Making Comfort Count: Using Quality Improvement to Promote Pediatric Procedural Pain Management

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ABSTRACT

BACKGROUND AND OBJECTIVES: Pediatric procedural pain management (PPPM) is best practice but was inconsistent in our large multisite general academic medical center. We hypothesized that quality improvement (QI) methods would improve and standardize PPPM in our health system within inpatient pediatric units. We aimed to increase topical anesthetic use from 10% to 40%, improve nursing pediatric pain knowledge, and increase parent satisfaction around procedures for children admitted to a general tertiary academic medical center.

METHODS: We used QI methods including needs assessment, self-identified champions, small tests of change, leadership accountability, data transparency, and a train-the-peer-trainer approach to implement PPPM. We measured inpatient use of topical anesthetic (goal of 40% of admissions), nursing pain knowledge, and parent satisfaction with child comfort during procedures. We used statistical process control and basic statistics to analyze data in this interrupted time series design.

RESULTS: Over 18 months, use of topical lidocaine rose from 10% to 36.5% for all inpatient admissions, resulting in a centerline shift. Nursing pain knowledge scores increased 7%. Mean parent satisfaction around procedural comfort increased from 83% to 88%.

CONCLUSIONS: A child-focused QI initiative around PPPM can succeed in a multisite general academic medical center. Key success factors for this effort included accountability, multidisciplinary core leadership, housewide training in a novel educational evidence-based framework, and use of data and champions to promote nurse and physician engagement. Future work will focus on sustaining and monitoring change.
Evidence-based child and family-centered management of pediatric procedural discomfort1-3 is routine in most children’s hospitals for nonemergent procedures.4,5 Standard of care for nonsedated pediatric procedural pain management (PPPM) integrates pharmacologic, environmental, and behavioral interventions that can include patient- and family-focused planning, age-appropriate active distraction, team communication, and analgesia.6 Benefits of adequate PPPM include decreased child pain and anxiety, improved parent and staff satisfaction, and decrease in long-term risk of medical traumatic stress including needle phobia and health care avoidance. However, barriers to highly reliable, consistent PPPM include system and workflow issues such as time, prioritization, and availability of effective topical anesthetic agents, skill and knowledge gaps, and lack of culture around consistent pain assessment and planning.7,8

In our multisite general academic medical center, we observed extensive variability around PPPM and overall lack of awareness and knowledge even in primary pediatric units and among housestaff. There was no comprehensive policy around PPPM or expectation of adherence to the scattered policies that existed. Previous local smaller efforts to improve this problem were unsuccessful, probably in part because of a lack of multidisciplinary, systematic quality improvement (QI) approaches.9-11

In the current study, we report on PPPM implementation and improvement in our inpatient pediatric units. We harnessed emerging QI skills, system-focused culture change, and resources to standardize and improve PPPM throughout a multisite, predominantly adult-oriented center by using a modified Model for Improvement (CFDI) approach. Our primary QI aim was to increase topical lidocaine usage from 10% to 40% of inpatient pediatric admissions over an 18-month period. Our secondary aims were to increase nursing pain knowledge12,13 and increase parent satisfaction around staff concern for child procedural pain.

**METHODS**

**Setting and Context**

Our children’s service consists of 109 inpatient beds within a 1069-bed multisite general academic medical center. At baseline, only 10% of inpatients received topical lidocaine. We estimated that 50% of pediatric inpatients (excluding those in the NICU) need nonurgent phlebotomy or intravenous line placement after admission and would thus be eligible for topical lidocaine based on admitting diagnosis and stability. Postoperative short-stay and oncology patients, for example, would not need additional phlebotomy or peripheral access. Venous access is performed predominantly by patient care technicians and nurses as well as physicians (primarily housestaff) and other licensed independent providers.

