. (Photo credits: Karolina Grabowska and Jessica Lewis from Pexels)

Traumatic Pain

The preceding sections provided an overview of general pain management principles and therapeutic options for pediatric patients. In this section, we will discuss common traumatic injuries and evidence-based pain regimen specific to each case (Table 1). [21, 23•, 29–37]

Lacerations are very common and generally elicit milder pain responses relative to other trauma-related injuries. Children are typically sedated using ketamine or intranasal dexmedetomidine and local anesthetic used for repair. For a more complex repair, a regional nerve block can be utilized to provide lasting anesthesia.

Fractures are common in childhood and can cause moderate to severe pain, with more severe pain during fracture reduction and in the perioperative setting. For this reason, opioids and regional anesthesia are frequently utilized. Procedural sedation is avoided as it can unnecessarily extend recovery time. In one study looking at closed reduction and percutaneous pinning for supracondylar humerus fractures, it was found that pain was highest in the ED and on the first postoperative day, with a significant reduction in opioid usage and pain scores by the third postoperative day. They found that 7 opioid doses at discharge were sufficient for these patients. [38] Their findings are consistent with other studies in which the most severe pain after a musculoskeletal injury occurred at the time of injury or within the first 48 h after. [24, 38] Regional nerve blocks for phalangeal fracture reduction [39] and popliteal nerve blocks for lower extremity injuries with lacerations have been reported. [40]

Concussions are also common in children, especially after sports-related trauma. Many institutions have standard concussion protocols, but it should be noted that a recent retrospective study of concussed patients in the ED demonstrated that analgesics are underused. [41]

Burn patients are a subset of trauma patients with special needs due to the multiple sources of pain. Post-traumatic stress disorder (PTSD) can develop in these patients if pain is not adequately addressed at the time of injury. Much of the recent literature has investigated the management of pain in burn-injured pediatric patients (Table 2). [8, 26, 27] It was shown that the use of IV opioids for acute pain, along with benzodiazepines for anxiety or ketamine or propofol sedation, in the first week after a severe burn reduces the development of PTSD. [5] Another study investigated the role of child life specialists in educating and preparing patients and their family. It was shown that this simple intervention alleviates the anxiety of both the child and caregivers. [42]

The unique challenge in burn victims is addressing each phase of pain. Immediately after the burn, there is an acute phase in which severe pain is from the injury itself or procedural pain from washing and debridement of the wounds. This is different from the more mild but chronic pain that arises as the wounds are healing [5]. It has been demonstrated that decreased pain and anxiety in the acute setting is associated with faster wound-healing. [26] Occupational therapists can play an important role in rehabilitation and should be involved in the care early on in the course. [43] As patients recover from the acute phase and are close to discharge, it is important to be mindful of weaning the need for sedation during dressing changes as this can prevent proper assimilation back to the outpatient environment. [44] In China, for example, due to provider discomfort with opioid use, all dressing changes were done in children under 50% nitrous oxide in a retrospective study. [45]

Finally, non-accidental trauma (child maltreatment, physical child abuse) presents a special population requiring extra care and consideration. According to the most recent National Survey of Children's Exposure to Violence, which publishes updated survey results at regular intervals, 15% of children have experienced maltreatment from a caregiver and at least 5% have endured physical abuse. [46] When children present with injuries or history suspicious for non-accidental trauma, providers must prioritize strategies to alleviate anxiety and foster a safe environment to enable patients to report their pain. Evidence from both preclinical and clinical studies demonstrates that childhood psychological trauma, encompassing child maltreatment and sexual abuse, can lead to chronic pain intolerance into adulthood. [2••]

Further Investigation

In addition to providing therapies in the appropriate settings, pain management requires considerations that are of ongoing research interest and clinical concern. The opioid epidemic has affected the USA at an alarming rate and adolescents are at risk of dependence and addiction due to their still-evolving neurologic system and high-reward seeking behaviors. [24] In a cross-sectional survey, there was found to be a lack of standardization in opioid prescription and education practices at level 1 and 2 pediatric trauma centers. [47] A more promising finding in a 9-year cross-sectional study of pediatric trauma patients was that 14% of patients with injuries ranging from ankle sprains to radius fractures were discharged from the ED with opioids, most commonly acetaminophen-codeine. However, the rate of discharge opioid prescription decreased by 30% over the period of the study. Notably, a higher percentage of prescriptions were given to adolescents and those children presenting in the evenings. [48]

