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Pediatric Procedural Pain

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Abstract

Reviews the various settings in which infants, children, and adolescents experience pain during acute medical procedures, and issues related to referral of children to pain management teams. In addition, self-report, reports by others, physiological monitoring, and direct observation methods of assessment of pain and related constructs are discussed and recommendations provided. Pharmacological, other medical approaches, and empirically supported cognitive behavioral interventions are reviewed. Salient features of the interventions are discussed and recommendations are made for necessary components of effective treatment interventions.

Pediatric Procedural Pain

Health care professionals strive to provide medical treatment while avoiding any undue pain and suffering by the patient. Despite these underlying goals, children's procedural pain due to medical treatments has historically been under-treated and under-recognized (e.g., Chambliss & Anand, 1997). Failure to adequately treat children's pain is likely due to beliefs that young children, and particularly infants, do not perceive as much pain as adults due to their immature nervous systems, and that untreated pain would not have adverse long-term consequences (see Schecter, Berde, & Yaster, 1993). Contrary to such views, it has been demonstrated that infants and children experience pain in a similar manner to adults (e.g., Porter, Wolf, Gold, Lotsoff, & Miller, 1997). Further, high levels of pain in children may have significant neurophysiological (e.g., Ruda, Ling, Hohmann, Peng, & Tachibana, 2000; Taddio, Katz, Ilersich, & Koren, 1997) and physiological (e.g., Eland, 1993) effects.

Inadequately managed pain in children can also have detrimental psychological consequences, which can in turn to lead to higher levels of pain during medical treatments. For example, emotional factors, such as elevated anxiety, distress, anger, and low mood, can increase the child's pain perception (McGrath, 1994), and render subsequent medical procedures and pain management more difficult (Frank, Blount, Smith, Manimala, & Martin, 1995). Moreover, a large-scale early study found that as many as one third of children who experienced medical procedures for diagnosis or treatment showed some evidence of subsequent psychological adjustment problems (Davies, Butler & Goldstein 1972). In addition, reports of fear and pain experienced during medical procedures in childhood are predictive of fear and pain during medical

procedures, as well as avoidance of medical care, during young adulthood (Pate, Blount, Cohen, & Smith, 1996).

In this paper we will review some of the medical contexts in which children experience procedural pain, address referral issues for pain management, review methods of assessing procedural pain and other associated variables, and critique the medical and psychological treatments for managing children's procedural pain.

Pain in Pediatric Patients

Children endure an array of painful medical treatments starting at birth and continuing thorough adolescence. These procedures may include heel sticks, circumcision, immunizations, catheter insertion, chest tube placement and removal, lumbar punctures, bone marrow aspirations, venipuncture, dental restorations, burn wound treatments, and many others. For each of these painful procedures, children's fear and anticipatory anxiety increase the likelihood of their experiencing more pain and distress during the actual procedures (e.g., Blount, Piira, & Cohen, in press; Blount, Sturges, & Powers, 1990). In addition, children typically report having overly negative expectations prior to medical procedures, regardless of whether a pharmacologic or behavioral pain management intervention will be employed (Cohen, et al., 2001).

Even though children's health status in part determines the kinds of painful procedures they will experience, painful medical procedures will be experienced by all children, including those who are healthy. For example, all children will experience heel sticks, immunizations, and dental restorations. In contrast, infants born preterm will undergo a different quantity and type of invasive treatments than healthy infants born full term. Children with chronic diseases also experience some medical tests and treatments

that can be relatively unique to those with a particular disorder. For example, procedures such as lumbar punctures and bone marrow aspirations are reserved for children with cancer. Children who have been in an accident must receive treatments to restore their health and functioning. In addition to variations in the types of treatments, the contexts in which children experience such painful procedures are also varied. Whereas some painful medical procedures are unique to a given context (e.g., bone marrow aspirations in an oncology clinic), others are common across medical clinics (e.g., needle sticks). Each of these medical situations deserves focused research and clinical attention, and each could serve as a referral source for assistance in reducing children's pain and suffering. Given that health care professionals typically work with one patient population (e.g., oncology, premature infants) or within one setting (e.g., dental clinic), the following section is organized by setting and population. Rather than attempting to be exhaustive, select medical settings and the procedures associated with them will briefly be reviewed below.

Neonatology. Newborns routinely experience a large number of painful invasive procedures, such as heel sticks, immunization, vitamin K injections, and circumcision. Premature and low-birthweight infants are likely to require additional invasive procedures (e.g., venous or arterial catheter insertion, chest tube placement and removal, tracheal intubation, lumbar puncture, and subcutaneous or intramuscular injections). It has been reported that 2 to 10 invasive procedures are conducted per day for the average newborn under 32 weeks' gestational age and weighing less than 1500 grams at birth (Johnston, Collinge, Henderson, & Anand, 1997).

Typically, neonates do not display significant behavioral responses to painful stimuli. However, this should not be mistaken for high pain tolerance. Research indicates

that neonates are able to differentiate between levels of pain intensity (Porter, Wolf, & Miller, 1999), and preterm neonates may have an increased sensitivity to pain (Anand, 1998a). Further, pain responses have been reported to develop about 23 weeks after conception (Lagercrantz & Ringstedt, 2001). In addition, untreated or inadequately managed pain in neonates may result in immediate consequences, such as increased heart rate, raised blood pressure, changes in autonomic tone, a fall in arterial oxygen saturation and reduced skin blood flow (Whitfield & Grunau, 2000), as well as longer-term consequences, such as changes in pain sensitivity. There is evidence to suggest that early painful stimuli might permanently alter the neuronal circuits that process pain in the spinal cord (Ruda et al., 2000). Compared to babies receiving topical anesthesia for circumcision or those uncircumcised, babies exposed to unanaesthetised circumcision shortly after birth have been found to have a more accentuated behavioral response to immunization injections at 4-6 months of age (Taddio et al., 1997).

Oncology. Childhood cancers have been reported to affect one in 600 children under the age of 15 years (Liossi, 1999). These children often endure a variety of invasive medical procedures, including bone marrow aspirations, lumbar punctures, finger sticks, intramuscular injections, and intravenous injections. Some children with cancer undergo as many as 300 venipunctures during the course of their treatment (Jacobsen et al., 1990). Because of the need for repeated treatments and the high level of pain involved, many children develop anticipatory anxiety and distress, which is evidenced as the time of the treatment nears. Further, because some of the procedures are for administering chemotherapy agents, which can produce nausea and vomiting, anticipatory nausea and vomiting can develop.

Patients frequently remark that procedural pain associated with the treatments is greater than pain due to the disease itself. Indeed, treatment-related pain occurs in about 50 percent of pediatric oncology patients, while disease-related pain occurs in only about 25 percent (Miser, Dothage, Wesley, & Miser, 1987). Similar results emerged from an interview-based study with pediatric oncology patients and their parents, where pain due to treatment and procedures was reported as a greater problem than pain due to the malignant disease itself (Ljungman, Gordh, Sorensen, & Kreuger, 1999).

