

Pain Outcomes in a US Children's Hospital: A Prospective Cross-Sectional Survey

abstract

BACKGROUND AND OBJECTIVES: Pain in hospitalized children may be underrecognized and undertreated. The objective of this survey was to benchmark pain prevalence, intensity, assessment, and pharmacologic as well as integrative treatment of pain in inpatients in a US children's hospital.

METHODS: This was a single-day, cross-sectional survey and electronic medical record review of inpatients who received medical care at a pediatric hospital. Inpatients and emergency department patients were asked to report their experience with pain and its management during the previous 24 hours.

RESULTS: Of 279 inpatients listed on the morning census, 178 children and parents were located and completed the survey. Seventy-six percent had experienced pain during the previous 24 hours, usually acute or procedural pain, 12% of whom possibly suffered from chronic pain. Twenty percent of all children surveyed experienced moderate and 30% severe pain in that time period. The worst pain reported by patients was caused by needle pokes (40%), followed by trauma/injury (34%). Children and their parents rated 5 integrative, nonpharmacologic modalities as more effective than medications. Pain assessments and management were documented in the medical record for 58% of patients covering the 24-hour period before the morning census. The most commonly prescribed analgesics were acetaminophen, morphine, and ibuprofen.

CONCLUSIONS: Despite existing hospital policies and a pain consult team, significant room for improvement in pain management was identified. A hospital-wide, 3-year Lean quality improvement initiative on reducing pain was commenced as a result of this survey.

The Decade of Pain Control and Research¹ (2001–2010) has passed, and the joint statement issued by the World Health Organization (WHO) and the International Association for the Study of Pain declared that “The relief of pain should be a human right.”² However it is unclear whether pain management in hospitalized children has improved in the United States as a result. Researchers at a large Canadian children's hospital reported that pain in inpatients was common, under-recognized, and undertreated.³ In a follow-up study assessing 3822 pediatric inpatients from 32 units, 33% experienced moderate to severe pain, with 88% being characterized as acute and 12% as chronic.⁴ Comparable US data have not been published.

Children's Hospitals and Clinics of Minnesota (CHC) is among the largest pediatric health systems in the United States with 381 staffed beds (half of those on

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KEY WORDS

pediatric, pain, audit, Lean, quality improvement, children's hospital

ABBREVIATIONS

CHC: Children's Hospitals and Clinics of Minnesota

NSAIDs: nonsteroidal anti-inflammatory drugs

WHO: World Health Organization

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ICUs) across 2 free-standing hospitals, 12 primary/specialty-care clinics, and 6 rehabilitation sites. Although pain management is provided by the primary team for the majority of patients, the Pain Service of the Department of Pain Medicine, Palliative Care and Integrative Medicine team is consulted for ~6% of inpatients annually. The pain question responses in the National Research Corporation Picker Group patient and family satisfaction survey conducted at CHC demonstrated an average improvement of ~1% annually over the previous 8 years (2005–2013). Positive responses to the question, “Did the hospital staff do everything they could to help control your child’s pain?” increased from 79% to 87% of respondents between 2005 and 2013. Although this rating is above the National Research Corporation 2013 national benchmark of 82%, there was still room for improvement. The purpose of this prospective, cross-sectional survey was to benchmark: (1) patient outcomes, such as pain prevalence, pain intensity, pain satisfaction, and (2) process outcomes, such as pain assessment documentation and pain management interventions for all inpatients on a typical day.

METHODS

This prospective, mixed-methods survey was approved by the institutional review board of CHC. The goal was to survey patients of all ages and their parents who were registered on the hospital census on a single morning across 2 campuses (Minneapolis and St Paul), on 5 medical/surgical, 3 PICU, 2 NICU, 2 intensive care step-down, 2 short-stay units, and 2 emergency departments. Interpreters were used for all non-English-speaking families because children belonging to a

cultural minority undergoing medical procedures are an especially vulnerable population.⁵