Table 1 Summary of level I–III evidence for pain management in pediatric trauma published between 2015 and 2020

Authors	Journal/title	Methods	Summary
Elsey NM, Tobias JD, et al	*Journal of Pain Research* "A prospective, double-blinded, randomized comparison of ultrasound-guided femoral nerve block with lateral femoral cutaneous nerve block versus standard anesthetic management for pain control during and after traumatic femur fracture repair in the pediatric population"	Randomized controlled trial	Patients receiving a lateral femoral cutaneous nerve block in addition to general anesthesia during surgical repair of femur fractures did not have reduced pain scores or opioid requirements compared to IV opioid use during anesthesia
Golden-Plotnik S, Ali S, et al	*Canadian Journal of Emergency Medicine* "A web-based module and online video for pain management education for caregivers of children with fractures: A randomized controlled trial"	Randomized controlled trial	Caregivers of patients with nonoperative fractures were randomized to watching an educational video, completing a web-based module, or receiving verbal instructions on managing pain while in the ED. Those who viewed the video or web module had improved knowledge of pain management without a significant improvement in functional outcomes of the patients
Frey TM, Florin TA, et al	*JAMA Pediatrics* "Effect of intranasal ketamine vs fentanyl on pain reduction for extremity injuries in children: The PRIME randomized clinical trial"	Randomized controlled trial	A noninferiority trial in ages 8 to 17 evaluating intranasal ketamine against intranasal fentanyl for reduction in pain after traumatic extremity injury, based on the visual analog scale. Intranasal ketamine was as effective as intranasal fentanyl, though ketamine had greater, transient adverse effects
Hartshorn S, Dissmann P, Coffey F, Lomax M	*Journal of Pain Research* "Low-dose methoxyflurane analgesia in adolescent patients with moderate-to-severe trauma pain: a subgroup analysis of the STOP! Study"	Randomized placebo-controlled trial	Subgroup analysis of adolescents in the STOP! Study evaluating methoxyflurane's analgesic effect for minor traumatic injuries—mostly soft tissue injury and sprains. Rescue medications were available upon request during the study. Methoxyflurane provided pain relief within 15 min compared to a saline placebo, though there was a large placebo effect for adolescents
May SL, Ali S, et al	*Pediatrics* "Oral analgesics utilization for children with musculoskeletal injury (OUCH trial): An RCT"	Randomized controlled trial	A three-armed study comparing ibuprofen + placebo, oral morphine + placebo, or morphine + ibuprofen. There was no statistically significant difference among the groups and only 30% in all groups achieved the target mild pain score
Lim KBL	"Evidence-based medicine/Post fracture pain in children can be adequately managed with ibuprofen"	Randomized controlled trial	5- to 17-year-old patients with radiographic evidence of an extremity fracture of less than 24 h were given morphine or ibuprofen, with acetaminophen for breakthrough pain. Pain relief in the ibuprofen and morphine groups were equivalent, though those in the morphine group had more nausea and drowsiness. Use of breakthrough medication was the same between groups

Table 1 (continued)

Authors	Journal/title	Methods	Summary
Liu DV and Lin Y-C	*Clinical Journal of Sports Medicine* "Current Evidence for Acute Pain Management of Musculoskeletal Injuries and Postoperative Pain in Pediatric and Adolescent Athletes"	Systematic review	1. Conservative measures for sprains (RICE) have mixed outcomes 2. NSAIDs and acetaminophen are equivalent for soft tissue injury of the ankle, but NSAIDs provide faster and greater pain relief over acetaminophen, codeine, and morphine for extremity injuries 3. Enteral opioids do not have a place in pain management for acute musculoskeletal injuries. Inhibition of bone healing by ibuprofen is not a significant concern 4. Intranasal fentanyl works fast and is better than IV fentanyl for acute, displaced fractures 5. Intranasal ketamine is as effective as intranasal fentanyl, but patients have more dizziness 6. Postoperative pain management: a. After orthopedic procedures, ibuprofen is more effective than oral morphine b. Perioperative administration of acetaminophen and NSAIDs reduces opioid use, as does postoperative ketorolac c. Intraarticular bupivacaine can be used postoperatively after reduction and pinning 7. Regional blocks: a. Adductor canal blocks with dexmedetomidine reduces pain in the saphenous nerve distribution without reducing quadriceps muscle strength b. Local anesthetic infused through catheters inserted under the fascial layers of incision can provide adequate pain relief c. Continuous popliteal sciatic nerve blocks are equivalent to continuous epidural infusions, but with less urinary retention, nausea, and vomiting side effects 8. Complementary and alternative medicine: acupuncture with low-frequency electric stimulation and hypnosis have been studied

