KANGAROO CARE, FACILITATED TUCKING AND NON-NUTRITIVE SUCKING
TO REDUCE PAIN IN NEONATES: A BEST PRACTICE PROPOSAL

By

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Abstract

Increasing survival rates of preterm infants and a greater understanding of the long-term consequences of prematurity and early exposure to pain have generated a greater need for non-pharmacological pain management measures in the neonatal intensive care unit (NICU) setting. These pain management interventions are necessary to decrease the potentially unfavorable consequences of early exposure to pain, and to promote positive long-term outcomes in this population. The purpose of this thesis was to propose a best practice plan for kangaroo care, facilitated tucking and non-nutritive sucking interventions for infants receiving care in the NICU. Synthesis of available research is presented to support the use of these interventions as methods of non-pharmacological pain management, and to formulate policies for implementation in the hospital setting. Policies included in this paper were specifically developed for use in the NICU at St. Joseph’s hospital in Tucson, Arizona. Effectiveness of the aforementioned interventions will be evaluated using an informal written questionnaire, distributed to nurses on the targeted unit.
CHAPTER 1:
INTRODUCTION

The purpose of this thesis was to propose a best practice plan for kangaroo care, facilitated tucking and non-nutritive sucking for pain management in infants receiving care in neonatal intensive care units (NICU). Survival rates of preterm infants have notably increased in recent decades due to advances in perinatal and neonatal care and technology (Smith et al., 2011). A greater understanding of the long-term consequences of prematurity and early exposure to pain suggests that these unfavorable experiences alter future pain perception and behavioral responses to pain (Grunau, Holsti, & Peters, 2006). Modifying patient care in the NICU to reduce the magnitude and frequency of pain responses in preterm infants may prove to be significant in reducing maladaptive alterations in nociceptive circuitry and future pain perception. This chapter provides a review of physiological aspects of pain in preterm infants and the significance of effective pain management in this vulnerable population.

Physiological Mechanisms of Pain in Preterm Infants

The International Association for the Study of Pain (IASP) defines pain as, “an unpleasant sensory and emotional experience associated with actual or potential tissue damage…” (IASP, 2013, para. 2). Pain can be assessed using a variety of different approaches including changes in autonomic, humoral/metabolic and behavioral responses (Fitzgerald, & McIntosh, 1989). However, these approaches should only be used as guidelines to pain assessment; infants in the NICU are often unable to mount an obvious response to pain (Whitfield, & Grunau, 2000). Factors interfering with assessment of pain in preterm infants include: mechanical ventilation, swaddling, and lack of physical strength/energy (Whitfield, & Grunau, 2000).
**Infant pain scales.** Clinicians and physicians use a variety of scales to measure pain in infants; each composite scale integrates both physical and autonomic aspects of pain. Various elements of a pain response are individually scored, and later translated into a single summary score; this score is indicative of the severity or intensity of an infant’s pain (Whitfield, & Grunau, 2000). With each infant pain scale, a high composite score is indicative of pain. Because rating with a composite scale is subjective, disadvantages include inconsistent and unpredictable allocation of ratings (Whitfield, & Grunau, 2000). In the sections below, explanations of various pain scales are provided.

**Premature Infant Pain Profile (PIPP).** The PIPP scoring system incorporates both physiological and behavioral measures of heart rate, transcutaneous oxygen saturation and facial action indicators (Johnson et al., 2008). The physiological scores are calculated based on changes in heart rate and oxygen saturation compared to the patient’s baseline values (Johnson et al., 2008). The final PIPP score can range from 0-21 (Johnson et al., 2008).

**Neonatal Infant Pain Scale (NIPS).** The NIPS scale includes six indicators of pain: facial expression, cry, breathing pattern, arm movement, leg movement and state of arousal (Kashaninia, Sajedi, Rahgozar, & Noghabi, 2008). Each of the six categories is rated on a scale of 0 to 1, except for the ‘cry’ category which has three possible descriptors and score options; total NIPS scores range from 0 to 7 (Kashaninia et al., 2008). The scores indicate pain levels in an infant as follows: 0-2 mild to no pain, 3-4 mild to moderate pain, and greater than 4 signifies severe pain.