A single weekday in June 2013 was chosen to provide a snapshot of pain experience because it was likely to represent a typical day at CHC and because it reduced the chance of advanced knowledge of the audit and possible increased vigilance to pain practices that would bias the results. Three pairs of interviewers, each comprising a research assistant and a nurse/nurse practitioner, introduced the project directly to patients and their parents using a short script. If the child and parent(s) gave verbal assent/consent to participate, the interviewer administered a brief (5-minute) questionnaire and recorded answers on an electronic tablet (Apple iPad). Patients were interviewed directly whenever possible, as long as they had completed kindergarten, their current clinical status (such as sedation level) was appropriate, and they were judged by the interviewer to have the developmental capacity to understand the questions and provide information about their pain and treatment. If this was not the case, the parent or caregiver was interviewed as proxy for the child. Up to 3 attempts were made to locate families, and if the child or caregiver was absent after 3 attempts, they were not included.

Measures

Data were obtained both from patient/parent interview and from the electronic medical record. The survey tool was developed based on Taylor et al’s (2008) audit.³ This revised survey included questions about the reason for admission to the hospital, length of time in the hospital, and the child’s general experience with pain before

and during the current admission (past 24 hours). If the child did not experience pain, the survey was discontinued at that point. Respondents were then asked to indicate the cause of the single “worst pain” experience while in the hospital during the previous 24 hours (ie, even if the child had been in the hospital >24 hours) and were asked to provide further details. For example, if a parent or child said the child’s worst pain was associated with a procedure, they specified the procedure (eg, chest tube removal), rated the pain associated with it on a 0 to 10 scale (0 = no pain; 10 = worst pain imaginable), explained what was done to manage the pain (eg, analgesia or nonpharmacologic strategies), how helpful it was, rated their satisfaction with how the pain was treated, and shared their feedback around what was done well and what could be improved.

Children and parents from CHC’s youth and parent advisory councils reviewed and edited drafts of the survey tool and interview process before finalization and administration, respectively. The interviewers practiced and standardized the survey administration process in an attempt to limit interrater bias and variability. After the audit, a focused chart review was conducted for all patients in the final sample to obtain information about pain assessment frequency and scores, as well as type and timeliness of interventions used by staff to reduce pain.

Analysis

Analyses were conducted by using IBM SPSS Statistics 20. Descriptive statistics (ie, frequencies and percentages) were run to describe baseline characteristics of the sample and families’ experience with pain and its management.

RESULTS

Patient and Parent/Caregiver Characteristics

There were 279 patients listed on the morning census, and 178 (64%) patients and their parents were located and interviewed (see Table 1). Most parents who were unavailable for interview after 3 attempts throughout the day were parents of infants located in the NICUs or special care nursery. Six families were not approached because they were in the midst of medical crises. The principal interviewee was the child in 26% of interviews. Children were a median age of 1.1 years (range

0–22.6) and 55% (*n* = 98) were girls. The most common reasons for admissions to the hospital were acute illness/infection (26%), prematurity (25%), and surgery (17%). Further information about the sample is provided in Table 1.

Patient Outcomes

Most hospitalized children indicated they had either not experienced pain routinely before admission to the hospital (*n* = 82, 46%), or the child was <1 year of age and the parents were unable to determine (*n* = 74, 42%). However, 22 children (12%) reported having pain routinely before admission. Of all 178 children (and/or their caregivers) who were interviewed, 135 (76%) said they had experienced pain during their current hospitalization in the previous 24 hours. Overall satisfaction with how pain was treated while in the hospital was high (*M* = 8.5, *SD* = 2.1) on a scale of 0 (not satisfied at all) to 10 (very satisfied), and the majority of children and parents (*n* = 111, 83%) who had questions or worries about pain felt that hospital staff members listened to them.

The average worst pain intensity score that children and families reported experiencing since coming to the hospital

was 6.1 (*SD* = 2.9) on a scale of 0 = no pain to 10 = worst pain possible (see Table 2). When asked about the cause of the worst pain, the most common reason given was “needle pokes,” such as intravenous access and laboratory draws (*n* = 54, 40%), followed by “trauma/injury” (*n* = 46, 34%). Interestingly, even though the former intervention was cited as the most painful, the average pain rating associated with needle pokes (*M* = 4.8, *SD* = 2.9) was the lowest among the common sources of pain (see Table 2). The highest average pain rating was for children who underwent surgery (*M* = 7.1, *SD* = 2.6).