Table 1 (continued)

Authors	Journal/title	Methods	Summary
Samuel N, Steiner IP, and Shavit I	*The American Journal of Emergency Medicine* "Prehospital pain management of injured children: a systematic review of current evidence"	Systematic review	1. Prehospital analgesia is of benefit to those who receive it; however, there is a low rate of administration, most commonly intranasal fentanyl. 0.3–3% of pediatric patients with pain receive analgesics, while 21% with fractures do but this is less than the rate in adults. Children less than 5 years old rarely receive analgesics. Being young, without IV access, and transported from the scene instead of interfacility are all associated with lower rates of analgesic administration 2. Methoxyflurane is effective and safe with only mild side effects 3. Ketamine, midazolam, and fentanyl are safe options, but the level of evidence is low. 1–3 μg/kg of IV fentanyl was an effective dose
Fauteux-Lamarre E, Burnstein B, et al	*Pediatric Emergency Care* "Reduced length of stay and adverse events using bier block for forearm fracture reduction in the pediatric emergency department"	Case–control study	6- to 18-year-old children who received Bier blocks were compared to those who received procedural sedation for closed reduction of forearm fractures. Those who had a Bier block had a lower length of stay with no difference in adverse events or success of reduction
Adams AJ, Buczek MJ, et al	*Journal of Pediatric Orthopaedics* "Perioperative ketorolac for supracondylar humerus fracture in children decreases postoperative pain, opioid usage, hospitalization cost, and length-of-stay"	Retrospective case–control study	Retrospective analysis of children 1 to 14 years old undergoing closed reduction and percutaneous pinning for supracondylar humerus fractures who received ketorolac versus not in the perioperative period. The ketorolac group had less opioid use, hospital length of stay, and lower inpatient costs
Pelaez CA, Davis JW, et al	*Journal of the American College of Surgeons* "Who hurts more? A multicenter prospective study of in-hospital opioid use in pediatric trauma patients in the Midwest"	Prospective secondary analysis of randomized controlled trial	Secondary analysis of opioids administered in the first 48 h of hospitalization in 10- to 17-year-old children in the Midwest. Morphine and fentanyl were the most frequently administered and 82% of patients received at least one dose. Older children and those going to the OR were more likely to receive opioids. Those with fractures were 3 times more likely to receive opioids, while those with a traumatic brain injury less likely. Females were more likely to receive opioids but did not receive a higher cumulative amount

Table 2 Summary of level I–III evidence for pain management in pediatric burns published between 2015 and 2020

Authors	Journal/title	Methods	Summary
Hyland EJ, D'Cruz R, et al	*Burns* "An assessment of early Child Life Therapy pain and anxiety management: A prospective randomized controlled trial"	Randomized controlled trial	Pain and anxiety scores were assessed in children undergoing their first burn dressing change. Those in the intervention arm received pre-procedural education, support, and specific distraction techniques by a child life therapist; pain was improved in the intervention arm
Chester SJ, Tyack Z, et al	*Pain* "Efficacy of hypnosis on pain, wound-healing, anxiety, and stress in children with acute burn injuries: a randomized controlled trial"	Randomized controlled trial	4- to 16-year-old children were randomized into a medical hypnosis group (in addition to standard of care) or the control group that received other nonpharmacological interventions. The pre-dressing pain intensity at the 2nd and 3rd dressing changes was lower in the hypnosis group, as was the anxiety at the 2nd dressing change. However, this did not result in a decreased mean time to re-epithelialization. The results demonstrated a stronger effect of hypnosis on anxiety than pain
Burns-Nader S, Joe L, and Pinion K	*Burns* "Computer tablet distraction reduces pain and anxiety in pediatric burn patients undergoing hydrotherapy: A randomized trial"	Randomized controlled trial	Children undergoing hydrotherapy for burn wounds received a computer tablet for distraction by a child life specialist in the intervention arm versus standard care; those with tablets had improved pain and anxiety

Disparities in health care delivery have also been of recent interest on a national scale. There have been multiple studies indicating healthcare providers are better at treating pain in higher acuity trauma patients than those with lesser injuries. [49] Racial disparities are increasingly well known to exist in the care of adult patients, especially in the trauma population, and these disparities are not exclusive of pediatric trauma care. [50] It is beyond the scope of this paper to discuss how we combat these disparities; however, it is vitally important that every clinician is aware that disparities exist and remain vigilant that pain is addressed in a systematic manner for all patients, regardless of acuity, gender, race, or other external factors.