**The FLACC Scale.** Each category in this system (F) Face; (L) Legs; (A) Arms; (C) Cry; (C) Consolability is scored with a number ranging from 1-3. The scores from each category are totaled, indicating the overall severity of pain. A score of 1 in each category suggests that the
infant has no particular expression, or smile, that he/she is relaxed, lying quietly and is content with no cry (Merkel, Voepel-Lewis, Shayevitz, & Malviya, 1997). A rating of 2 in each category suggests the infant occasionally grimaces/frowns, is restless, squirming, moaning/wimpering, and reassured by touch or distraction (Merkel et al., 1997). Finally, a score of 3 in each category suggests the infant has a quivering chin or clenched jaw, is kicking or has his/her legs drawn up towards the body, has jerky movements, cries steadily, screams/sobs, and is difficult to comfort (Merkel et al., 1997).

**Neonatal facial coding system (NFCS).** This pain assessment tool evaluates ten facial actions: brow lower, eye squeeze, nasolabial furrow, open mouth, vertical stretch mouth, horizontal stretch mouth, chin quiver, lip purse, taut tongue, and tongue protrusion (Whitfield, & Grunau, 2000). The NFCS also differentiates between, “tissue insult (pain) and nontissue insult (stressful but not painful) procedures,” and whether the infant is receiving sucrose or an opioid analgesic during an invasive procedure (Whitfield, & Grunau, 2000, para. 8). An infant’s pain score is rated using a complex coding system comprised of action units (AU), correlating to specific muscles or groups of muscles, and intensity scores, ranging for A (trace) to E (maximum) intensity (Whitfield, & Grunau, 2000).

**Nociception in Neonates**

Nociceptive (pain) systems are present and functioning in early stages of fetal development, with afferent pathways reaching the cerebral cortex between 20 and 26 weeks gestation (Simmons, & Tibboel, 2006). Evidence exists to demonstrate that early activation of nociceptive systems can lead to long-term alterations in sensory perception and perception of pain (Grunau, & Tu, 2007). Though research on this topic has primarily been conducted in rat
pups, the outcomes are analogous to what has been observed in human neonates (Fitzgerald, 2005).

Nociception is the process by which a noxious stimulus is communicated to the central nervous system (Lewis, Dirksen, Heitkemper, Bucher, & Camera, 2011). It involves four stages: transduction, transmission, perception and modulation (Lewis et al., 2011). The first stage (transduction) begins with a noxious stimulus that causes the release of chemicals (prostaglandins, bradykinin, serotonin, substance P and histamine); these chemicals activate pain receptors called nociceptors (Lewis et al., 2011). As an action potential is generated at the end of the transduction stage, stage two (transmission) begins. Pain impulses are transmitted from peripheral nerves to the dorsal horn of the spinal cord via rapidly conducting, myelinated A-delta fibers, and slowly conducting, unmyelinated C fibers (Lewis et al., 2011). The action potential continues to travel from the spinal cord to the brainstem and thalamus where it is then transmitted to the cerebral cortex for processing (Lewis et al., 2011). The third stage of nociception (perception) occurs when a person experiences pain; this stage of pain is highly individualized and modifiable (Lewis et al., 2011). During the last stage of nociception (modulation), descending pathways of the spinal cord are activated, and release endogenous opioid substances, which facilitate inhibition of pain (Lewis et al., 2011).

Alterations in brain structure and function have been attributed to early exposure to pain in the NICU, however these outcomes are speculative, and based on findings of animal studies, due to ethics concerning human neonatal experimentation (Smith et al., 2011). During the early postnatal period, C fibers undergo proliferation and gradual maturation while pathways in the dorsal horn of the spinal cord also continue to develop (Fitzgerald, & McIntosh, 1989). Researchers speculate that repetitive, painful stimulation during a time of major neonatal
nociceptive pathway reorganization causes alterations in synaptic development (Simmons, & Tobboel, 2006). These alterations could lead to long-term changes in perception of sensations such as light touch, pain, pressure and temperature as well as changes in behavior due to an altered neurological state (Lewis et al., 2011; Simmons, & Tobboel, 2006).