Burns. The treatment of pediatric burns patients often poses a significant challenge to health professionals. Although approximately 90% of pediatric burns can be cared for on an outpatient basis, the 10% that require hospitalization are usually very complex, often requiring lengthy hospitalizations and multiple procedures (Henry & Foster, 2000). The management of severe burns typically requires painful wound care procedures that must be performed daily or even several times a day. Some procedures are sometimes carried out with general anesthesia, however often these procedures are conducted on conscious patients with a combination of pharmacological and psychological interventions. As highlighted in a recent Policy Statement by the American Academy of Pediatrics (2001), the key to effective management of procedure-related pain and distress is anticipation. The need for effective early pain management in this patient group is crucial, given that the procedures are repeated and necessary over an extended period of time. Highly aversive initial procedures are likely to result in a cycle of pain, distress, conditioned anticipatory anxiety, and more pain (Choinière, 2001).

Emergency care. Striving for pain-free emergency rooms (Kennedy & Luhmann, 1999) has resulted in greater mindfulness of a variety of pain-management approaches.

Despite these positive intentions, there continues to be considerable pain experienced by children in this setting. Many children arrive at the emergency room upset and already in pain. Once there, many pediatric patients require procedures that may be uncomfortable or painful. In response to the growing awareness of the importance of minimizing children's pain, many centers have witnessed a trend towards the increased use of anesthesia, and conducting more of the medical treatments in operating rooms.

Pediatric intensive care. Many intensive care procedures are uncomfortable or painful. In a study of a pediatric intensive care unit in Staffordshire, UK, it was reported that of 55 patients between the ages of 1 month and 12.5 years endured a total of 181 invasive procedures, with a median duration of 5 minutes per procedure (Southall, Cronin, Hartmann, Harrison-Sewell, & Samuels, 1993). Of these procedures, 50 (28 %) were conducted without additional analgesia or sedation.

Dentistry. Procedural pain is also a relatively common issue in the field of pediatric dentistry. In a sample of 69 children between the ages of 6 and 14 years, 35 percent reported experiencing pain while in the dental chair (Mares, Hesova, Skalska, Hubkova, & Chmelarova, 1997). In addition, 6.7 to 22.4 percent of children experience high dental fear (Bergius, Berggren, Bogdanov, & Hakeberg, 1997; Klinberg, 1995). The incidence of behavior management problems with children during dental procedure has been reported at 10.5 percent (Klinberg). Despite the documented fear and pain associated wih pediatric dentistry, dentists do not routinely query children about their procedural pain. Further, Murtomaa and colleagues (Murtomaa, Milgrom, Weinstein, & Vuopio, 1996) found that dentists did not rate pediatric dental procedures as being particularly painful or unpleasant.

Routine care. Needle pain is the most common type of procedural pain and causes many children considerable distress. Surveys have found more than 50 percent of children and adolescents who undergo venipuncture for routine blood sampling experience moderate to severe levels of distress or pain (Fradet, McGrath, Kay, Adams, & Luke, 1990). Younger children typically report greater levels of pain intensity (e.g., Goodenough et al., 1997) and unpleasantness (Goodenough et al., 1999) from needles than older children. Although needle pain can be significantly reduced with the use of local anesthetics such as EMLA, there is considerable variability between health professionals regarding the use of local anesthetics for venipuncture or venous cannulation (Schecter, Blankston, Pachter, Sullivan, & Costa, 1997).

Frequent needles may also be needed for some children with chronic conditions such as insulin dependent diabetes mellitus, renal failure, growth hormone deficiency and idiopathic short stature. Healthy children experience up to three immunization injections on five separate occasions between their 2nd and 15th months of age, and again prior to entering school. Psychological interventions may assist the child to develop strategies to cope with the frequent needles.

Referral Issues

Pain management for children's medical procedures is carried out by a variety of health professionals. Some patients are formally referred to a "Pain Team," where they might be seen by professionals from any of a number of disciplines (e.g., pain specialist or pain nurse, clinical psychologist or psychiatrist, physical therapist, occupational therapist, social worker, or play therapist / child life specialist). Other patients may be managed by the medical staff who are conducting the procedure. Broadly speaking, the

referral of a child to a Pain Team may occur for one of three reasons: (a) if the treating team believes the necessary procedure to be highly painful or distressing; (b) if the treating team has concerns about the child's ability to cope with the procedure; and (c) if the child has experienced more than expected pain and distress during previous procedures.

Ideally, the first two of the reasons for referral are preferable as they enable potential problems to be addressed before they arise, thus preventing and minimizing the child's discomfort and distress. Unfortunately, with resources often stretched in many hospitals, the majority of pain consultations address pain problems that arise *after* the procedure or surgery has been conducted (e.g., Shapiro, Cohen, Covelman, Howe, & Scott, 1991). Pain Team members could also present seminars to address pharmacological issues, strategies on how to prepare the child for the procedure, how to respond to the child during the procedure, how to best utilize the assistance of the child's parents, when to refer, and the roles of Pain Team members. Knowledge of how to support the child and parents during a painful procedure enables staff to facilitate more helpful interactions in the treatment room and to model more appropriate coping behaviors. This is important in light of the findings of Cohen, Blount and Panapoulos (1997), who demonstrated that, in at least in some cases, staff modeling of helpful coping promoting behaviors cued untrained parents to engage in more coping-promoting behaviors.

A poor knowledge of the role of the clinical psychologist and other team members will reduce referrals. It is the responsibility of clinical psychologists working in a medical context to educate other health professionals that psychological services are not just for

those with psychological disorders, but rather for helping children deal with the challenges, including pain and distress, which they face in medical settings. Pain is more than a result of particular sensory stimulation. Instead, pain perception is dependent upon various additional factors, such as the child's emotional state (e.g., fear and anxiety), the behaviors of parents and adults who accompany they child (e.g., Blount et al., 1989), and the coping skills the child may employ. Clinical psychologists are in a unique position to assist in reducing children's fear, pain, and suffering prior to, during and after medical treatments.

Assessment Methods

Assessment of children's procedural pain and distress may be accomplished by use of self-report, reports by adults who are present with the children, physiological monitoring, and observational methods. Researchers generally advocate including a range of assessment instruments to attain a comprehensive evaluation (e.g., Jay, 1988; McGrath, 1990). However, it is not unusual for there to be a lack of correlation among the measures, which complicates the assessment of children's reactions to painful procedures. When measures disagree, which one is to be considered as valid?

Children's self-report and ratings by adults. Because pain and distress are personal and subjective events, self-report has been referred to as the 'gold standard' of assessment (Finley & McGrath, 1998). Whereas using self-report to evaluate procedural distress in adults is reasonable, this approach quickly becomes complicated when working with children, particularly those ages 5-6 years and below. Compared to adults, young children might not be as accurate in their estimates of pain; more susceptible to response bias and situational demands; less able to separate pain from other unpleasant

emotions, such as fear, anger, sadness, and anxiety; and have fewer painful experiences to which to compare the current event.