Conclusions

How we manage traumatic pain in children has evolved from believing infants and young children do not experience pain to a robust database of literature introducing multimodal regimens to address pain and anxiety experienced in these acute settings. While pain is better addressed in the past two decades [51], since 2015, the pharmacologic management of pediatric traumatic pain has mostly remained unchanged. The addition of tablets and virtual reality technologies for distraction are innovative and effective tools with newer evidence to support their utility in pediatric trauma.

Declarations

Conflict of Interest Drs. Kashyap and Blinman declare no conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

References

Papers of particular interest, published recently, have been highlighted as:
• Of importance
•• Of major importance

1•• Verghese, ST, Hannallah RS. Acute pain management in children. J Pain Res. 3:105–23. **This article from 2010 is a narrative review of analgesic options for pediatric pain management.**
2•• Burke NN, Finn DP, McGuire BE, Roche M. Psychological stress in early life as a predisposing factor for the development

of chronic pain: clinical and preclinical evidence and neurobiological mechanisms. J Neurosci Res. 2017;95:1257–70. **In this detailed review, both animal studies and clinical evidence are cited in discussing the neuroscientific effects of trauma in childhood on the development of chronic pain in adulthood.**

3. Berde CB, Sethna NF. Analgesics for the treatment of pain in children. N Engl J Med [Internet]. Massachusetts Medical Society; 2002 [cited 2020 Jun 22];347:1094–103. https://doi.org/10.1056/NEJMra012626.
4. Weisman SJ, Bernstein B, Schechter NL. Consequences of inadequate analgesia during painful procedures in children. Arch Pediatr Adolesc Med [Internet]. 1998 [cited 2020 Nov 28];152. Available from: http://archpedi.jamanetwork.com/article.aspx?doi=10.1001/archpedi.152.2.147.
5. Pardesi O, Fuzaylov G. Pain management in pediatric burn patients: review of recent literature and future directions. J Burn Care Res [Internet]. Oxford Academic; 2017 [cited 2020 Jun 28];38:335–47. Available from: http://academic.oup.com/jbcr/article/38/6/335/4773994.
6. Berde C, Wolfe J. Pain, anxiety, distress, and suffering: interrelated, but not interchangeable. J Pediatr [Internet]. 2003 [cited 2020 Nov 28];142:361–3. Available from: http://www.sciencedirect.com/science/article/pii/S0022347603001203.
7. 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 [Internet]. 1999 [cited 2020 Nov 28];46:1215–47. Available from: http://www.sciencedirect.com/science/article/pii/S003139550570184X.
8. Hyland EJ, D'Cruz R, Harvey JG, Moir J, Parkinson C, Holland AJA. An assessment of early child life therapy pain and anxiety management: a prospective randomised controlled trial. Burns [Internet]. 2015 [cited 2020 Jun 15];41:1642–52. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0305417915001618.
9. Montero SI, Villamor CL, Lara JA, Casado T, Uriarte PJ, Miguel F. 28 Pain management of pediatric trauma patient in a prehospital medical service. BMJ Open [Internet]. British Medical Journal Publishing Group; 2019 [cited 2020 Jun 29];9. Available from: http://bmjopen.bmj.com/content/9/Suppl_2/A10.3.
10. Browne LR, Shah MI, Studnek JR, Ostermayer DG, Reynolds S, Guse CE, et al. Multicenter evaluation of prehospital opioid pain management in injured children. Prehosp Emerg Care [Internet]. Taylor & Francis; 2016 [cited 2020 Jun 27];20:759–67. https://doi.org/10.1080/10903127.2016.1194931.
11. Schauer SG, Arana AA, Naylor JF, Hill GJ, April MD. Prehospital analgesia for pediatric trauma patients in Iraq and Afghanistan. Prehosp Emerg Care [Internet]. Taylor & Francis; 2018 [cited 2020 Jun 29];22:608–13. https://doi.org/10.1080/10903127.2018.1428839.
12. Rutkowska A, Skotnicka-Klonowicz G. Prehospital pain management in children with traumatic injuries: Pediatr Emerg Care [Internet]. 2015 [cited 2020 Jun 29];31:317–20. Available from: http://journals.lww.com/00006565-201505000-00001.