Hypersensitization is especially prominent before 35 weeks gestation (Fitzgerald, & McIntosh, 1989). Spatial summation, a contributing factor to hypersensitization, refers to an increase in the number of nerve fibers stimulated, while hyperalgesia and allodynia indicate a lower threshold and an increased response, respectively (IASP, 2013; Mosby, 2009). Theories such as the wind-up phenomenon propose that repeated noxious stimuli can eventually lead to non-noxious stimuli being perceived as pain, consequently amplifying detrimental effects to neonatal brain development (Whitfield, & Grunau, 2000).

Significance of Pain Management for Preterm Infants

An estimated 13 million infants are born prematurely each year, worldwide (Beck et al., 2010). On average, premature infants in the NICU are subjected to 34 painful procedures within the first two weeks of life; the majority of these painful procedures are repeated heel lances or heel sticks (Stevens et al., 1999; Sundaram, Shrivastava, Pandian, & Singh, 2013). Exposure to pain at this young age can have long-term consequences on the development of an infant’s brain due to its effect on nociceptive neural circuits (Kashaninia et al., 2008). These alterations of the pain system during early development can lead to lower pain thresholds, in addition to cognitive and behavioral deficits as the infant matures (Kashaninia et al., 2008). Stress reduction and pain management, therefore, are essential components of neonatal care.

Non-pharmacological methods of pain management in neonates are a vital area of research, essential to reducing disruptions in an infant’s developmental processes. Cong et al.
(2012b) states that, “opioids have been found ineffective against procedural pain in preterm infants and are not recommended,” while interventions incorporating parental participation are encouraged (p. 636). Findings of important research indicate that skin-to-skin contact, also known as kangaroo care, between the mother and infant, effectively reduced cortisol levels in premature infants; lower cortisol levels suggest less pain and stress throughout painful procedures in the NICU (Cong, Ludington-Hoe, & Walsh, 2011). Study results also indicate that facilitated tucking, a nursing intervention that involves gently holding the infant in a flexed posture under the head and buttocks, “reduced deterioration of physiological parameters and enhanced infants’ behavioral stabilization during procedures” (Liaw et al., 2012, p. 307).

Though research is ongoing, several explanations regarding the effect of sucrose on pain relief and transmission have been proposed. One hypothesis suggests that sucrose stimulates gustatory (taste) receptors on the tongue, causing the gustatory pathway to stimulate inhibitory interneurons, which in turn stimulate the release of endogenous opioids (Mitchell, Brooks, & Roane, 2000). Endogenous opioids work to inhibit pain impulses at synapses in the dorsal horn of the spinal cord, thereby producing an analgesic effect (Mitchell, Brooks, & Roane, 2000). Because the gustatory pathway and nucleus tractus solitarius (NTS), a group of nerves found in the medulla, contain pathways that inhibit the transmission of pain, when the pain and gustatory pathways converge in the NTS, it is suggested that the transmission of pain is reduced (Mitchell, Brooks, & Roane, 2000).

**Purpose**

The purpose of this thesis is to propose a best practice plan for kangaroo care, facilitated tucking and non-nutritive sucking for pain management in preterm infants receiving care or undergoing painful procedures in NICUs. The author will review current and relevant literature
surrounding non-pharmacological methods of pain management that has been published in the last 5 to 10 years, or that remains unchanged in the last 20 years.