The average worst pain intensity was 2.9 of 10 (*SD* = 3.05) for the 104 children included in the chart review, which is lower than worst pain intensity recall reported by children and parents who completed the survey (see Fig 1). Of the *n* = 110 children who reported pain in the survey, 18 (16.4%) experienced mild (1–3 out of 10), 35 (31.8%) moderate (4–6 out of 10), and 53 (48.2%) severe pain (7–10 out of 10) during the 24-hour period before the morning census. However, nursing documentation painted a different picture, with only 15% reported as having severe pain.

TABLE 1 Sample Characteristics and Survey Disposition (*N* = 178)

	<i>n</i> (%)
Time in hospital at survey >24 h	137 (78)
Respondent (<i>n</i> = 178)	
Child	45 (26)
Mother	103 (59)
Father	23 (13)
Other (grandmother, great aunt)	5 (3)
Female	98 (55)
Patient age, y	
<1	84 (48)
1 to <3	22 (12)
3 to <5	11 (6)
5 to <7	6 (3)
7 to <10	14 (8)
10 to <13	16 (9)
≥13	25 (14)
Language	
English	163 (92)
Other	15 (8)
Reason for hospital visit ^a	
Acute illness/infection	46 (27)
Prematurity	45 (26)
Surgery	31 (18)
Known disease	27 (16)
Other medical	12 (7)
Accident/injury	6 (4)
Diagnostic workup	3 (2)
Location of care, 8 AM census	
Inpatient (medical/surgical units)	76 (43)
NICU/Nurseries	40 (23)
PICU/CVCC	41 (23)
Short-stay units	13 (7)
Emergency department	8 (4)

CVCC, Cardio-Vascular Care Center
^a *N* = 170.

TABLE 2 The Most Painful Procedures and Conditions for Children Who Experienced Pain While in the Hospital

Cause of “Worst Pain” ^a	<i>n</i> (%)	“Worst” Pain Score ^b
		Mean (SD)
All Patients ^c	110 (100)	6.1 (2.9)
Needle pokes	43 (39)	4.8 (2.9)
Trauma/injury/other medical ^d	37 (34)	7.2 (2.3)
Surgery	11 (10)	7.1 (2.6)
Procedure	9 (8)	6.7 (3.5)
Acute infection/illness	6 (5)	5.8 (2.8)
Known disease	4 (4)	5.3 (3.2)

^a Pain ratings were obtained directly from children (when possible) or their parents.

^b 0 = no pain; 10 = worst pain imaginable pain.

^c Twenty-five of the 135 children/parents (19%) who experienced pain while in the hospital chose not to give a pain rating; 20 (80%) of these children were <1 year of age.

^d Examples of “other medical” in patients’/parents’ words were, for example, postsurgical overexertion, dizziness, pain at site of port.

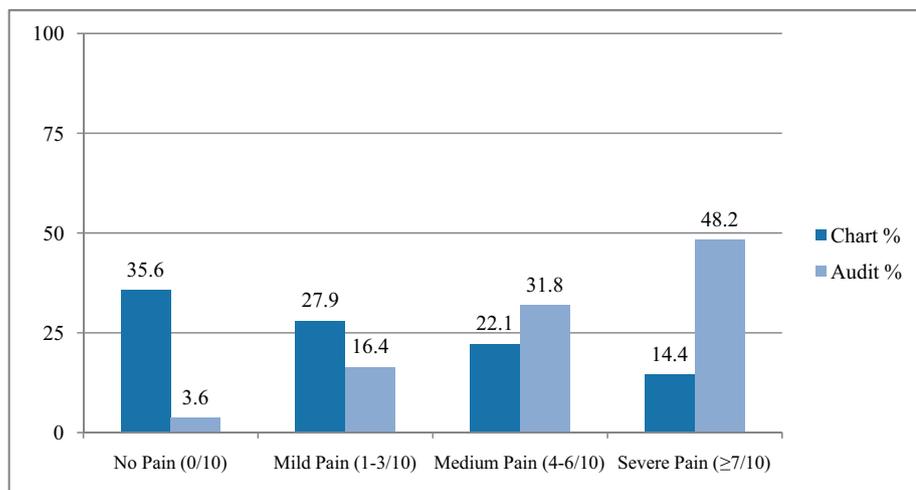


FIGURE 1 “Worst pain” intensity scores in the past 24 hours (or since admission) by pain intensity category and source of information.