In spite of these considerations, there is a significant body of literature documenting various pediatric self-report instruments (for reviews, see Champion, Goodenough, von Baeyer, & Thomas, 1998; and Karoly, 1991). The most widely used child self-report scales are pictorial ones, usually with either photographed or cartoon faces ranging in expression from positive (e.g., smiling) or neutral to negative (e.g., crying, frowning), and most often used with preschool age and older children. For example, the Oucher scale (Beyer, Denyes, & Villarruel, 1992) depicts six photographs of children's faces spanning from a neutral expression to one of distress, with a corresponding number scale from 0 to 100 for older children. The scale is available in three versions for Caucasian, African-American, and Hispanic populations. Researchers have also used simple scales such as computer-generated faces ranging from a smile to a frown (e.g., Cohen et al., 1997). Another variation of this type of scale is the Faces Pain Scale-Revised (FPS-R; Hicks, von Baeyer, Spafford, van Korlaar, & Goodenough, 2001), which depicts six faces ranging from a neutral face to one in apparent pain. In addition to these faces scales, researchers have used other pictorial measures for young children, such as pain thermometers (e.g., Bush & Holmbeck, 1987). Older children and adolescents can use measures similar to those used with adults, such as visual analog line scales (VASs) or likert-type ratings (Champion et al., 1998). Some advantages of VASs are that older children understand the format, and there is less clustering of scores than with categorical scales (Goodenough et al., 1997; Varni, Walco, & Wilcox, 1990).

In addition to self-report, and especially when working with clients who are unable to provide self-report (e.g., infants), parent and medical staff ratings are invaluable sources of information. Medical staff can assess children's pain responses using a broad range of children's reactions based on comparisons with children of a similar age. Parents usually have knowledge of how children's reactions during current medical treatments compares to past or typical reactions (e.g., Blount et al., 1992). Researchers have used a variety of methods for adults to rate children's pain, anxiety, and cooperation (e.g., Blount et al., 1997), including likert-type scales and VASs. The use of VASs has been shown to be valid and reliable for this purpose (McGrath, 1990).

Physiological monitoring. There are a number of physiological measures of pediatric procedural pain. For example, studies have been conducted evaluating a number of different supraspinal processing measurement techniques (e.g., EEG, fMRI; for a review, see Anand, 1998b), vagal tone (e.g., Gunnar, Porter, Wolf, Rigatuso, & Larson, 1995), heart rate (e.g., Cohen, Blount, Cohen, Schaen, & Zaff, 1999), blood pressure (e.g., Marchette, Main, Redick, Baggs, & Leatherland, 1991), and intracranial pressure (Stevens & Johnson, 1994). Despite the lack of response bias and apparent objectivity, no single physiological index has been shown to be ideal. In fact, many physical measures vary not just according to pain, but also emotional states, temperature in the environment, body movement, and other extraneous factors. Further, some of the measures are invasive and introduce other variables (e.g., discomfort) that might influence the distress experience. Lastly, physiological instruments can be impractical in terms of time and cost associated with their use.

Observational measures. Another method for assessing pediatric distress is via children's overt behavior. Although many of these scales were originally developed for use with children undergoing BMA and LP procedures and other needle stick procedures, they are generally applicable to various painful medical procedures. Among the first observational measures was the Procedural Behavior Rating Scale (Katz, Kellerman, & Siegel, 1980). With the PBRS, the occurrence or non-occurrence of 11 behaviors indicative of behavioral distress were recorded during the anticipatory, encounter, and recovery phases of medical procedures. Age and gender differences in children's distress were revealed during BMA and LP procedures, with younger and female children showing higher levels of distress. Based in part on the PBRS, Jay, Ozolins, Elliott, and Caldwell (1983) developed the Observational Scale of Behavioral Distress (OSBD). With the OSBD, 11 distress behaviors are coded as occurring or not occurring during 15-second intervals. Individual distress behaviors are weighted on a scale from 1.0 to 4.0 on the basis of the severity of distress they represented. Weighted scores are added to provide phase or whole session distress scores. This reliably scored instrument has been used frequently in treatment outcome studies.

In addition to child distress, other important variables are children's coping behaviors and the behaviors of parents and medical staff that promote children's coping, and distress (see Blount, Bunke, & Zaff, 2000ab, Blount et al., in press, and Varni, Blount, Waldron, & Smith, 1995, for reviews). To address this need, the Child-Adult Medical Procedure Interaction Scale (CAMPIS; Blount et al., 1989) was developed. The CAMPIS includes 35 child and adult behaviors. In the original investigation (Blount et al., 1989) with children undergoing BMAs and LPS, child distress was found to be most

often preceded by adults' reassuring comments, apologies, empathy, giving control to the child over the beginning of the medical procedure, and criticism of the child. The first three of these behaviors could be thought of as emotion eliciting and also as focusing of the children's attention on the distressing parts of the medical procedure and on their own distress reactions. Reassurance, apologies, and empathic comments from adults may be therapeutic when children face longer lasting stressors, such as failing a class, death of a loved one, or a disappointing performance during an important athletic competition, but not during acute painful medical procedures. The effects of reassurance have been tested experimentally and found to promote children's distress during analogue cold pressor pain induction procedures (Chambers, Craig, & Bennett, 2002) and during needle injections in some (Manimala, Blount, & Cohen, 2000), but not other studies (Gonzalez, Routh, & Armstrong, 1993).

Children's coping behaviors include forms of distraction, therapeutic breathing, and making coping statements. Children's coping behaviors were facilitated by adult prompts for the children to perform them prior to and during the painful procedures (Blount et al., 1990). Child coping has been found to vary from the anticipatory to the painful phases, with more conversation and distracting interactions during the anticipatory phase and simple coping behaviors, such as therapeutic breathing, during the painful phase (Blount et al., 1990). The types of adult prompts to the children to cope also co-varied with child coping patterns during the different phases. Child coping and adults' coaching of the children to cope were inversely correlated with child distress (Blount et al., 1990).

The 35 CAMPIS codes were grouped into the 6-code CAMPIS-R (Blount et al., 1990; Blount et al., 1997) based on conceptual and empirical factors. The CAMPIS-R has been widely used for monitoring child coping, adults' coping promoting and distress promoting behaviors, and to a lesser extent child distress, during correlational and treatment outcome research. Reliability and validity are high for both the CAMPIS and CAMPIS-R versions of the scales. However, as with most direct observation scales, their use can be labor intensive and time consuming. To help address this practical issue, CAMPIS-Short Form was developed (CAMPIS-SF; Blount, Bunke, Cohen, & Forbes, 2001). The CAMPIS-SF is used to monitor the same important categories of behavior as the CAMPIS-R, but requires much less time. Initial reliability and validity data are promising (Blount et al., 2001). There are also other rating scales for children's procedural distress, such as the Distress subscale of the Behavioral Approach-Avoidance and Distress Scale (BAADS; Bachanas & Blount, 1996; Hubert, Jay, Saltoun, & Hayes, 1988). The Distress scale in particular has been shown to be reliable and valid.

