Enhancing Pain Management in the PICU by Teaching Guided Mental Imagery: A Quality-Improvement Project

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Objective  This quality-improvement study, following the PDCA methodology, compared the effectiveness of teaching mental imagery (MI) for pain management versus conducting a detailed inquiry (DI) about pain-related experiences with acutely injured PICU patients.  Methods  Participants included 44 hospitalized children and adolescents assigned to one of two intervention groups, MI (N = 24) or DI (N = 20). Pain was assessed pre- and post-intervention using the Wong-Baker Faces Pain Rating Scale and a 0–10 Likert pain rating scale, and the Pediatric Trauma Score was utilized to assess the severity of each child’s injuries.  Results  Boys in the MI condition exhibited a significant decrease in average pain ratings [t(38) = 3.41, p = .0015]. Girls in the MI condition exhibited a non-significant decrease in average pain ratings.  Conclusions  Teaching children the use of MI for pain management in an intensive-care setting was supported; the use of DI with boys was not supported.

Key words  accidents and injuries; children; coping; pain.

Research has shown that pediatric pain is not treated as comprehensively and attentively in children as it is in adults, in part because of the slow translation of empirical knowledge into routine clinical practice (Howard, 2003; Schechter, 1989). Despite the fact that non-pharmacological pain treatment procedures have been cited as promising in the effort to reduce pediatric pain (Lasseter, 2006), pre-surveys conducted with the staff of the pediatric intensive care unit (PICU) of a suburban level-I trauma medical center at which the current study was conducted indicated that there was much about non-pharmacological pain treatment options, procedures, and effectiveness that physicians did not know. Physicians in particular tended to believe that children did not experience pain in the same way adults do and as such tended to minimize their pain.

Numerous negative outcomes of inadequate pain management among children have been cited in the literature, including long-term behavioral changes, pain-perception impairment, pain-tolerance reduction, physical disability, and emotional disability (Howard, 2003). Inadequate pain management may be particularly detrimental to children and adolescents facing life-threatening injury or illness on a PICU, as well as to the parents of such children and adolescents. According to Turner (2005), “pain negatively impacts physiologic responses of nearly every body system, potentially contributing to hemodynamic, respiratory, metabolic, and neurological instability. Parents, already overwhelmed by the high-tech environment of the PICU, feel even more helpless and distressed when they see their child’s discomfort” (pp. 388–389).

The PICU pain-management quality-improvement (QI) initiative, of which the current study was a part, was begun in response to patient complaints about pain and the observation of the staff that the unit’s current methods of pain control were inadequate and involved painful procedures (e.g., injections, IV pushes). Over the course of the QI initiative, which employed the PDCA methodology (Plan, Do, Check, Act), three different non-pharmacological interventions were implemented for pain management in PICU patients: distraction, detailed inquiry (DI), and teaching guided mental imagery (MI).
Distraction is one of the most essential, if not the most essential, element of psychological pain-reduction interventions for young children in distress (MacLaren & Cohen, 2005) and was an essential component of an early successful non-pharmacological pediatric pain management study (Elliott & Olson, 1983). For these reasons, it was selected as the first intervention for the PICU QI initiative. Psychological debriefing was a popular post-trauma intervention in the late-1990s (for evidence, see Moran, 1998), and neither its modification to DI regarding pain-related experiences nor its implementation required extensive additional staff training; for these reasons, it was employed during the second PDCA cycle of the PICU QI initiative. Teaching MI for pain management in children was supported, at the time when the third PDCA cycle of the PICU QI initiative began, by Powers (1999) who reviewed 13 published outcome studies of empirically-supported psychological treatments for pediatric pain related to medical procedures and found that CBT techniques, including but not limited to MI, comprised the only “well-established treatment” for procedure-related pain in children and adolescents. MI has been shown to be effective in cases of pediatric functional abdominal pain (Ball, Shapiro, Monheim, & Weydert, 2003; Youssef et al., 2004) and after surgery (Lambert, 1996; Martz Huth, Broome, & Good, 2004), in addition to during a variety of painful medical procedures (Martz Huth et al., 2004).