Summary

Chapter 1 introduced physiologic mechanisms of pain in neonates while also describing methods of pain assessment and the significance of pain management in preterm infants. Relevant terms and concepts were also defined, and are included in the table below.
Table 1.0

Relevant Terms and Concepts

<table>
<thead>
<tr>
<th>Term/Concept</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Allodynia</td>
<td>Pain response caused by a normally non-noxious stimuli (IASP, 2013).</td>
</tr>
<tr>
<td>Facilitated Tucking</td>
<td>A nursing intervention that involves gently cradling or holding the infant in a flexed posture under the head and buttocks (Liaw et al., 2012).</td>
</tr>
<tr>
<td>Hyperalgesia</td>
<td>Increased pain response at a normal threshold level (IASP, 2013).</td>
</tr>
<tr>
<td>Kangaroo Care</td>
<td>Skin-to-skin contact between an infant and a caregiver; usually the infant’s mother (Cong, Ludington-Hoe, &amp; Walsh, 2011).</td>
</tr>
<tr>
<td>Neonate</td>
<td>A newborn baby who is less than four weeks old (U.S. National Library of Medicine, 2013a).</td>
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<tr>
<td>Nociception</td>
<td>The process by which a noxious stimulus is communicated to the central nervous system (Lewis et al., 2011).</td>
</tr>
<tr>
<td>Non-Nutritive Sucking</td>
<td>An analgesic nursing intervention that involves orotactile stimulation with or without added sucrose (Liaw et al., 2012).</td>
</tr>
<tr>
<td>Preterm Infant</td>
<td>An infant born before 37 weeks gestation (U.S. National Library of Medicine, 2013b).</td>
</tr>
<tr>
<td>Spatial Summation</td>
<td>A number of spatially separated pre-synaptic neurons are simultaneously stimulated to allow one post-synaptic neuron to exceed its threshold, creating an action potential (Mosby, 2009).</td>
</tr>
<tr>
<td>Wind-up Phenomenon</td>
<td>Theory stating that repeated noxious stimuli could eventually lead to non-noxious stimuli being perceived as painful (Whitfield, &amp; Grunau, 2000).</td>
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CHAPTER 2:
REVIEW OF RESEARCH

Contemporary research about non-pharmacological pain management for preterm infants was reviewed in this chapter, as the foundation for proposing a best practice protocol for managing pain in preterm infants in the NICU. Articles included in this section were collected using PubMed and CINAHL online journal databases. The articles were organized according to subject matter, and furthermore organized by significance of relevant findings. All journal articles were peer-reviewed.

Kangaroo Care

Akcan, Yigit, and Atici (2009) evaluated the effect of kangaroo care on pain reduction in premature infants compared to the control group, before, during (first, second and third minutes) and after (first and second minutes) an invasive procedure. The study was a comparative randomized controlled study, conducted in a NICU facility at the Mersin University Research and Training Hospital in Turkey (Akcan et al., 2009). A total of 50 infants between the ages of 25 and 36 weeks gestational age were included in the sample; among the 50 participants, 54% were male and 46% were female (Akcan et al., 2009). Infants were ineligible to participate if they had any or all of the following: congenital abnormality, sepsis, mechanical ventilation, or surgical intervention (Akcan et al., 2009).

Severity of pain was assessed in each of the infants using the Premature Infant Pain Profile (PIPP) while other indicators of pain were measured by behavioral responses to pain, and physiological variables such as heart rate and oxygen saturation (Akcan et al., 2009). The PIPP scoring system is, “a composite measure of pain including physiological [heart rate, transcutaneous oxygen saturation], and behavioral [facial action] indicators” (Johnson et al.,
2008, p. 3). The final PIPP score can range from 0-21; a 2-point difference between the composite scores calculated during various experimental conditions (e.g. kangaroo care versus the control group) is considered clinically significant (Johnson et al., 2008).