Observational scales are critical for a thorough evaluation of infants' procedural distress. The Modified Behavioral Pain Scale (MBPS; Taddio, Nulman, Goldbach, & Ipp, 1994) is a rating scale of facial expression, cry, and body movement indicators of infant pain. This scale, derived from the Children's Hospital of Eastern Ontario Pain Scale (CHEOPS; McGrath et al., 1985), was specifically developed to assess injection pain in infants. Using an alternative approach, the Neonatal Facial Coding System (NFCS; Grunau & Craig, 1987) examines 10 facial movements indicative of infant pain expression (e.g., eyes squeezed, taut cupped tongue). Crying is probably the most recognized infant distress reaction, and has been examined in terms of latency, duration,

intensity, and frequency of cry (Gunnar et al., 1995). The limitations of cry are that not all infants cry when distressed and it is difficult to distinguish among different types of cry (e.g., hunger, anger, pain).

Some of the drawbacks associated with the use of observational measures are that they may be time-consuming and often require videotaping so that behaviors might be coded, or perhaps even transcribed and coded at a later time. Thus, the more time consuming of the observational scales are probably most useful for research, as opposed to fast paced clinical settings.

Summary and recommendations for assessment. The choice of specific measures should be determined by children's developmental level, the nature of the setting, and whether assessment is for research or clinical purposes. Self-report and reports by adults have the unique advantages of being easily and quickly collected, and they provide unique perspectives on children's reactions to painful procedures. Self-report is a more valid method for older than for younger children. Given the ease of administration and subjective nature of pain, ratings should be included in most clinical and research pain assessment endeavors.

Physiological monitoring offers the possibility of objective assessment, but the measures may be influenced by movement, emotional state, and factors other than pain that influence children's physiology. Also, in some cases, invasiveness and expense could contraindicate this approach for clinical, as opposed to research purposes. However, if the patient is not able to provide verbal report, as in the case of newborns, physiological monitoring might be critical, for both clinical and research activities.

Observational methods offer a wealth of information about the topography of distress, coping behaviors, and about the behaviors of others in the medical treatment room. Observational methods can be utilized across the age range, from premature infants to adolescents and even adults. The main drawback of comprehensive observational scales is that they can be time consuming. To help extend their utility into the clinical arena, ratings scales, such as the CAMPIS-SF (Blount et al., 2001) and the Distress Scale of the BAADS (Bachanas & Blount, 1996; Hubert et al., 1988), or particular individual coping and coping promoting codes from the CAMPIS (Blount et al., 1997) are recommended. The effects of children's coping behaviors, and of adults' behaviors on children's coping and distress are too important to ignore. Observational measures should be included in practically any pediatric pain research project and, if feasible, clinicians should consider incorporating observational measures.

Treatments to Reduce Pain and Distress

Procedural pain has been treated using medical, psychological, and combined interventions. Medical interventions include pharmacological agents and improvements in medical equipment and procedures that are intended to produce less pain. With decreased pain children should be less likely to develop conditioned anticipatory anxiety to the procedure. The psychological interventions have similar goals in that they are intended to reduce fear and anxiety prior to and during the procedures, minimize distress and pain during the procedure, and increase children's and parents' sense of mastery during challenging medical procedures.

Medical approaches. Pharmacological interventions for pediatric pain include anti-inflammatory and antipyretic drugs such as aspirin and acetaminophen; opiate

analgesics like morphine and codeine; psychotropic drugs such as tranquilizers, antidepressants, and psychostimulants; nitrous oxide; and combinations of different medications. Despite the efficacy of these approaches for children's surgery, chronic pain, and highly invasive medical procedures (e.g., bone marrow aspiration), such treatments would not be recommended for brief outpatient procedures such as venipuncture (McGrath, 1991). Pharmacological attempts to decrease pediatric distress for the more common procedures such as immunizations and venipuncture have included dermal analgesia (e.g., lidocaine, benzocaine, ketocaine, and mixtures of different anaesthetics); but, these have not been widely accepted due to inadequate pain reduction, the requirement of a painful needle injection to anesthetize the skin, dermal irritation, or toxicity (Hallén, Carlsson, & Uppfeldt, 1985). A recent topical medication is the eutectic mixture of the local anesthetics lidocaine (2.5%) and prilocaine (2.5%) (EMLA). When applied to the skin, EMLA inhibits the ionic fluxes that initiate and conduct pain impulses, thus, resulting in local anesthesia. EMLA, available in cream or patch form, requires approximately one hour to provide sufficient epidermal and dermal anesthesia.

By their very nature, needles produce some physical sensations that can be painful and anxiety provoking. To help reduce the sensory aspects of pain produced by needles, many pediatric hospitals have taken initiatives to ensure that children receive fewer injections, such as through the use of a central line. There have been numerous publications evaluating alternative, less painful methods of injection, such as the use of automatic needle insertion (Main, Jorgensen, Hertel, Jensen, & Jakobsen, 1995), micro-fabricated micro-needles (Kaushik et al., 2001), and needless injectors (Cooper, Bromley, Baranowski, & Barker, 2000). Compared to standard needle injections, needless

injectors have resulted in superior ratings for convenience, nervousness, pain, and overall performance (e.g., Murray et al., 2000). However, at this point, they are more typically used for children requiring repeated treatments, such as children with diabetes and with growth hormone problems. Also, despite medical advancements, procedures are still a source of considerable anxiety, pain, and distress for many children.

Cognitive behavioral approaches. In response to the Society of Pediatric Psychology's (Division 54 of the American Psychological Association) initiative, Powers (1999) determined that cognitive behavioral therapy was a well-established and "empirically supported treatment" for procedure related pain in children and adolescents. Some of the particular cognitive behavioral approaches that have been utilized include relaxation, desensitization and in vivo exposure, breathing exercises or use of a blower, counting, behavioral rehearsal, reinforcement, modeling, imagery, distraction, making coping statements, and parental and/or nurse coaching of the child to use coping behaviors. The use of these techniques is described in detailed method sections of the articles in which they are used (see Powers, 1999). To our knowledge, treatment manuals have not been used except in one investigation (Cohen et al., 1999). For reviews of psychological treatments for pediatric procedural pain, see McGrath (1991), Varni et al. (1995), Blount et al. (2000ab), Blount et al. (in press), Dahlquist (1999), and Rudolph, Dennig, and Weisz (1995).

Within the various cognitive behavioral interventions, there is usually a mixture of information provided to the child about the medical treatment, particularly when using modeling and behavioral rehearsal to use coping skills, and some degree of distraction. When conducted in a safe situation, information provision and behavioral rehearsal can

serve as an exposure-based treatment to reduce the conditioned anticipatory anxiety and distress prior to a medical treatment, reduce the fear of the unknown, and well as provide the child with skills to use during the treatment. Age-appropriate procedural and sensory information may also remove fear of the unknown for children who are unfamiliar with what the medical treatment entails. It is also helpful to direct such preparatory interventions at both children and their parents, as parents can serve a very important role in facilitating their child's coping if provided with appropriate guidance.