Although a few studies have examined the efficacy of psychological approaches to pediatric pain management with injured children in hospital settings (Elliott & Olson, 1983; Tanabe, Ferket, Thomas, Paice, & Marcantonio, 2002), there is a relative lack of studies that address the need for and efficacy of brief, easily taught and learned, “real-world” psychological and complementary-therapy interventions for pain reduction in injured children (see Lasserter, 2006 for a review of the documented use of complementary therapies for hospitalized children), and little is known about the effectiveness of guided MI as a pain-reducing distraction technique specifically for children and adolescents with serious medical conditions. Despite this, MI remains an appealing non-pharmacological intervention for children because of its simplicity and potential to enhance a child’s sense of self-efficacy in managing his or her pain (Dillard & Knapp, 2005). For the above reasons, in addition to its painlessness, the PICU staff selected MI as the cognitive-behavioral pain-management intervention to teach patients during the third PDCA planning phase of its QI initiative.

The third PDCA cycle was begun after the interventions piloted in the first and second PDCA cycles fell short of eradicating pain and were found to be cumbersome to implement. When videos and video games were made available as distractions from pain during the first PDCA cycle of the QI initiative, patients’ pain medication use was rated by staff as having increased, decreased or remained constant. Although 56% of patients used less medication over time while videos and video games were available to them on the PICU, 30% of patients used more medication, and there were no baseline data for comparison. In addition, purchasing new videos and video games was costly, and managing the required technology was time-consuming for staff nurses. The use of DI during the second PDCA cycle was not experienced by PICU staff as burdensome and led to self-reported pain reductions in 36% of patients, but this pain-reduction rate seemed inadequate compared to the results achieved during the first PDCA cycle. The current study, based on the results of the third PDCA cycle which employed a much more rigorous assessment protocol, compares the effectiveness of teaching MI to the effectiveness of DI.

**Hypotheses**

It was predicted that there would be a significantly greater average reduction in pain ratings among participants who were taught to employ MI as a means of pain management compared to participants who participated in the DI condition and were not taught MI techniques. Based on literature indicating that boys and girls may have different preferences for emotion-focused versus active coping techniques (Keogh, Hatton & Ellery, 2000; Recklitis & Noam, 1999; Spiritto, Stark, Gil & Tyc, 1993), there was a secondary, exploratory hypothesis that gender would interact with treatment condition.

**Method**

The current study was conducted as an archival analysis of data collected between 1999 and 2001 for a QI initiative on the PICU of a large suburban public hospital in response to ongoing patient complaints about pain and the observation of the PICU nursing staff that the unit’s current methods of pain control were not sufficient and involved painful procedures (e.g., injections, IV pushes). Institutional Review Board (IRB) approval of the protocol was obtained from the hospital at which the study was conducted.

**Participants**

Participants included 44 children who were admitted to the hospital PICU from the hospital’s Emergency
Department between 1999 and 2001. In 2001, the principal investigator left the hospital and no further participants were enrolled in the study. Participants included 20 females and 24 males with a mean age of 13.5 years and a range of 6–18. All participants were English-speaking, and victims of non-intentional injuries. Participants came from a wide socioeconomic status range. The rates of injury causes and types were as follows: In the MI group, 46% of the participants were struck by automobiles, while 50% had closed head injuries related to being a passenger in a motor vehicle accident (MVA), and 4% had other physical injuries from an MVA. In the DI group, 40% were pedestrians struck by automobiles, while 60% had closed head injuries as a result of being a passenger in an MVA. Because burn victims were treated on a separate medical unit, no burn victims were included in the sample. The mean length of stay on the PICU was 5.34 ± 3.84 days, with a range of 2–21 days.

Twenty participants, including 11 girls and 9 boys, were included in the DI condition and 24 participants, including 9 girls and 15 boys, were included in the MI condition. See Table I for a breakdown of demographic characteristics, mean length of stay, pediatric trauma scores, and baseline pain ratings for participants in the MI and DI groups. There were no statistically significant group differences on any of these variables.