**Intervention**

In the beginning, we built a small core multidisciplinary team committed to the project based on their diverse professional roles and commitment to PPPM improvement, including pediatric hospital medicine, child life, inpatient and emergency medicine nursing, clinical pharmacy, patient experience, nursing quality, pediatric housestaff, and, eventually, a family consultant. We enlisted early departmental and administrative executive leader buy-in and mentorship. We planned, in a way novel to our institution, to use a modified Model for Improvement and transparent continuous QI approach to implementing an educational and system change process across sites. To understand current resources, practice, and capacity, we developed a needs assessment with qualitative and quantitative baseline data including pain management knowledge and practice surveys of >200 pediatric nurses and physicians, including barriers to using PPPM (Fig 1); interviews with frontline staff to gauge current practice and attitudes; and literature review and benchmarking for PPPM evidence-based standards.

To build a clinical champion and leader network to inform, educate, and advocate in-home constituencies, one of the core team members met individually with each area, unit, or service leader (including medical and surgical divisions) to explain the initiative and request a volunteer representative to participate in this role and serve as conduit and champion. We then held an initial interdisciplinary, structured QI meeting of leaders and unit or area designated clinician volunteers (champions) to brainstorm key drivers and solutions. This session itself was novel in our institution because of the variety of clinical stakeholders, especially bedside staff and housestaff from both pediatric and mixed adult and pediatric areas, engaged in a systematic, integrated process evaluation and particularly in the context of a pediatric-focused initiative.

Based on this extensive needs assessment and discussion, we identified and prioritized key drivers (Fig 2) to promote effective PPPM, including development of comprehensive evidence-based PPPM policy; system and structural change including access to topical anesthetic and distraction tools; culture change; and knowledge and skills including tools, techniques, and planning. We used plan–do–study–act (PDSA) cycles to maximize effectiveness (Fig 2). Below we highlight the most impactful changes; other PDSA cycles are listed in Appendix 1.

**Key Interventions (Fig 3)**

**Development of a Motivated Clinical Champion Network**

Because of the diversity of settings (mixed and pediatric-only) visited by and providers involved with pediatric inpatients, early collaboration and buy-in from every inpatient discipline and area that cares for children, particularly those most likely to perform procedures, such as patient care technicians, nurses, and housestaff, was necessary to inform the education, identify barriers, and promote and teach clinical standards. This clinical champion network, based on attendees from the kick-off meeting described earlier, was the conduit for information, training, role modeling, and microsystem advocacy and local practice change. We communicated with both champions and leadership on progress, including data and updates, via e-mail and in large multidisciplinary meetings every 3 to 4 months. We also developed a smaller...
surgical services group that met earlier to accommodate surgical teams’ operating schedules.

**Interdisciplinary Policy Development to Promote New Standard of Care**

Absence of an evidence-based policy was a rate-limiting step, essential to anchor education and confirm process. We prioritized collaborative development, review, and approval of a new comprehensive institutional PPPM policy. We gathered clinical expertise and input from each medical and surgical division that cared for admitted children, including critical care, radiology, and emergency medicine, to ensure that the minimum standard for each specialty-specific procedure was evidence-based and feasible for nonemergent situations. For example, we collaborated with the neurosurgical team to agree on best practice for aspirating ventriculoperitoneal shunts.

**Leveraging Electronic Health Order Entry**

We instituted system changes within the electronic health record, including altering all existing pediatric admission order sets to have preselected orders for topical lidocaine, reconfiguring automated dispensing cabinets, and partnering with inpatient pharmacy to reduce barriers for ordering and dispensing topical analgesia and thereby decrease the barriers of “insufficient time” and “lack of order” (Fig 1).

**Stepwise Development of a Flexible Multimedia Educational Framework**

Once policy and physical barriers were addressed, we developed and tested a comprehensive educational framework around procedural pain incorporating best practices, guidelines, and local patterns (“The 6 Ps”; Appendix 2). By addressing the importance of PPPM with evidence for harm and appealing to providers’ empathy, we sought to encourage prioritization of quality over perceived time constraints.