Process Outcomes

Pain assessments and management were documented in the electronic medical record for 104 of 178 (58%) patients covering the 24-hour period

before the morning census. Of those, 59 (33%) were admitted to Children’s on or after June 11, so documentation time was shorter than 24 hours. Children received an average of

3.2 (SD = 3.8) pain assessments using a validated measure during the previous 24-hour period. None of the 15 children with ≥1 severe pain score documented received a pain consultation from the Palliative Care and Integrative Medicine team (see Table 3).

Among the 104 patients with documented pain assessment, 38 (37%) patients had ≥1 documented pain score ≥4 out of 10 within the previous 24 hours. For 30 (79%) of them, a pain management approach was undertaken and documented within 60 minutes, as required by CHC policy. For all 38 children, 20 (53%) received pharmacologic interventions, and 16 (42%) received nonpharmacologic strategies (eg, positioning, distraction).

TABLE 3 Characteristics of Children With “Severe Pain”^a as Documented in the Medical Record in the Past 24 Hours

Patient	Age (y)	Time in Hospital (d)	Reason for Admission	No. of Assessments ≥7	No. of Interventions Within 30 min ^b	No. of Interventions Within 60 min	Pain Management Strategies ^c	Pain Consult
1	17.5	7	Chronic abdominal pain	2	0	0	None	No
2	6.6	13	Urethral fistula repair	1	0	0	None	No
3	8.9	9	Neurogenic bowel/bladder	1	1	1	Analgesics, relaxation, distraction, environmental, other	No
4 ^d	12.5	4	New acute myeloid leukemia	2	1	1	Analgesics	No
5 ^d	0.7	9	Neuroblastoma	1	1	1	Analgesics, distraction, environmental	No
6	17.0	1	Pectus excavatum	8	8	8	Analgesics	No
7	11.3	6	Bowel perforation	1	0	0	None	No
8	0.5	3	Abdominal pain/ <i>Clostridium difficile</i>	4	3	3	Analgesics, reposition, environmental, other	No
9	0.8	28	Aspiration	1	1	1	Analgesics, environmental, other	No
10	12.9	1	Abdominal pain	2	1	1	Analgesics, distraction	No
11	13.7	1	Fall	7	4	6	Analgesics	No
12	0.7	235	Trisomy 21/AV canal defect	4	1	2	Analgesics	No
13	17.9	1	New onset diabetes	1	0	1	Analgesics	No
14	0.1	1	Hydronephrosis	1	1	1	Analgesics, environmental, other	No
15	11.6	3	Left ankle/Achilles pain	1	1	1	Analgesics, distraction, other	No

^a A pain score ≥7 was considered “severe pain.”

^b A child was considered to have received an “intervention” if a health care team member documented an attempt to manage the pain (eg, with analgesia) within 30 to 60 min of the pain assessment.

^c Examples of “environmental” pain management strategies included, but were not limited to, adjustments in room lighting and minimizing noise.

^d Patients 4 and 5 were undergoing inpatient chemotherapy and received integrative medicine consultations from a integrative medicine nurse practitioner to help manage nausea and vomiting. However, neither patient was referred for a pain consultation.

When analgesics were administered, the most common medications given to manage pain for the total sample of 178 were acetaminophen ($n = 48$, 27%), followed by opioids ($n = 42$, 24%) and nonsteroidal antiinflammatory drugs (NSAIDs; $n = 26$, 15%; see Table 5). The most commonly prescribed WHO Step 1 analgesics for mild pain were acetaminophen ($n = 48$, 27%) and NSAIDs ($n = 24$, 13%), with ibuprofen the most common. WHO Step 2 analgesics for medium-severe pain (ie, opioids) were prescribed for 34 patients (19%) and were delivered enterally or intravenously (including via a nurse- or patient-controlled analgesia pump), morphine being the most commonly prescribed drug. Interestingly, children and parents perceived 5 integrative strategies as being more helpful than medications in reducing pain (see Table 4).