### Recruitment

Potential study participants were initially identified by PICU nursing staff. To determine actual study eligibility, study staff inquired about the nature of each potential participant’s injury or illness and reviewed the child’s chart to determine whether the child’s injuries met the inclusion criterion of being moderate to severe as determined by his or her Pediatric Trauma Score on admission to the PICU (scores between 5 and 12).

### Measures

Pain rating scales were employed, including the 0–10 Likert pain rating scale for children ages 8 and older and the Wong-Baker Faces Pain Rating Scale for children ages 3–7 (Wong & Baker, 1988). The 0–10 Likert pain rating scale (0 = no pain, 10 = worst pain) is a commonly used psychometric pain reporting instrument that is considered reliable and valid (Breivik, Bjornsson, & Skovlund, 2000), as is the Wong-Baker Faces Pain Rating Scale for use with verbal children (Keck, Gerkensmeyer, Joyce, & Schade, 1996). The Wong-Baker faces range in expression from happy to extremely pained.

The Pediatric Trauma Score (Tepas, Mollitt, Talbert, & Bryant, 1987) was utilized to assess the severity of each child’s injuries. The Pediatric Trauma Score is an established and highly-reliable means of assessing the severity of injuries in children (Ramenofsky et al., 1988; Tepas, Veldenz, Discala, & Pieper, 1997) and is calculated based on evaluations of respiration, alertness, systolic blood pressure, estimated body weight, and the presence and severity of soft tissue injuries and fractures, each of which is scored between −1 and +2 (lower scores indicate greater trauma severity). Scores less than nine points are considered to indicate a potentially life-threatening situation (Tepas et al., 1987).

### Interventions

#### Teaching Mental Imagery

MI exercises were developed by study staff in response to the plan developed during the planning stage of the third PDCA cycle. As is recommended by Alden, Dale, & DeGood (2001), participants were encouraged to employ pleasant imagery as distraction from pain. The protocol was brief to accommodate the needs of the setting in which the study was conducted. Participants were first instructed to relax and were led through an exercise during which they were to imagine a light of their favorite color shining on a painful part of their bodies and removing the pain; the imagery was thus focused both externally and internally, which is common in real-world clinical practice despite the recommendation that mental imagery be internally focused for maximum efficacy (Alden et al., 2001). Participants were then instructed to imagine their favorite object (e.g., a toy or a pet) and their favorite experience (e.g., playing/hanging out with friends, being at the

### Table I. Selected demographic variables by group

<table>
<thead>
<tr>
<th>Variable</th>
<th>DI (n = 20)</th>
<th>MI (n = 24)</th>
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</thead>
<tbody>
<tr>
<td>Age, mean (SD)</td>
<td>13.8 (2.9)</td>
<td>13.3 (3.64)</td>
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<tr>
<td>Sex, n (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>11.0 (55)</td>
<td>9.0 (37.5)</td>
</tr>
<tr>
<td>Male</td>
<td>9.0 (45)</td>
<td>15.0 (62.5)</td>
</tr>
<tr>
<td>Race, n (%)</td>
<td></td>
<td></td>
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<tr>
<td>White</td>
<td>10 (50)</td>
<td>9 (38)</td>
</tr>
<tr>
<td>African-American</td>
<td>6 (30)</td>
<td>5 (21)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3 (15)</td>
<td>9 (38)</td>
</tr>
<tr>
<td>Asian</td>
<td>1 (5)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Other</td>
<td>0 (0)</td>
<td>1 (4)</td>
</tr>
<tr>
<td>Insurance status, n (%)</td>
<td></td>
<td></td>
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<tr>
<td>Medicaid, no insurance</td>
<td>6 (29)</td>
<td>9 (39)</td>
</tr>
<tr>
<td>Private insurance</td>
<td>15 (71)</td>
<td>14 (61)</td>
</tr>
<tr>
<td>Length of stay, mean (SD)</td>
<td>4.7 (2.3)</td>
<td>5.88 (4.8)</td>
</tr>
<tr>
<td>Baseline pain ratings, mean (SD)</td>
<td>4.45 (2.9)</td>
<td>5.3 (2.5)</td>
</tr>
<tr>
<td>Pediatric trauma score, mean (SD)</td>
<td>9.2 (2.0)</td>
<td>9.0 (2.0)</td>
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</table>

Note: Percents may not add to 100 due to rounding.
beach, or being at a toy store) and were encouraged to continue utilizing these techniques for pain management.