13. Mellion SA, Adelgais K. Prehospital pediatric pain management: continued barriers to care. Clin Pediatr Emerg Med [Internet]. 2017 [cited 2020 Jun 30];18:261–7. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1522840117300678.
14. Porter RN, Chafe RE, Newhook LA, Murnaghan KD. Multiple interventions improve analgesic treatment of supracondylar fractures in a pediatric emergency department. Pain Res Manag J Can Pain Soc [Internet]. 2015 [cited 2020 Jun 27];20:173–8. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4532201/.
15. Meyer ZI, Krucylak P, Mo M, Miller ML, Wall LB. Opioid use following operatively treated pediatric elbow and femur fractures. J Pediatr Orthop [Internet]. 2019 [cited 2020 Jun 28];39:e253–7. Available from: https://journals.lww.com/01241398-201904000-00006.
16. Committee on Fetus and Newborn and Section on Anesthesiology and Pain Medicine. Prevention and management of procedural pain in the neonate: an update. Pediatrics [Internet]. 2016 [Cited 2020 Jul 14];137:E20154271–E20154271. Available From: http://Pediatrics.Aappublications.Org/Cgi/Doi/10.1542/Peds.2015-4271.
17. Reiter PD, Clevenger AC. Nalbuphine reduces opioid-associated urinary retention in pediatric patients. Pediatr Crit Care Med [Internet]. 2019 [cited 2020 Jul 15];20:e240. Available from: https://journals.lww.com/pccmjournal/Abstract/2019/05000/Nalbuphine_Reduces_Opioid_Associated_Urinary.18.aspx.
18. McNicol ED, Rowe E, Cooper TE. Ketorolac for postoperative pain in children. Cochrane Database Syst Rev [Internet]. 2018 [cited 2020 Nov 28];2018. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6513208/.
19. Gyanesh P, Haldar R, Srivastava D, Agrawal PM, Tiwari AK, Singh PK. Comparison between intranasal dexmedetomidine and intranasal ketamine as premedication for procedural sedation in children undergoing MRI: a double-blind, randomized, placebo-controlled trial. J Anesth [Internet]. 2014 [cited 2020 Nov 28];28:12–8. https://doi.org/10.1007/s00540-013-1657-x.
20. Ketamine as an anesthetic for patients with acute brain injury: a systematic review [Internet]. [cited 2021 Mar 14]. Available from: https://www-ncbi-nlm-nih-gov.proxy.library.upenn.edu/pmc/articles/PMC7223585/.
21. Samuel N, Steiner IP, Shavit I. Prehospital pain management of injured children: a systematic review of current evidence. Am J Emerg Med [Internet]. 2015 [cited 2020 Jun 29];33:451–4. Available from: http://www.sciencedirect.com/science/article/pii/S0735675714009140.
22. Lambert C, Goldman RD. Pain management for children needing laceration repair. Can Fam Physician [Internet]. 2018 [cited 2020 Jun 28];64:900–2. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6371869/.
23• Liu DV, Lin Y-C. Current evidence for acute pain management of musculoskeletal injuries and postoperative pain in pediatric and adolescent athletes: Clin J Sport Med [Internet]. 2019 [cited 2020 Jun 15];29:430–8. Available from: http://journals.lww.com/00042752-201909000-00014. **This is a very thorough systematic review of pain management strategies for pediatric patients presenting with musculoskeletal injuries after athletic trauma.**
24. Liesen EJ, Tatebe LC. Current strategies for pain management in pediatric trauma and risk for opioid use disorder. Clin Pediatr Emerg Med [Internet]. 2020 [cited 2020 Jun 15];100759. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1522840120300136.
25. Locatelli C, Bellieni CV. Sensorial saturation and neonatal pain: a review. J Matern Fetal Neonatal Med [Internet]. 2018 [cited 2020 Jul 15];31:3209–13. Available from: https://www.tandfonline.com/doi/full/10.1080/14767058.2017.1366983.
26. Chester SJ, Tyack Z, De Young A, Kipping B, Griffin B, Stockton K, et al. The efficacy of hypnosis on pain, wound healing, anxiety and stress in children with acute burn injuries: a randomized controlled trial. PAIN [Internet]. 2018 [cited 2020 Jun 23];1. Available from: http://journals.lww.com/00006396-900000000-98912.
27. Burns-Nader S, Joe L, Pinion K. Computer tablet distraction reduces pain and anxiety in pediatric burn patients undergoing hydrotherapy: a randomized trial. Burns [Internet]. 2017 [cited 2020 Jun 15];43:1203–11. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0305417917301304.