Previous nursing and physician education around PPPM would have been promoted by nurse educators using didactic and self-directed material review. Instead, we used a train-the-(peer) trainer approach with subject matter expert nurse–child life team providing training of champions in all sites and charging champions with facilitating competency completion.

However, the staff curriculum did not meet pediatric housestaff educational needs. We began a parallel effort to create a flexible multimedia curriculum for physicians and licensed independent providers, with pediatric housestaff champions and members of the core team (see [http://www.letsimaginehealth.org/work2](http://www.letsimaginehealth.org/work2)), with funding from a local foundation.

To facilitate and reinforce in-person training and culture change, we developed and distributed original materials, including badge buddies and acute pain management pocket cards, to nurses, physicians, and other staff between November 2013 and February 2014 in paper and electronic form.

**Public Data Sharing of Participation in Training (Ongoing)**

We used project management and QI tools, such as housewide and unit-based...
staff completion of competencies, which were distributed to all managers, to motivate participation in the training. Within 2 months, we trained >90% of inpatient nursing and technician staff. A small but helpful contribution was the employment of a temporary, part-time project manager, funded by a local foundation, who helped organize the training outside the routine staff education designation for a 6-month period (December 2013–May 2014). This type of work could also be covered by reallocation of existing administrative staff time from departments of quality, nursing education, or child life, or, given the short time frame needed, an administrative or graduate student intern.

STUDY OF THE INTERVENTION
We delineated specific measurable aims based on initial data collection and used small tests of change (PDSA) cycles. Data were shared via run and control charts for primary and secondary outcomes and process measures of lidocaine usage and parent satisfaction, and pre-post $\chi^2$ for nursing knowledge change.

MEASURES
Our primary outcome was improvement in rates of topical anesthetic usage. Use of topical lidocaine is a key strategy in decreasing pain secondary to phlebotomy, intravenous cannulation, and incision. Its use was limited before the intervention because of system and knowledge gaps; therefore, any improvements would indicate changes in both domains, as indicated in the key driver diagram (Fig 2). Topical lidocaine prescribing practices were expressed as the percentage of patients with a topical lidocaine order during admission. Usage was calculated as the proportion of total doses of lidocaine removed from the automated dispensing cabinet over a denominator of inpatient census. Based on monthly census diagnoses, we estimated that 50% of admitted patients would need nonurgent phlebotomy or intravenous line placement after arrival to the inpatient units, and our goal was 40%, or quadruple the baseline rate of 10%. We also tracked lidocaine orders as a process measure related to the outcome of prescription, with a goal of 100%.

For our secondary outcome, improvement in pediatric nurses’ pain management...
knowledge, we compared the modified Pediatric Nurses’ Knowledge and Attitudes Survey Regarding Pain scores before and 18 months after the intervention. This measure was chosen because it was based on a general pain knowledge measure previously administered at our institution. We estimated that a 5% increase in scores would represent significant improvement.

For our other secondary outcome, reduction of child pain and discomfort around procedures, we originally attempted to survey inpatient parents’ perception of recent phlebotomy, but this survey was abandoned after a 6-week trial because of lack of feasibility and reliability. We therefore relied on parent and patient satisfaction survey data around procedures (Press Ganey, Chicago, IL, 2014). Press Ganey methods are a common industry standard for trending patient perceptions of care; we sought to improve families’ perceptions of how we approached procedural management. We tracked 1 specific question related to patient-centeredness within Tests and Treatments: “Staff concern for comfort.” We estimated that sustaining a 5% increase would represent a meaningful trend in patient satisfaction.

FIGURE 3 Run chart of topical lidocaine (LMX) orders (3a) and use (3b) over time, inpatient pediatric units, February 2013–September 2014. (1) Planning and needs assessment. (2–3) Interdisciplinary unifying policy built and LMX added to electronic record pediatric order sets. (4a–c) Development and distribution of staff training and materials training on inpatient units. Goal inpatient order = 100%; inpatient usage = 40%.
**ANALYSIS**

We used interrupted time series design to study the intervention. We extracted data monthly from the electronic health record and automated dispensing cabinet systems regarding topical lidocaine use. We retrieved institutional mean percentage satisfaction scores monthly from the Press Ganey online warehouse. We used statistical process control via run charts to evaluate lidocaine usage and p charts to evaluate patient satisfaction measures through QI Macros. We used simple paired t tests to compare nursing pain knowledge and parent satisfaction scores before and after the intervention.