Results of the data analysis suggest kangaroo care beginning 30 minutes prior to an invasive procedure and continuing 10 minutes afterward is an effective method of pain relief in preterm infants (Akcan et al., 2009). Findings also demonstrated significantly lower PIPP scores in infants receiving kangaroo care before (4.0), during (7.0, 4.0, 4.0) and after (4.0, 4.0) the procedure, compared to the PIPP scores of the infants in the control group before (4.0), during (15.0, 15.0, 15.0) and after (12.5, 12.5) the procedure (Akcan et al., 2009). A lower PIPP score represents a lower level of pain; a score between 0-6 points indicates mild pain, 7-12 moderate pain, and 13-21 severe pain (Akcan et al., 2009). Overall, the infants in the kangaroo care group cried less than those in the control group (Akcan et al., 2009).

Cong et al. (2012b) compared the autonomic responses in preterm infants receiving 15 or 30 minutes of kangaroo care versus infants receiving only incubator care (control group). The study was designed as a randomized crossover trial and took place in the northeast United States (Cong et al., 2012b). A total of 26 infants were included in the sample; among the participants, 50% were male and 50% were female (Cong et al., 2012b). Infants were eligible to participate if they met the following criteria: 28 to 32 weeks gestational age, less than 14 days old when recruited, receiving standard incubator care, nil per os (NPO) status, receiving a bolus feed diet, and born to an English-speaking mother at least 18 years old (Cong et al., 2012b). Infants were ineligible to participate in the study if they had any or all of the following: congenital abnormalities, hemorrhage, history of surgery, prescription for sedatives, vasopressors or analgesics, tissue breakdown/inflammation of heel(s), or mother with a history of drug abuse,
Autonomic responses to pain were measured by evaluating heart rate, while taking into account the infant’s behavioral state and severity of illness (Cong et al., 2012b). An infant’s behavioral state was measured using the Anderson Behavioral State Scoring System (ABSSS), which ranges from a score of 1 (very quiet) to 12 (hard crying) (Cong et al., 2012b). Severity of illness was accounted for using the Score for Neonatal Acute Physiology Version II (SNAP-II) (Cong et al., 2012b). Both behavioral state and severity of illness were measured due to their potential influence on heart rate variance and ability to respond to pain (Cong et al., 2012b).

Results of the study suggest that infants receiving incubator care experience more heart rate fluctuations than infants receiving both 15 and 30-min kangaroo care (Cong et al., 2012b). Furthermore, “longer duration of maternal KC [kangaroo care] significantly affected infants’ sympathetic and parasympathetic responses during heel stick compared to incubator care” (Cong et al., 2012b, p. 641). In addition, during the first three minutes of the procedure, infants receiving 30 min of kangaroo care cried for 48% of the time, while infants receiving 15 min of kangaroo care and incubator care cried for 49% and 60% of the time, respectively; the differences were not statistically significant (Cong et al., 2012b).

Johnson et al. (2008) evaluated the efficacy of kangaroo care versus incubator care (control group) in decreasing pain response in very premature infants. The study was designed as a single blind randomized crossover trial, and was conducted in Canada (Johnson et al., 2008). A total of 61 infants between 28 to 31 weeks gestational age were included in the sample; the mean age among the participants was 30.5 weeks gestation (Johnson et al., 2008).

Infants were eligible to participate if they met the following criteria: 28 to 31 weeks gestational age, informed parental consent, APGAR scores greater than 6 at 5 min within 10 days
of birth, breathing unassisted, no congenital abnormalities, no hemorrhage, no history of surgery, no paralytic, analgesic or sedative medication within 48 hours prior to beginning of study (Johnson et al., 2008). Pain response was measured by evaluating the infants’ oxygen saturation, PIPP scores and changes in heart rate (Johnson et al., 2008).

Results of the data analysis suggest that although kangaroo care is effective in decreasing pain response in very premature infants (28-31 weeks gestation), the response does not occur as quickly as it has been found to do in slightly older, premature infants (31-36 weeks gestation) (Johnson et al., 2008). Despite slowed pain reduction, mean PIPP scores recorded at 90 seconds post-procedure were significantly lower among infants in the kangaroo care group (8.871) than those receiving incubator care in the control group (10.677) (Johnson et al., 2008). Return to baseline heart rate (RBHR) was significantly different between the two groups (Johnson et al., 2008). The mean value of kangaroo care RBHR was 123 seconds, while the mean value of RBHR among infants in the control group was 193 seconds (Johnson et al., 2008). Additionally, oxygen saturation levels at 60 and 90 seconds post-procedure among infants in the kangaroo care group (95, 94, respectively) were significantly higher than the values obtained from infants in the control group (92, 93, respectively) (Johnson et al., 2008).