Conducting a Detailed Inquiry
At the time of the current study, DI in the tradition of critical incident stress debriefing was the most recent intervention employed as part of the QI initiative. Although there is significant variability in the actual practice of conducting inquiries regarding patients’ pain-related experiences, the DI condition in the current study involved the following activities: detailed inquiry about a patient’s current pain-related experiences, providing an opportunity for the patient to express his or her thoughts and feelings, active listening, reflecting and reframing the person’s verbalizations, providing information, and providing comfort. Study interventionists were trained, under supervision by the primary investigator, to elicit participant descriptions of their experiences of the accidents in which they were involved as well as their subsequent pain-related experiences, particularly those related to their medical treatment. Interventionists were also trained to elicit participant descriptions of thoughts and feelings experienced during an accident, during medical interventions, and at the time of participation in the study. Effort was made by study interventionists to provide support and to normalize common reactions. No experimenter script was used in this condition.

Procedure
Within 24 h of a conscious, extubated, and verbal child’s admission to the PICU through the hospital’s Emergency Department, nursing staff contacted the study team at the Pediatric Psychology Consultation and Liaison Service. Once a child was determined to meet criteria for entrance into the study, consent was requested from the legal guardian. Children aged 14 and older were asked for their written assent before entry into the study.

Participants were assigned to one of the two participant groups based on whether they were admitted to the PICU on an odd-numbered day or an even-numbered day. It should be noted that, in the QI project from which these data come, perfect participant randomization was not a priority. Prior to participating in the MI or DI protocol, study staff, comprised of the first author and graduate students in clinical psychology, administered the appropriate self-report pain rating scale based on a participant’s age and obtained demographic, injury severity, and pain medication use information from PICU staff and from the participant’s medical record. In an effort to minimize the influence of relatively recent painful procedures, participants were asked to rate their pain since their arrival on the PICU unit. Once the above information was obtained, participation in the MI and DI protocols took place in a single session at bedside on the PICU. Participation was led by a member of the study staff and lasted 15–20 min.

Within 48 h, each child/adolescent was re-evaluated using the same assessment procedure as above (pain was assessed “since the last time we talked”). These follow-up assessments included, for participants in the MI condition, an inquiry about participants’ use of the MI techniques and their usefulness in reducing pain.

Statistical Analysis
Changes in pain data were analyzed using a 2 (group) × 2 (gender) × 2 (time) repeated-measures mixed-factorial ANOVA design. In order to further examine differences between treatment groups, pairwise comparisons (t-tests) were utilized to examine differences between groups that exhibited decreases in pain ratings and those groups that exhibited increases in pain ratings. Finally, as a descriptive measure, the proportion of participants in each group whose pain ratings increased between baseline and follow up was calculated.

Results
The following results constitute the check phase of the third PDCA cycle. Means and standard deviations for the pre- and post-intervention pain ratings of boys and girls in the MI and DI groups are presented in Table II and depicted graphically in Figure 1. Mean pain ratings decreased among both girls and boys in the MI condition (particularly for boys) and among girls in the DI condition. However, mean pain ratings increased among boys in the DI condition. A boxplot (Figure 2) depicting the changes in pain scores provides additional information regarding gender and group differences. The boxplot again indicates that boys in the mental imagery condition appeared to benefit the most. Girls in both conditions exhibited some

<table>
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<tr>
<th>Table II. Mean Pre- and Post-Intervention Pain Assessment Scores for Male and Female Participants in the DI and MI Conditions</th>
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<tr>
<td>Condition</td>
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</tr>
<tr>
<td>DI</td>
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<tr>
<td>Boys</td>
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<tr>
<td>Girls</td>
</tr>
<tr>
<td>MI</td>
</tr>
<tr>
<td>Boys</td>
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<tr>
<td>Girls</td>
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improvement in pain scores, although girls in the DI had a greater range of responses, including more girls who pain ratings worsened. The boxplot indicates that the majority of boys in the DI fared the poorest, with most pain scores either not changing, or actually worsening over time.