**RESULTS**

Topical lidocaine use increased from 10% to 36.5% for all pediatric inpatients over an 18-month period affecting 4298 children (Fig 3). This improvement was maintained over time. Orders for topical lidocaine, our process measure, increased from <10% to nearly 100%.

Our secondary measure, overall nursing pain knowledge in the Pediatric Nurses’ Knowledge and Attitudes Survey Regarding Pain, improved from 31.9 (77.8%) to 34.2 (83.4%) out of 41, a 7% change (95% confidence interval, −4.4, −0.2; P = .04) in the same cadre of nurses.

Our other secondary measure, parent satisfaction with staff “concern for comfort” during tests and treatments on Press Ganey, increased from 83% (October 2012, preintervention) to 88% consistently by September 2014, and annual mean score improvement correlated with the intervention with a centerline shift, with 8 consecutive points above the baseline (Fig 4).

An interesting contextual interaction emerged with a drop in parent satisfaction (March–April 2014), which correlated with a decrease in topical lidocaine usage because staff chose less effective but instant and easily accessible vapocoolant spray. Once the spray was physically removed by a core group member, staff began using topical lidocaine again, and patient satisfaction scores also increased.

**DISCUSSION**

We initiated and sustained an effort to improve PPPM in a general academic medical center; demonstrating improvements in processes 18 months after its inception, including tripling topical lidocaine use from 10% to 36.5% (goal of 40%) and improving nursing pain knowledge and parent satisfaction around procedures. This culture and practice change around PPPM in a general academic medical center with fewer initial pediatric resources is noteworthy because most previously reported work in this area has occurred in freestanding or large children’s hospitals within hospitals, in the setting of a robust QI infrastructure or with a pediatric pain service.

Individual clinician PPPM knowledge alone, without QI and cultural and system changes, has been persistently insufficient in changing PPPM. A review of successful procedural pain initiatives at several children’s hospitals identified 7 important strategies for successful implementation, including multidisciplinary leadership, evidence-based approach, system-wide policy, system changes such as standing orders and easy access, unit- and institution-wide support for educational efforts, nonpharmacologic techniques, and quantifying success. Each of these was critical to our success for a pediatric initiative in a general academic center; an effort in a community hospital also demonstrated success in phlebotomy- and circumcision-related PPPM.

Our effort succeeded for 3 key reasons. First, our emphasis and origins on core multidisciplinary leadership, including nursing, child life, physicians, housestaff, clinical pharmacists, patient experience, and nursing quality, was key. Each core group member contributed unique perspective, skills, and expertise and served as an accountable liaison to her constituency. For example, clinical pharmacist and physician leaders were able to tackle issues of topical anesthetic availability. Furthermore, the core group served as mega-champions and resources in their respective areas.

Second, using a QI model facilitated communication and accountability in an organization with emerging QI resources. Bedside and unit champion and leadership accountability and small goal setting were key to incrementally tackling small tasks and challenges and identifying additional opportunities. Data sharing, especially of successes, helped motivate continued culture change.

Third, because we developed and encouraged local and leadership champions early and often with a consistent evidence-based education framework and materials developed with consideration for workflow, subsequent updates and pushes for change were developed, shared, and relayed back through units and areas much more quickly than a typical nurse education model, which would also not reach nonnursing staff, that is, physicians. All types of clinical bedside providers were involved in needs assessment, guideline development, and education development, fostering ownership of the problem and informing a comprehensive integrated approach of shared accountability for PPPM.