DISCUSSION

This prospective, cross-sectional survey at a large US tertiary children’s hospital reveals that pain remains

common, underrecognized, and undertreated in pediatric inpatients. The majority of pediatric inpatients experienced pain during the previous 24 hours. Pain was largely described as acute and/or procedural in nature and among the children in pain, more than half rated it as severe. Despite a hospital policy of implementing regular pain assessment, documentation was not present for more than one-third of the inpatients in this audit. Nonpharmacologic modalities were rated by those who completed the survey as more effective than pain medications.

According to this audit, the worst pain children reported experiencing in the hospital was due to needle pokes, such as intravenous access and laboratory draws (40%), followed by pain due to trauma/injury (34%). Up to one-quarter of adults display fear of needle procedures that developed during childhood, resulting in avoidance of health care, including nonadherence with vaccination schedules.^{6,7}

Untreated procedural pain in children is associated with significant adverse consequences throughout the age continuum from infancy to adolescence. Repetitive procedural pain in preterm infants is associated with reduced early body growth and head circumference, after accounting for multiple medical confounders.⁸ Repeated pain exposure in neonates induces long-term changes in pain sensitivity^{9,10} and the developing brain¹¹ and has serious short- and long-term consequences, with each painful event causing immediate physiologic and behavioral instability.¹² Inadequate analgesia for initial procedures in children diminishes the efficacy of adequate analgesia in subsequent procedures,¹³ and memory of a previous painful experience has great influence on the pain experience during subsequent procedures.¹⁴ Interestingly, children in this study recall the needle pokes as the “worst pain,” even though the average “worst pain” scores reported for needle pokes were not as high on average as those for surgery, trauma, and other

TABLE 4 Strategies Used to Manage Most Painful Procedures/Conditions and Their Helpfulness as Reported by Patients and Parents (N = 135)

Strategy	How Helpful Was the Strategy? ^a	Cause of Worst Pain, n (%)			
		M (SD)	Needle Pokes (n = 54)	Procedure (n = 11)	Surgery (n = 14)
Patient participation	9.2 (1.6)	3 (6)	0 (0)	1 (7)	2 (4)
Caregiver participation	8.2 (2.7)	18 (33)	4 (36)	6 (43)	18 (32)
Infant comfort (swaddling, rocking, etc.)	8.0 (2.3)	6 (11)	4 (36)	6 (43)	6 (11)
Distraction	7.8 (2.2)	13 (24)	3 (27)	1 (7)	17 (30)
Positioning	7.7 (2.4)	17 (32)	4 (36)	1 (7)	12 (21)
Pain medicine	7.5 (2.6)	11 (20)	5 (46)	14 (100)	45 (80)
Other ^b	7.5 (3.0)	1 (2)	0 (0)	2 (14)	6 (11)
Education/information/preparation	7.2 (2.4)	14 (26)	2 (18)	2 (14)	5 (9)
Sucrose/pacifier	7.2 (2.5)	14 (26)	4 (36)	1 (7)	6 (11)
Integrative medicine strategies (eg, aromatherapy, guided imagery)	6.2 (3.4)	0 (0)	0 (0)	1 (7)	9 (16)
Warm/cold pack	4.6 (3.4)	7 (13)	0 (0)	2 (14)	10 (18)
Epidural/blocks	N/A	0 (0)	0 (0)	0 (0)	0 (0)

^a 0 = not helpful at all; 10 = very helpful. A small number of children/parents did not rate the helpfulness of strategies that they identified.

^b Examples of “other” strategies were laxatives, diet change, feeding food or fluids, playing with stuffed animal, dark/quiet room, and using drainage tube.

procedures. Fear of needle pokes is common among children and fear of pain appears to play both a facilitative and inhibitory role in relation to treatment response, and fear of injury or penetration may in fact have an evolutionary survival value independent of pain severity.^{15,16} Despite the existence of a nurse-led nitrous gas program for painful procedures at CHC,¹⁷ and solid evidence regarding the use of combined positioning, distraction, and topical anesthesia (such as lidocaine 4% cream), as well as sucrose for children under 12 months,⁶ these evidence-based needle poke protocols were not in place at CHC at the time of this audit.