Distraction serves to redirect attention *from* threatening and anxiety provoking aspects of medical treatments *to* non-threatening objects or situations. The most likely threatening stimuli for children to focus on during medical treatments are the sights, smells, and sounds accompanying the medical treatment, and their own unpleasant sensations of fear, distress, and pain. Refocusing to relatively pleasant objects, activities, or situations should be seen as a means of engaging in behaviors that are incompatible with anticipatory anxiety, distress, and pain. While distraction has proven to be highly during acute pediatric painful procedures, it has been suggested in the adult literature that distraction may be less effective when coping with prolonged pain (e.g., McCall & Malott, 1984; Suls & Fletcher, 1985). This issue remains to be addressed in the pediatric literature.

It is better to use distracting activities that can be observed, in order to confirm that the child is actually engaging in the activity, rather than attempting to utilize unobservable coping behaviors, such as telling patients to "relax" or use imagery. Focusing concentration away from the noxious stimuli and toward something positive may modify cognitive pain perceptions by altering nociceptive responses and triggering

an internal pain-suppressing system (McGrath, 1991). For an expanded discussion of how to balance information provision and distraction approaches, see the latter part of the chapter by Blount, Smith, and Frank (1999), and Blount et al. (in press).

Non-pharmacological treatments for infant procedural distress have begun to emerge in the literature. For example, there is some research to support infant pain management with sucrose (for a review, see Stevens, Taddio, Ohlsson, & Einarson, 1997), non-nutritive sucking on pacifiers (for a review, see Field, 1999), rocking and a pacificer (Campos, 1994), having access to a security blanket (Ybarra, Passman, & Eisenbert, 2000) and distraction (Cohen, 2002).

Only a few studies have compared or combined pharmacological and cognitive behavioral interventions. In a comparison between EMLA and music distraction (Arts et al., 1994), EMLA was found to be superior to the music distraction for the 4- to 6-year-old children, but not for the 7- to 11- or the 12- to 16-year-olds. It is possible that music distraction was not sufficiently engaging of the children's attention. Later, Cohen et al. (1999) compared EMLA to a more potent, nurse-prompted, child-selected, videotaped cartoon distraction for reducing distress in 4th grade African-American males undergoing a series of three immunization injections. Nurse prompted videotaped distraction resulted in more child coping and less behavioral distress than either EMLA or the standard medical care control condition. Children preferred both EMLA and the videotaped cartoon distraction to standard medical care. In addition, distraction was more economical than EMLA. In a 6-month follow-up of these children (Cohen et al., 2001), EMLA was remembered by the children to be superior to distraction, which was remembered to be superior to standard care for reducing anxiety. For pain relief, the

children recalled no differences between EMLA and distraction, and both were remembered to be superior to standard medical care.

Jay and her colleagues found their cognitive behavior therapy treatment package to be superior to Valium for reducing distress, pain, and pulse rates for children undergoing BMAs (Jay, Elliott, Katz, & Siegel, 1987). Further adding Valium to the cognitive behavioral program did not significantly improve children's responses during BMAs beyond cognitive behavior therapy alone (Jay, Elliott, Woody, & Siegel, 1991). Jay, Elliott, Fitzgibbons, Woody, and Siegel (1995) then compared the cognitive behavioral program to general anesthesia (Halothane delivered using a face mask) for children undergoing BMAs. The investigators found less distress for the anesthesia condition during the painful phase, but fewer adjustment symptoms in the 24 hours following the BMA for the cognitive behavioral program. There were no significant differences in the children's preferences for the two treatments. As was true in the study by Cohen et al. (1999), the cognitive behavioral condition was more economical than the pharmacological treatment. Kazak et al. (1996) compared conscious sedation using midazolam and morphine to the combination of conscious sedation and distraction during BMAs and LPs. The combined treatment was found to be superior to conscious sedation alone when assessed by nurse and mother ratings of child distress.

Summary of treatment efficacy, and practice recommendations. Both cognitive behavioral and medical approaches have been shown to be effective for reducing children's fear, anxiety, distress, and pain. The use of smaller needles, less frequent medical procedures, conscious sedation, and topical anesthesia are some of the medical alternatives to reduce procedural pain. Similarly, the Society of Pediatric Psychology has

determined that cognitive behavioral treatment programs are well established for the reduction of pediatric procedural anxiety, pain, and distress (Powers, 1999). We further emphasize the key importance of distraction, or redirecting of the child's attention from threatening to non-threatening stimuli, in order to produce therapeutic benefit (e.g., Varni et al., 1995). Selecting a method of distraction that is salient, age appropriate, appealing to the children, and involves observable behavior, should be the goal. Simple yet effective interventions, such as blowing on a party blower and watching highly engaging cartoons, may have a greater likelihood of being adapted for ongoing use in clinical settings. Providing procedural information to the child about the upcoming medical treatment can be used in this context to both bring about anxiety reduction, using principles of in vivo exposure and desensitization, and for the purpose of teaching coping skills (e.g., Blount et al., 1992, 1999; Blount, Powers, Cotter, Swan, & Free, 1994). Ideally, such procedural information should be provided to the child well ahead of the scheduled medical procedure in order to allow time for anxiety initially generated by the information to dissipate and for the child to plan and rehearse possible coping strategies (see Blount et al., in press).

Training adults to prompt children to use coping behaviors should be included in treatment programs. Frequent prompts to the child to engage in the coping behavior, particularly at key procedural junctures such as cleaning a site just prior to an injection or at signs of child distress, are often necessary to ensure that the coping behavior occurs. We have observed that a nurse who provides frequent prompts to the child to attend to a distracting video also cues the parents to prompt the child, even without the necessity of training the parents (Cohen et al., 1997). As with children, parents can be taught to

engage in those behaviors which prompt child coping rather than those which increasingly have been shown to prompt child distress, such as reassuring the child, being apologetic, or being overly empathic about the child's pain (e.g., Blount et al., 1997; Blount et al., in press; Chambers et al., 2002; Manimala et al., 2002). These emotionally focused adult behaviors focus the child's attention on their fear, pain, and distress, rather than away from those factors. Because coping promoting and distress promoting are mutually incompatible behaviors, assuring that parents and medical staff engage in more coping promoting behaviors simultaneously assures that they engage in fewer of the undesirable distress promoting behaviors. The importance of children, parents, and medical staff working together to ensure that children cope is essential, and should be a feature of most cognitive behavioral training programs. Combinations of cognitive behavioral and medical approaches should be used whenever possible to reduce children's procedural distress.