The repeated-measures ANOVA revealed a significant three-way interaction among group, gender, and time, $F(1, 39) = 5.52, p = .024, \eta^2 = 0.10$. Further analysis of simple effects revealed a significant change in pain ratings between baseline and follow-up for participants in the MI condition [$t(38) = 2.66, p = .01$] but not among participants in the DI condition. Follow-up analyses for the MI condition indicated that pain ratings decreased significantly between baseline and follow-up for male participants [$t(38) = 3.41, p = .0015$]. The decreases in mean pain ratings between baseline and follow-up for female participants in the MI and DI conditions were not statistically significant.

In order to qualitatively examine the number of participants whose pain ratings worsened, the proportion of participants in each group whose pain ratings increased between baseline and follow-up were calculated. In the DI condition, four of nine boys (44%) and 4 of 11 girls (36%) reported an increase in pain ratings. There were fewer participants reporting increased pain scores in the MI condition; 2 of 15 boys (13%) and two of nine girls (22%) reported increases in pain ratings over time.

T-tests were used to compare the participants in the DI condition who reported increased pain levels over time with all other participants. There were no significant differences in age, trauma severity, or use of pain medication between DI participants whose average pain ratings increased and all other subjects. However, there was a trend [$t(41) = -1.68, p = .10$] towards lower baseline pain ratings among the DI participants who reported increased pain at follow-up ($M = 3.5, SD = 2.2$) compared to other participants ($M = 5.23, SD = 2.7$).

**Discussion**

The current study indicates that teaching the use of MI is a more effective pain intervention for injured boys on a PICU than is conducting a DI. Boys who were taught MI techniques evidenced a significant reduction in self-reported pain ratings over time compared to boys in the DI condition whose average pain ratings actually increased over time. Girls in both the MI and DI conditions evidenced decreases in average self-reported pain ratings over time. However, 36% of girls in the DI condition experienced an increase in pain ratings. Because injured boys benefited from being taught MI for pain management and because teaching MI to injured girls was not contraindicated by the results of the current study, teaching MI to both boys and girls who are experiencing pain related to traumatic injury is recommended if only one non-pharmacological pain intervention can be implemented on a PICU.

The above conclusion led the medical and nursing staff of the Department of Pediatrics of the hospital at which the study was conducted to implement a new training protocol for all current and future PICU nurses, medical residents, and fellows, to teach them how to instruct patients in the use of MI for pain management. While in many QI projects the action phase is meant to
perfect an intervention based on obtained results, in the third PDCA cycle of the present QI initiative, the result of teaching the use of MI to PICU patients was so positive that the action phase involved implementing the teaching of MI as standard treatment on the PICU. In addition, as a result of the current QI initiative, the hospital’s psychiatric liaison and consultation service eliminated DI as a component of treatment-as-usual during psychiatric consultations on the PICU.

Limitations and Suggestions for Future Research

Limitations of the current study include the relatively small number of participants, the lack of follow-up evaluation beyond participants’ stays in the PICU, the lack of PICU patient pain assessment once MI became the standard treatment, and the lack of standardization of the DI condition. Furthermore, there is a potential confounding effect of pain medication which was not consistently measured during the study. It is possible that differences existed in the types and dosages of pain medications administered to participants in the MI and DI groups. It is also of note that there was no significant difference found in pain-rating changes between girls in the MI and girls in the DI conditions; this limits the strength of the conclusion that MI is the preferred non-pharmacological pain intervention for girls.

Conflicts of interest: None declared.

Received August 30, 2008; revisions received March 20, 2009; accepted March 21, 2009

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