A significant subgroup of pediatric inpatients (12%) “usually” experienced pain or hurt routinely before admission, indicating the possibility of a chronic pain disorder in addition to possible acute/procedural pain. Chronic pain is a significant problem in the pediatric population, conservatively estimated to affect 15% to 20% of children.¹⁸ Effective treatment strategies for children usually include a rehabilitative outpatient program through a pediatric pain clinic. However, such clinics are few and poorly reimbursed in the US, resulting in limited access for children and potentially explaining the relatively high number of children with chronic pain in our sample.

Adequate opioid analgesia administration after severe trauma in children is associated with lower levels of post-traumatic stress disorder.^{19–22} In regard to choice of analgesic medications, WHO guidelines appeared to have been followed at the CHC (see Table 5).²³ Of the 135 children in the audit who reported experiencing pain, 33% were prescribed acetaminophen, 11%

TABLE 5 Scheduled and Unscheduled Pharmacologic Pain Management Interventions for Children Who Reported Experiencing Pain in the Past 24 Hours

	All Children (N = 178)	Children Who Reported Pain (n = 135)
	n (%)	n (%)
“Simple” analgesia		
Acetaminophen	48 (27.0)	45 (33.3)
Ibuprofen	16 (9.0)	15 (11.1)
Ketorolac	7 (3.9)	7 (5.2)
Celecoxib	1 (0.6)	1 (0.7)
“Weak” opioids		
Tramadol	9 (5.1)	9 (6.7)
Codeine-acetaminophen	0 (0)	0 (0)
“Strong” opioids		
Morphine	22 (12.4)	21 (15.6)
Fentanyl	4 (2.2)	4 (3.0)
Hydromorphone	3 (1.7)	3 (2.2)
Methadone	2 (1.1)	1 (0.7)
Oxycodone	2 (1.1)	2 (1.5)
Hydrocodone-acetaminophen	1 (0.6)	1 (0.7)
Adjuvant analgesia		
Amitriptyline	4 (2.2)	4 (3.0)
Gabapentin	0 (0)	0 (0)
Low-dose ketamine	2 (1.1)	2 (1.5)
Dexmedetomidine	0 (0)	0 (0)
Clonidine	1 (0.6)	1 (0.7)
Topical lidocaine patch	1 (0.6)	1 (0.7)

NSAIDs, and 24% an opioid (see Table 5). These numbers were lower than expected and may be attributed to resistance of clinical staff to prescribe and administer them, or they may not have been indicated for the underlying pain pathology. Opioid analgesics are commonly viewed as an appropriate choice in the management of acute pain; however, this is less so for procedural pain (such as needle pokes) or chronic pain (such as functional abdominal pain), which could explain why not all children who experienced pain received these analgesics. Like many pediatric hospitals, CHC inpatient pharmacy removed codeine from its formulary in 2012, adhering to WHO guidelines²³ and a recent Food and Drug Administration warning²⁴ about the use of this medication resulting in inadequate analgesia and deaths in different populations of children.^{25–27} This audit confirms that codeine has not been used.

As can be seen in Table 4, although analgesic medications were the most commonly used modality to treat pain (54%), it was not necessarily the most effective. Children and their parents rated 5 integrative, nonpharmacologic modalities to be more effective than analgesics: patient and caregiver participation, infant comfort, distraction, and positioning. Although recall bias may play a role, the importance of integrating nonpharmacologic pain modalities is well documented in the literature.^{28–33} This has led to an integrative approach at CHC, with massage therapists and integrative medicine nurse practitioners available for consults. Integrative medicine training has been provided to >10% of hospital nursing staff.

The worst pain intensity scores reported by children and parents in the survey were much higher, on average, than the average worst pain scores

documented in the patients' medical records (see Fig 1). This may represent a nursing bias or patient recall bias. It is also worth noting that pain scores for procedural pain including needle pokes were not documented, despite an institutional policy to do so. In fact, the CHC policy on pain prevention, assessment, and management states: "Inpatients will be re-assessed at least every shift and whenever there is a verbal report of pain from the patient or parent, with a change in vital signs or behavior suggestive of pain, and during and after painful procedures. Pain intensity will be reassessed as appropriate following a pharmacologic or non-pharmacologic intervention." A significant minority (42%) of children who participated in the survey had no pain scores documented in their charts for the previous 24 hours.