Cost-effectiveness is an additional consideration in medical care. Researchers and practitioners alike should monitor the time and personnel required to promote the effective use of coping and coping promoting behaviors by the children, parents, and medical staff; costs of medications and other medical techniques used to reduce pain and suffering; the length of medical stay and care; and other health related dependent variables. Additional clinically relevant dependent variables are consumer satisfaction and preference for pain reduction approaches. Documentation of cost-effectiveness and consumer preference and satisfaction (e.g., Blount, 1987; Cohen et al., 1997, 1999, 2001; Jay et al., 1987, 1995) would go far toward the justification, enhancement, and

dissemination of pain management services, and the concomitant reduction in pain and suffering in children.

References

American Academy of Pediatrics. (2001). The assessment and management of acutein infants, children, and adolescents. *Pediatrics, 108,* 793-797.

Anand, K. J. (1998a). Clinical importance of pain and stress in preterm neonates. *Biology of the Neonate, 73,* 1-9.

Anand, K. J. (1998b). Neurophysiological and neurobiological correlates of supraspinal pain processing: Measurement techniques. In G. A. Finley & P. J. McGrath (Eds.), *Measurement of pain in infants and children, progress in pain research and management, Vol. 10* (pp. 21-46). Seattle: IASP Press.

Arts, S. E., Abu-Saad, H. H., Champion, G. D., Crawford, M. R., Fisher, R. J., Jiniper, K. H., et al. (1994). Age-related response to lidocaine-prilocaine (EMLA) emulsion and effect of music distraction on the pain of intravenous cannulation. *Pediatrics, 93,* 797-801.

Bachanas, P. J. & Blount, R. L. (1996). The Behavioral Approach-Avoidance and Distress Scale: An investigation of reliability and validity during painful medical procedures. *Journal of Pediatric Psychology, 21,* 671-681.

Bergius, M., Berggren, U., Bogdanov, O. & Hakeberg, M. (1997). Dental anxiety among adolescents in St. Petersburg, Russia. *European Journal of Oral Sciences, 105,* 117-122.

Beyer, J. E., Denyes, M. J., & Villarruel, A. M. (1992). The creation, validation, and continuing development of the Oucher: A measure of pain intensity in children. *Journal of Pediatric Nursing, 7,* 335-346.

Blount, R. L. (1987). The dissemination of cost-effective psychosocial programs for children in health care settings. *Children's Health Care, 15,* 206-213.

Blount, R. L., Bachanas, P .J., Powers, S. W., Cotter, M. C., Franklin, A., Chaplin, W., Mayfield, J., Henderson, M. & Blount, S. D. (1992). Training children to cope and parents to coach them during routine immunizations: Effects on child, parent and staff behaviors. *Behavior Therapy, 23,* 689-705.

Blount, R. L., Bunke, V. L., Cohen, L. L., & Forbes, C. J. (2001). The Child-Adult Medical Procedure Interaction Scale-Short Form (CAMPIS-SF): Validation of a rating scale for children's and adults' behaviors during painful medical procedures. *Journal of Pain and Symptom Management, 22,* 591-599.

Blount, R. L., Bunke, V. L., & Zaff, J. F. (2000a). The integration of basic research, treatment research, and clinical practice in pediatric psychology. In D. Drotar (Ed.), *Handbook of research in pediatric and child clinical psychology: Practical strategies and methods*. (pp. 491-510). New York: Kluwer Academic/Plenum Publishers.

Blount, R. L., Bunke, V. L., & Zaff, J. F. (2000b). Bridging the gap between explicative and treatment research: A model and practical implications. *Journal of Clinical Psychology in Medical Settings, 7,* 79-90.

Blount, R. L., Cohen, L. L., Frank, N. C., Bachanas, P. J., Smith, A. J., Manimala, M. R., & Pate, J. T. (1997). The Child-Adult Medical Procedure Interaction Scale-Revised: An assessment of validity. *Journal of Pediatric Psychology, 22,* 73-88.

Blount, R. L., Corbin, S. M., Sturges, J. W., Wolfe, V. V., Prater, J. M., & James, L. D. (1989). The relationship between adults behavior and child coping and distress during BMA/LP procedures: A sequential analysis. *Behavior Therapy, 20*, 585_601.

Blount, R. L., Piira, T., & Cohen, L. L. (in press). Management of pediatric pain and distress due to medical procedures. In M. C. Roberts (Ed.), *Handbook of pediatric psychology* (3rd.). New York: Guilford.

Blount, R.L., Powers, S.W., Cotter, M. W. Swan S. C., & Free, K. (1994). Making the system work: Training pediatric oncology patients to cope and their parents to coach them during BMA/LP procedures. *Behavior Modification, 18,* 6-31.

Blount, R. L., Smith, A. & Frank, N. (1999). Preparation to undergo medical procedures. In A. J. Goreczny & M. Hersen (Eds.), *Handbook of pediatric and adolescent health psychology*. (pp. 305-326). Needham Heights, MA: Allyn and Bacon.

Blount, R. L., Sturges, J. W., & Powers, S. W. (1990). Analysis of child and adult behavioral variations by phase of medical procedure. *Behavior Therapy, 21*, 33-48.

Bush, J. P, & Holmbeck, G. N. (1987). Children's attitudes about health care: Initial development of a questionnaire. *Journal of Pediatric Psychology, 12,* 429-443.

Campos, R. G. (1994). Rocking and pacificiers: Two comforting interventions for heel stick pain. *Research in Nursing & Health, 17,* 321-331.

Chambliss, C. R. & Anand, K. J. (1997). Pain management in the pediatric intensive care unit. *Current Opinion in Pediatrics, 9,* 246-253.

Chambers, C. T., Craig, K. D., & Bennett, S. M. (in press). The impact of maternal behavior on children's pain experiences: An experimental analysis. *Journal of Pediatric Psychology, 27,* 293-301.

Champion, G. D., Goodenough, B., von Baeyer, C. L., & Thomas, W. (1998). Measurement of pain by self-report. In G. A. Finley & P. J. McGrath (Eds.), *Measurement of pain in infants and children, progress in pain research and management, Vol. 10* (pp. 123-160). Seattle: IASP Press.

Choinière, M. (2001). Burn pain: a unique challenge. *Pain: Clinical Updates, 7,* 1-4.

Cohen, L. L. (in press). Reducing infant immunization distress through distraction. *Health Psychology.*

Cohen, L. L., Blount, R. L., Cohen, R. J., McClellan, C. B., Bernard, R. S., & Ball, C. M. (2001). Children's expectations and memories of acute distress: The short- and long-term efficacy of pain management interventions. *Journal of Pediatric Psychology, 26,* 367-374.

Cohen, L. L., Blount, R. L., Cohen, R. J., Schaen, E. R., & Zaff, J. (1999). Comparative study of distraction versus topical anesthesia for pediatric pain management during immunizations. *Health Psychology, 18,* 591-598.

Cohen, L. L., Blount, R. L., & Panopoulos, G. (1997). Nurse coaching and cartoon distraction: An effective and practical intervention to reduce child, parent, and nurse distress during immunizations. *Journal of Pediatric Psychology, 22,* 355-370.

Cooper, J. A., Bromley, L. M., Baranowski, A. P. & Barker, S. G. (2000). Evaluation of a needle-free injection system for local anaesthesia prior to venous cannulation. *Anaesthesia, 55,* 247-250.