An unanticipated consequence was the influence of this work on administrative processes in the Children’s Service and in the general academic medical center. Increased funding for child life services was able to build on the network to provide reinforcement and sustainability. Within the “adult” remainder of the Magnet-certified medical center, the approach of the PPPM Collaborative to motivate champions and focus on a clinical problem through QI methods has been adapted for hospital-acquired condition prevention and pain management.

We approached but did not achieve the primary goal of 40% topical anesthetic usage during the study time frame, which occurred right after the hospital was recovering from the Superstorm Sandy–related closure. Either our goal was an overestimate given institutional priorities or, more likely, we did not achieve our reasonable goal. This outcome may have been caused by competing time priorities or lack of true internalization of topical anesthetic as a standard of care, instead viewed as an extra item that some staff used more than others. Nursing staff,
including patient care technicians, were gaining skills in phlebotomy over this same time period and may have focused on the basic skills rather than pain management.

Currently, the major challenges of sustaining early successes in our general academic center may be difficult as other priorities and staffing changes emerge, as PPPM makes the transition from focused QI project to standard of care and another unit-accountable quality measure. More established programs have struggled with maintaining this care, even in the setting of pain teams.18,19 Future efforts will need to include data and emotional appeals to integrate reliable practice to promote comfort for patients and families as part of patient-centeredness, along with the development of multimedia, interactive training initiated by pediatric housestaff champions that is being piloted for housewide use to reinforce learning and sustain culture change.

This study had several limitations. As with any QI interrupted time series, we were not able to completely control for secular change. An optimal PPPM measure could compare child postprocedural pain scores or at least satisfaction closer to the time of procedures, but this was not feasible. Nonetheless, we improved the reliability of care from poor to much improved, if still only fair.

For this single-site study with an electronic health record and temporary project manager, another limitation may be generalizability. Most of the work was provided by committed volunteer multidisciplinary leaders and local champions. Our motivation was based on clinical bedside observation of a need rather than an administration request for action. However, use of actual patient testimony, qualitative feedback from satisfied families, and increasing awareness through setting expectations and discipline-specific education of best practice and standard of care provided external motivation to propel cultural change.

This project also benefited from executive leadership endorsement, which helped with engagement from general, mixed adult and pediatric areas. The electronic health record was most useful for making lidocaine ordering automatic, but the same could be achieved with paper order sets with standing prechecked anesthetic orders.

CONCLUSIONS

Decreasing medical-related trauma and pain is an important patient-centered improvement for hospitals, particularly for children and families. The daunting task of changing culture and practice around PPPM was possible with a strong multidisciplinary core group who prioritized this effort, development of a clinical network, use of QI methods such as data transparency and small tests of change, and positive reinforcement of success. Future efforts to sustain change may require different strategies until such practices are truly ingrained as culture and standard of care.

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REFERENCES


FIGURE 4 Control chart: Parent satisfaction with tests and treatments: concern for comfort (Press Ganey), January 2012–August 2014. Centerline shift as demonstrated by 8 consecutive points above the baseline.16 Major interventions: (1) Planning and needs assessment; (2–3) Interdisciplinary unifying policy built and LMX added to electronic record pediatric order sets. (4a–c) Development and distribution of staff training and materials training on inpatient units. *Decreased use of LMX in lieu of vapocoolant spray (see Results).