Results from this US children's hospital audit, in combination with results from a recently published Canadian survey and another study in which pediatric patients in the US were followed longitudinally in 2007 and 2008 from admission to discharge or 5 days of hospitalization³⁴ suggest that the Decade of Pain Control and Research (2001–2010) may not have led to as much improvement in pediatric pain control as one would have hoped.³⁵ This is despite the fact that parents of children admitted to hospitals rated "taking care of pain" as the second highest priority (after "getting the diagnosis right"),³⁶ and parents' greatest distress results from failing to protect their child from pain.^{37,38} In 1 study, when compared with adults, pediatric patients routinely received fewer and/or incorrectly dosed analgesics.³⁹ In another study, 580 neonates experienced >17 500 painful procedures in 1 week (ie, >4 procedures/

day/child), of which 46% to 57% went untreated.⁴⁰

Improving pain management in a children's hospital is ethically essential and leads to improved clinical outcomes and increased satisfaction of patient, families, and staff. Optimal pain management also carries important financial implications because childhood pain brings significant direct and indirect costs from health care utilization and lost wages due to taking time off work to care for the child.^{41,42} The total health care cost of pain management in 2010 was between \$560 and \$635 billion in the United States—more than for heart disease, cancer, and diabetes combined.⁴³ As the Affordable Care Act becomes integrated into the US health care system, patient/parent satisfaction scores will have an impact on reimbursement to children's hospitals. The Pediatric Hospital Consumer Assessment of Healthcare Providers and Systems include 2 pain questions in their current survey, stressing the value of high-quality pediatric pain programs.⁴⁴

Knowledge translation initiatives result in improvements of pain processes, such as pain assessment documentation and pain management interventions, and clinical outcomes, such as pain prevalence and pain intensity.⁴⁵ As a result, CHC Hospital leadership embraced the idea of improving pain management practices, launching the 2013, system-wide "No Needless Pain" initiative as a 3-year Lean Value Stream.^{46,47} The findings of this audit led us to target pain management for needle pokes as the first area of focus. Improving needle procedure pain management practices undertaken by CHC laboratory technicians will affect ~60 000 children per year,

half of them in the outpatient laboratory setting. Using Lean methodology, 1-week events (ie, rapid process improvements) were initiated in November 2013 in CHC outpatient laboratories and in April 2014 in inpatient medical-surgical units. Mandatory protocols for distraction, positioning, topical anesthesia (plus orally administered sucrose for infants) were implemented. In addition to procedural pain Lean events, acute pain Lean events are scheduled in the emergency departments, PICUs, NICUs, and outpatient clinics throughout 2014 and 2015. Finally, we are planning a multi-site, national benchmarking audit with other US children's hospitals.

Limitations

Although there are limitations to generalizability inherent in a single-center audit, CHC is representative of many pediatric tertiary care centers in the United States in its staffing mix, analgesic approaches (including opioid administration via patient-controlled analgesia pumps and neuroaxial therapies), and the nature of diagnoses and conditions seen. Although the mean age was slightly >1 year of age, infant data were underrepresented because of inability to locate some parents.

In conclusion, this prospective, cross-sectional survey (which is available on request) demonstrated that there is significant room for improvement in how pain is managed for patients at a large US children's hospital, despite the existence of a busy inpatient and outpatient pediatric pain consult team. The audit showed that needle pokes for intravenous access or laboratory investigation represented the worst pain experience for inpatients at this institution, although reported pain scores for surgery or procedures were

higher. A surprisingly large number (12%) of children may be displaying features of chronic pain, an entity possibly better treated on an outpatient basis, which supports the need to increase the number of pediatric pain clinics available to affected children. Finally, nonpharmacologic therapies were rated as effective in treating pediatric pain and should be an integral part in managing a child's pain in a hospital.

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