Davies, R., Butler, N. & Goldstein, H. (1972). *From birth to seven: The second report of the National Child Development Study (1958 Cohort)*. London: National Children's Bureau.

Dahlquist, L. M. (1999). *Pediatric pain management.* New York: Kluwer Academic / Plenum Publishers.

Eland, J. M. (1993). Pain in children. *Nursing Clinics of North America, 25,* 871-884.

Field, T., (1999). Sucking and massage therapy reduce stress during infancy. In M. Lewis & D. Ramsay (Eds.), *Soothing and stress* (pp. 157-169). Mahway, NJ: Erlbaum.

Finley, G. A., & McGrath, P. J. (1998). Introduction: The roles of measurement in pain management and research. In G. A. Finley & P. J. McGrath (Eds.), *Measurement of pain in infants and children, progress in pain research and management, Vol. 10* (pp. 1-4). Seattle: IASP Press.

Fradet, C., McGrath, P. J., Kay, J., Adams, S & Luke, B. (1990). A prospective survey of reactions to blood tests by children and adolescents. *Pain, 40,* 53-60.

Frank, N. C., Blount, R. L., Smith, A. J., Manimala, M. R. & Martin, J. K. (1995). Parent and staff behavior, previous child medical experience, and maternal anxiety as they relate to child procedural distress and coping. *Journal of Pediatric Psychology, 20,* 277-289.

Gonzalez, J. C., Routh, D. K., & Armstrong, F. D. (1993). Effects of maternal distraction versus reassurance on children's reactions to injections. *Journal of Pediatric Psychology, 18,* 593-604.

Goodenough, B, Addicoat, L, Champion, G. D., McInerney, M., Young, B., Juniper, K. & Ziegler, J. B. (1997). Pain in 4- to 6-year-old children receiving intramuscular injections: a comparison of the Faces Pain Scale with other self-report and behavioral measures. *Clinical Journal of Pain, 13,* 60-73.

Goodenough, B., Kampel, L., Champion, G.D., Laubreaux, L., Nicholas, M. K., Ziegler, J. B. & McInerney, M. (1997). An investigation of the placebo effect and age-related factors in the report of needle pain from venipuncture in children. *Pain, 72,* 383-391.

Goodenough, B., Thomas, W., Champion, G. D., Perrott, D., Taplin, J. E., von Baeyer, C. L. & Ziegler, J. B. (1999). Unravelling age effects and sex differences in needle pain: ratings of sensory intensity and unpleasantness of venipuncture pain by children and their parents. *Pain, 80,* 79-190.

Grunau, R. V., & Craig, K. D. (1987). Pain expression in neonates: Facial action and cry. *Pain, 28,* 395-410.

Gunnar, M. R., Porter, F. L., Wolf, C. N. Rigaruso, J., & Larson, M. C. (1995). Neonatal stress reactivity: Prediction to later emotional temperament. *Child Development, 66,* 1-13.

Hallén, B., Carlsson, P., & Uppfeldt, A. (1985). Clinical study of a lignocaine-prilocaine cream to relieve the pain of venipuncture. *British Journal of Anaesthesia, 57,* 326-328.

Henry, D. B. & Foster, R. L. (2000). Burn pain management in children. *Pediatric Clinics of North America, 47(3),* 681-698.

Hicks, C. L., von Baeyer, C. L., Spafford, P. A., van Korlaar, I. & Goodenough, B. (2001). The Faces Pain Scale-Revised: toward a common metric in pediatric pain measurement. *Pain, 93,* 173-183.

Hubert. N. C., Jay, S. M., Saltoun, M. & Hayes, M. (1988). Approach-avoidance and distress in children undergoing preparation for painful medical procedures. *Journal of Clinical Child Psychology, 17,* 194-202.

Jacobsen, P., Manne, S., Gorfinkle, K., Schorr, O., Rapkin, B. & Redd, W. (1990). Analysis of child and parent activity during painful medical procedures. *Health Psychology, 9,* 559-576.

Jay, S. M. (1988). Invasive medical procedures: Psychological intervention and assessment. In D. K. Routh (Ed.), *Handbook of pediatric psychology* (pp. 401-425). New York: Guilford.

Jay, S. M., Elliott, C. E., Fitzgibbons, I., Woody, P., & Siegel, S. (1995). A comparative study of cognitive behavioral therapy versus general anesthesia for painful medical procedures in children. *Pain, 62,* 3-9.

Jay, S. M., Elliott, C. E., Katz, E., & Siegel, S. E. (1987). Cognitive-behavioral and pharmacologic interventions for children's distress during painful medical procedures. *Journal of Consulting and Clinical Psychology, 55,* 860-865.

Jay, S. M., Elliott, C. E., Woody, P. D., & Siegel, S. (1991). An investigation of cognitive-behavior therapy combined with oral Valium for children undergoing medical procedures. *Health Psychology, 10,* 317-322.

Jay, S. M., Ozolins, M., Elliott, C. H., & Caldwell, S. (1983). Assessment of children's distress during painful medical procedures. *Health Psychology, 2,* 133-147.

Johnston, C. C., Collinge, J. M., Henderson, S. J. & Anand, K. J. (1997). A cross-sectional survey of pain and pharmacological analgesia in Canadian neonatal intensive care units. *Clinical Journal of Pain, 13,* 308-312.

Karoly, P. (1991). Assessment of pediatric pain. In J. P. Bush & S. W. Harkins (Eds.), *Children in pain: Clinical and research issues from a developmental perspective (pp. 59-82).* New York: Springer.

Katz, E. R., Kellerman, J., & Siegel, S. E. (1980). Distress behavior in children with cancer undergoing medical procedures: Developmental considerations. *Journal of Consulting and Clinical Psychology, 48,* 356-365.

Kaushik, S., Hord, A.H., Denson, D. D., McAllister, D. V., Smitra, S., Allen, M. G. & Prausnitz, M. R. (2001). Lack of pain associated with microfabricated microneedles. *Anesthesia & Analgesia, 92,* 502-504.

Kazak, A. E., Penati, B., Boyer, B. A., Himelstein, B., Brophy, P. Waibel, M. K., et al., (1996). A randomized controlled prospective outcome study of a psychological and pharmacological intervention protocol for procedural distress in pediatric leukemia. *Journal of Pediatric Psychology, 21,* 615-631.

Kennedy, R. M. & Luhmann, J. D. (1999). The "ouchless emergency department". Getting closer: advances in decreasing distress during painful procedures in the emergency department. *Pediatric Clinics of North America, 46,* 1215-1247.

Klingberg, G. (1995). Dental fear and behavior management problems in children. A study of measurement, prevalence, concomitant factors, and clinical effects. *Swedish Dental Journal, 103,* 1-78.

Lagercrantz, H. & Ringstedt, T. (2001). Organization of the neuronal circuits in the central nervous system during development. *Acta Paediatrica, 90,* 707-715.