28. Scapin SQ, Echevarría-Guanilo ME, Fuculo Junior PRB, Martins JC, Barbosa M da V, Pereima MJL, et al. Use of virtual reality for treating burned children: case reports. Rev Bras Enferm [Internet]. Associação Brasileira de Enfermagem; 2017 [cited 2020 Jun 30];70:1291–5. Available from: http://www.scielo.br/scielo.php?script=sci_abstract&pid=S0034-71672017000601291&lng=en&nrm=iso&tlng=en.
29. Elsey NM, Tobias JD, Klingele KE, Beltran RJ, Bhalla T, Martin D, et al. A prospective, double-blinded, randomized comparison of ultrasound-guided femoral nerve block with lateral femoral cutaneous nerve block versus standard anesthetic management for pain control during and after traumatic femur fracture repair in the pediatric population. J Pain Res [Internet]. 2017 [cited 2020 Jun 15];10:2177–82. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5590772/.
30. Golden-Plotnik S, Ali S, Drendel AL, Wong T, Ferlisi F, Todorovich S, et al. A web-based module and online video for pain management education for caregivers of children with fractures: a randomized controlled trial. CJEM [Internet]. 2018 [cited 2020 Jun 15];20:882–91. Available from: https://www.cambridge.org/core/product/identifier/S1481803517004146/type/journal_article.
31. Frey TM, Florin TA, Caruso M, Zhang N, Zhang Y, Mittiga MR. Effect of intranasal ketamine vs fentanyl on pain reduction for extremity injuries in children: the PRIME randomized clinical trial. JAMA Pediatr [Internet]. American Medical Association; 2019 [cited 2020 Jun 23];173:140–6. Available from: http://jamanetwork.com/journals/jamapediatrics/fullarticle/2718506.
32. Hartshorn S, Dissmann P, Coffey F, Lomax M. Low-dose methoxyflurane analgesia in adolescent patients with moderate-to-severe trauma pain: a subgroup analysis of the STOP! study [Internet]. J. Pain Res. Dove Press; 2019 [cited 2020 Jun 26]. p. 689–700. Available from: https://www.dovepress.com/low-dose-methoxyflurane-analgesia-in-adolescent-patients-with-moderate-peer-reviewed-fulltext-article-JPR.
33. May SL, Ali S, Plint AC, Mâsse B, Neto G, Auclair M-C, et al. Oral analgesics utilization for children with musculoskeletal injury (OUCH trial): an RCT. pediatrics [Internet]. American Academy of Pediatrics; 2017 [cited 2020 Jun 15];140. Available from: http://pediatrics.aappublications.org/content/140/5/e20170186.
34. Lim KBL. Postfracture pain in children can be adequately managed with ibuprofen. BMJ Evid-Based Med [Internet]. Royal Society of Medicine; 2015 [cited 2020 Jun 29];20:105–105. Available from: http://ebm.bmj.com/content/20/3/105.
35. Fauteux-Lamarre E, Burstein B, Cheng A, Bretholz A. Reduced length of stay and adverse events using bier block for forearm fracture reduction in the pediatric emergency department: Pediatr Emerg Care [Internet]. 2019 [cited 2020 Jun 30];35:58–62. Available from: http://journals.lww.com/00006565-201901000-00010.
36. Adams AJ, Buczek MJ, Flynn JM, Shah AS. Perioperative ketorolac for supracondylar humerus fracture in children decreases postoperative pain, opioid usage, hospitalization cost, and length-of-stay: J Pediatr Orthop [Internet]. 2019 [cited 2020 Jun 29];39:e447–51. Available from: http://journals.lww.com/01241398-201907000-00014.
37. Pelaez CA, Davis JW, Spilman SK, Guzzo HM, Wetjen KM, Randell KA, et al. Who hurts more? A multicenter prospective study of in-hospital opioid use in pediatric trauma patients in the midwest. J Am Coll Surg [Internet]. 2019 [cited 2020 Jun 30];229:404–14. Available from: http://www.sciencedirect.com/science/article/pii/S1072751519303448.