15. KnowWare International. QI Macros for Excel. Denver, CO: KnowWare International; 2014


### APPENDIX 1
Select Plan–Do–Study–Act Cycles to Improve Compliance With Procedural Pain Policy

<table>
<thead>
<tr>
<th>Intervention (Plan)</th>
<th>Date (De)</th>
<th>Leadership Impression of Efficacy and Data (Study)</th>
<th>Improvements After Implementation (Act)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Include prechecked order for topical lidocaine in all pediatric admission order sets</td>
<td>May 2013</td>
<td>Extremely effective system change; barrier removed for nursing, although does still require planning for patient care technicians; this step may actually help with bundling of behaviors with delay</td>
<td>Make vapocoolant available as second-line agent</td>
</tr>
<tr>
<td>Increase ambulatory access to topical lidocaine</td>
<td>June 2013</td>
<td>Difficult to implement because of complexity, insurance coverage, and overall workflow</td>
<td>Pursue larger system changes on medication administration</td>
</tr>
<tr>
<td>Development of 6 P curriculum to operationalize policy</td>
<td>May 2013</td>
<td>Nursing and patient care tech staff found useful; still in use</td>
<td>Converted to checklist for physicians</td>
</tr>
<tr>
<td>Pilot competency education using train-the-trainer nursing</td>
<td>Nov–Dec 2013</td>
<td>Staff found useful, correlated with improvements in Press Ganey scores</td>
<td>Used strategy throughout organization for all staff (Feb–May 2014)</td>
</tr>
<tr>
<td></td>
<td>Dec 2013</td>
<td>Less effective for pediatric housestaff</td>
<td>Developed flexible multimedia interactive curriculum, led by pediatric housestaff</td>
</tr>
</tbody>
</table>
| Decrease in lidocaine use and associated decrease in satisfaction | May 2014 | Inpatient teams using less effective vapocoolant spray and less likely to use planning and distraction skills | • Education boost  
• Removal of vapocoolant spray from unit  
• Nurse manager direct supervision of workflow and priority change |
| Parent engagement preparation handout with Family Advisory Council | May 2014 | Original too detailed and overwhelming | Restructured and edited by Family Advisory Council & Family Consultant |
| Pilot interactive video-based housestaff module for pediatric interns | June 2014 | Positive evaluations, enthusiastic feedback | Adapt multimedia curriculum for senior pediatric housestaff and surgical housestaff |

### APPENDIX 2
6 Ps Pediatric Procedural Pain Management Education Framework

1. **Patient**
   - How old is the child, and is she or he developmentally appropriate for her or his chronological age?
   - Rapport/make a connection: Positively acknowledge something familiar that can help child feel comforted (eg, comment on their light-up sneakers, the music they are listening to, a current TV character).
   - What does the child know about the procedure? Ask parent or caregiver and also the patient when appropriate.
   - Temperament and coping of patient and caregiver.

2. **Preferences**
   - Assess past history with painful procedures, if any.
   - Determine preferences for pharmacologic (eg, topical liposomal lidocaine [LMX], sucrose, Tylenol) and nonpharmacologic (eg, deep breathing, bubbles, comfort positions, coping kit tools).

3. **Parent or Caregiver**
   - Who will be present from family during the procedure?
   - What role will they play?
   - Encourage positions for comfort for caregiver participation and added support for child.
   - Empower their role as an important part of the team.

4. **Plan and Prepare (Communicate With Team, Patient, Caregiver)**
   - Determine the appropriate pharmacologic interventions and nonpharmacologic interventions.
Who will be in the room during the procedure? Minimize the number of nonessential people and voices; designate who will be talking directly with the patient. One person speaking to the patient during the procedure is preferred.

Describe what will happen during the procedure. Use age-appropriate language to describe the procedure in concrete terms. Consider the senses: what they will hear, feel, see, taste, and smell. Use child life staff when available.

Empowerment: Offer realistic choices for patient and caregiver (e.g., "Do you want to watch or look away?"; "Sit on Mom’s lap or on your own?"). Explain and encourage choices for coping strategies (e.g., bubbles, music, storytelling, coping kit items).

Practice the plan (when possible). Rehearsing can reinforce the plan and help with mastery.

5. Place

- Determine when and where procedure will take place.
- Set the scene: Encourage use of treatment room or quiet, private space. Avoid using patient’s bed for procedures whenever possible.
- Eliminate nonessential people in the space.

6. Praise: Before, During, and After

- Do provide positive, specific praise: “You are staying as still as you can.”
- Don’t say “Be a big girl or boy” or “Be brave,” and don’t offer false promises (e.g., “If you stay still we’ll get this in 1 try.”).
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