Liossi, C. (1999). Management of paediatric procedure-related cancer pain. *Pain Reviews, 6,* 279-302.

Ljungman, G., Gordh, T., Sorensen, S. & Kreuger, A. (1999). Pain in paediatric oncology: interviews with children, adolescents and their parents. *Acta Paediatrica, 88,* 623-630.

Main, K. M., Jorgensen, J. T., Hertel, N. T., Jensen, S. & Jakobsen, L. (1995). Automatic needle insertion diminishes pain during growth hormone injection. *Acta Paediatrica, 84,* 331-334.

Manimala, R., Blount, R. L., & Cohen, L. L. (2000). The effects of parental reassurance versus distraction on child distress and coping during immunizations. *Children's Health Care, 29,* 161-177.

Marchette, L., Main, R., Redick, E. Baggs, A. & Leatherland, J. (1991). Pain reduction interventions during neonatal circumcisions. *Nursing Research, 40,* 241-244.

Mares, J., Hesova, M., Skalska, H., Hubkova, V. & Chmelarova, R. (1997). Children's pain during dental treatment. *Acta Medica (Hradec Kralove), 40,* 103-108.

McCaul, K. D., & Malott, J. M. (1984). Distraction and coping with pain. *Psychological Bulletin, 95,* 516-533.

McGrath, P. A. (1990). *Pain in children: Nature, assessment and treatment.* New York: Guilford.

McGrath, P. A. (1991). Intervention and management. In J. P. Bush, & S. W. Harkins (Eds.), *Children in pain: Clinical and research issues from a developmental perspective* (pp. 83-115). New York: Springer-Verlag.

McGrath, P. A. (1994). Psychological aspects of pain perception. *Archives of Oral Biology, 39,* 55-62.

McGrath, P. J., Johnson, G., Goodman, J. T., Schillinger, J., Dunn, J., & Chapman, J. (1985). CHEOPS: A behavioral scale for rating postoperative pain in children. In H. L. Fields, R. Dubner, & F. Cervero (Eds). *Advances in Pain Research and Therapy, Vol 9*. Proceedings of the Fourth World Congress on Pain. New York: Raven Press. 395-402.

Miser, A. W., Dothage, J. A., Wesley, R. A. & Miser, J. S. (1987). The prevalence of pain in a pediatric and young adult cancer population. *Pain, 29,* 73-83.

Murray, F. T., Silverstein, J. H., Johnson, S. B., Gertner, J. H., Frye, K., Gironda, G., et al. (2000). Bioequivalence and patient satisfaction with a growth horomone (Siazen) needle-free device—results of clinical and laboratory studies. *Today's Therapeutic Trends, 18,* 71-86.

Murtomaa, H., Milgrom, P., Weinstein, P. & Vuopio, T. (1996). Dentists' perceptions and management of pain experienced by children during treatment: a survey of groups of dentists in the USA and Finland. *International Journal of Paediatric Dentistry, 6,* 25-30.

Pate, J. T., Blount, R. L., & Cohen, L. L., Smith, A. J. (1996). Childhood medical experience and temperament as predictors of adult functioning in medical situations. *Children's Health Care, 25,* 281-296.

Porter, F. L., Wolf, C. M., Gold, J., Lotsoff, D., & Miller, J. P. (1997). Pain and pain management in newborn infants: a survey of physicians and nurses. *Pediatrics, 100,* 626-632.

Porter, F. L., Wolf, C. M. & Miller, J. P. (1999). Procedural pain in newborn infants: the influence of intensity and development. *Pediatrics, 104,* 105.

Powers, S. W. (1999). Empirically supported treatments in pediatric psychology: Procedure-related pain. *Journal of Pediatric Psychology, 24,* 131-145.

Ruda, M. A. Ling, Q. D. Hohmann, A. G., Peng, Y. B. & Tachibana, T. (2000). Altered nocioceptive neuronal circuits after neonatal peripheral inflammation. *Science, 289*, 628-631.

Rudolph, K. D., Dennig, M. D. & Weisz, J. R. (1995). Determinants and consequences of children's coping in the medical setting: conceptualization, review, and critique. *Psychological Bulletin, 118,* 328-357.

Schecter, N. L., Berde, C. B. & Yaster, M. (1993). Pain in infants, children, and adolescents: an overview. In. N.Schecter, C.B. Berde & M.Yaster (Eds.). *Pain in infants, children, and adolescents*. Baltimore: Williams and Wilkins.

Schechter, N. L., Blankson, V., Pachter, L. M., Sullivan, C.M. & Costa, L. (1997). The ouchless place: no pain, children's gain. *Pediatrics, 99,* 890-894.

Shapiro, B. S., Cohen, D. E., Covelman, K. W., Howe, C. J., & Scott, S. M. (1991) Experience of an interdisciplinary pediatric pain service. *Pediatrics, 88,* 1226-1232.

Southall, D. P., Cronin, B. C., Hartmann, H., Harrison-Sewell, C. & Samuels, M. P. (1993). Invasive procedures in children receiving intensive care. *British Medical Journal, 306,* 1512-1513.

Stevens, B. J., & Johnson, C. (1994). Physiological responses of premature infants to a painful stimulus. *Nursing Research, 43,* 226-231.

Stevens, B., Taddio, A., Ohlsson, A., & Einarson, T. (1997). The efficacy of sucrose for relieving procedural pain in neonates – A systematic review and meta-analysis. *Acta Paediatrica, 86,* 837-842.

Suls, J., & Fletcher, B. (1985). The relative efficacy of avoidant and nonavoidant coping strategies: A meta-analysis. *Health Psychology, 4,* 249-288.

Taddio, A., Katz, J., Ilersich, A. L. & Koren, G. (1997). Effect of neonatal circumcision on pain response during subsequent routine vaccination. *Lancet, 349,* 599-603.

Taddio, A., Nulman, I., Goldbach, M., & Ipp, M. (1994). Use of lidocaine-prilocaine cream for vaccination pain in infants. *Journal of Pediatrics, 124,* 643-648.

Varni, J. W., Blount, R. L., Waldron, S. A., & Smith, A. J. (1995). Management of pain and distress. In M. C. Roberts (Ed.), *Handbook of pediatric psychology* (2nd ed., pp. 105-123). New York: Guilford.

Varni, J. W., Walco, G. A., & Wilcox, K. T. (1990). Cognitive-biobehavioral assessment and treatment of pediatric pain. In A. M. Gross & R. S. Drabman (Eds.), *Handbook of clinical behavioral pediatrics* (pp. 83-97). New York: Plenum.

Whitfield, M. F. & Grunau, R. E. (2000). Behavior, pain perception, and the extremely low-birth weight survivor. *Clinics in Perinatology, 27,* 363-379.

Ybarra, G. J., Passman, R. H., & Eisenberg, C. S. L. (2000). The presence of security blankets or mothers (or both) affects distress during pediatric examinations. *Journal of Consulting and Clinical Psychology, 68,* 322-330.