38. Nelson SE, Adams AJ, Buczek MJ, Anthony CA, Shah AS. Postoperative pain and opioid use in children with supracondylar humeral fractures: balancing analgesia and opioid stewardship. J Bone Jt Surg [Internet]. 2019 [cited 2020 Jun 29];101:119–26. Available from: http://journals.lww.com/00004623-201901160-00003.
39. Mori T, Nomura O, Ihara T. Ultrasound-guided peripheral forearm nerve block for digit fractures in a pediatric emergency department. Am J Emerg Med [Internet]. 2019 [cited 2020 Jun 30];37:489–93. Available from: http://www.sciencedirect.com/science/article/pii/S073567571830946X.
40. Mori T, Hagiwara Y. Ultrasound-guided popliteal sciatic nerve block for an ankle laceration in a pediatric emergency department: Pediatr Emerg Care [Internet]. 2017 [cited 2020 Jun 30];33:803–5. Available from: http://journals.lww.com/00006565-201712000-00010.
41. Lambrinakos-Raymond K, Ali S, Dubrovsky AS, Burstein B. Low usage of analgesics for pediatric concussion-related pain in US emergency departments between 2007 and 2015. J Pediatr [Internet]. 2019 [cited 2020 Jun 24];210:20–25.e2. Available from: http://www.sciencedirect.com/science/article/pii/S0022347619302677.
42. Block L, King TW, Gosain A. Debridement techniques in pediatric trauma and burn-related wounds. Adv Wound Care [Internet]. 2015 [cited 2020 Jun 23];4:596–606. Available from: http://www.liebertpub.com/doi/10.1089/wound.2015.0640.
43. Kipping B, Miller K. Occupational therapists' role in facilitating pain management in children with burn injuries. Aust Occup Ther J [Internet]. 2017 [cited 2020 Jun 27];64:35–8. Available from: http://onlinelibrary.wiley.com/doi/abs/10.1111/1440-1630.12378.
44. Dissanaike S. Is it ethical to treat pain differently in children and adults with burns? AMA J Ethics [Internet]. American Medical Association; 2018 [cited 2020 Jun 24];20:531–6. Available from: https://journalofethics.ama-assn.org/article/it-ethical-treat-pain-differently-children-and-adults-burns/2018-06.
45. Wang H-X, Li Y-X, Zhou R-Z, Zhao J-J. Medical workers' cognition of using 50% nitrous oxide in children with burns: a qualitative study. Burns [Internet]. 2015 [cited 2020 Jun 27];41:1275–80. Available from: http://www.sciencedirect.com/science/article/pii/S0305417915000108.
46. Finkelhor D, Turner HA, Shattuck A, Hamby SL. Prevalence of childhood exposure to violence, crime, and abuse: results from the national survey of children's exposure to violence. JAMA Pediatr [Internet]. 2015 [cited 2021 Mar 14];169:746. Available from: http://archpedi.jamanetwork.com/article.aspx?doi=10.1001/jamapediatrics.2015.0676.
47. Cao SA, Monteiro K, Wills H. Discharge narcotic prescribing and management practices at pediatric trauma centers in the United States. J Pediatr Surg [Internet]. 2019 [cited 2020 Jun 23];S0022346819308097. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0022346819308097.
48. Foster AA, Porter JJ, Bourgeois FT, Mannix R. The use of opioids in low acuity pediatric trauma patients. PLoS ONE [Internet]. 2019 [cited 2020 Jun 30];14. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6913969/.
49. Day LM, Huang R, Okada PJ. Management of pain after pediatric trauma. Pediatr Emerg Care [Internet]. 2019 [cited 2020 Jun 27];Publish Ahead of Print. Available from: https://journals.lww.com/00006565-900000000-98235.
50. LaPlant MB, Hess DJ. A review of racial/ethnic disparities in pediatric trauma care, treatment, and outcomes: J Trauma Acute Care Surg [Internet]. 2019 [cited 2020 Jun 15];86:540–50. Available from: http://journals.lww.com/01586154-201903000-00021.
51. Schechter NL, Blankson V, Pachter LM, Sullivan CM, Costa L. The ouchless place: no pain, children's gain. Pediatrics [Internet]. American Academy of Pediatrics; 1997 [cited 2020 Nov

28];99:890–4. Available from: https://pediatrics.aappublications.org/content/99/6/890.