Cong, Ludington-Hoe and Walsh (2011) tested three hypotheses about the efficacy of kangaroo care in reducing infant PIPP scores and salivary and serum cortisol levels compared to infants in the control group receiving incubator care (Cong et al., 2011). All three hypotheses stated that kangaroo care would reduce pain levels in infants as evidenced by lower PIPP scores, and lower salivary and serum cortisol levels (Cong et al., 2011). The study was a prospective randomized crossover trial (Cong et al., 2011). A total of 28 infants between the ages of 30-32 weeks gestational age were recruited by convenience sampling; among the participants, 61%
were male and 39% were female (Cong et al., 2011). Infants were eligible to participate if their mothers spoke English, but ineligible for participation if they met any or all of the following criteria: congenital abnormalities, hemorrhage, history of surgery, administration of sedatives, vasopressors or analgesics 24 hours prior to testing (Cong et al., 2011).

Severity of pain was surveyed in each of the infants using the PIPP scoring system (Cong et al., 2011). Other indicators of pain such as salivary and serum cortisol levels were measured prior to the heel stick procedure and 20 minutes after completion, using saliva samples and blood from the heel stick procedure (Cong et al., 2011). Severity of illness, previous exposure to kangaroo care and number of previous invasive procedures were also accounted for throughout the data collection process (Cong et al., 2011).

Results of the study are consistent with all three of the proposed hypotheses. The validity of the hypotheses is evidenced by the following data. During recovery, infants receiving 30 minutes of kangaroo care had ‘mild pain’ from 0.5-5 min and ‘minimal to no pain’ from 3.5-5.0 min, while infants in the control group had ‘moderate to severe pain’ at 0.5 min, ‘mild pain’ from 1.0-2.0 min and ‘minimal or no pain’ from 2.5-5.0 min (Cong et al., 2011). In addition, among the 30 min kangaroo care study participants, values of salivary and serum cortisol were significantly lower than those among infants in the control group, during heel stick (Cong et al., 2011). Unexpectedly, however, 80 min of kangaroo care before the heel stick procedure was ineffective in reducing pain response (Cong et al., 2011).

Kashaninia et al. (2008) evaluated the efficacy of kangaroo care on behavioral responses, of term infants, to the pain of an intramuscular injection, versus infants receiving incubator care in the control group. The study was a randomized controlled trial, and was conducted in Bandar Abbas City, Iran (Kashaninia et al., 2008). A total of 100 infants, with a gestational age of 37
weeks or greater were included in the sample; among the 100 participants, 44% were male and 56% were female (Kashaninia et al., 2008). Infants were eligible to participate if they met the following criteria: birth weight between 2,500 and 4,000 g, within 2 hours of age, unfed, APGAR scores of at least 7 at 1 min heart rate between 100-160 beats per min (bpm), oxygen saturation greater than 94%, and no congenital abnormalities (Kashaninia et al., 2008). Infants were ineligible to participate if they had any or all of the following: born by cesarean section, previous vaccines or injections, birth trauma, or drug abuse by mother during pregnancy (Kashaninia et al., 2008).

Infant pain and distress after intramuscular injection were measured using the NIPS tool (Kashaninia et al., 2008). Results of the study suggest that 10 min of kangaroo care is effective in reducing crying time during minor, painful procedures (Kashaninia et al., 2008). In addition, the percentage of behavioral responses indicating severe pain immediately after injection in the control group were significantly higher (60%) than in the intervention group (6%), as evidenced by total NIPS scores (Kashaninia et al., 2008). Lastly, the duration of crying after injection was significantly less in infants receiving kangaroo care (14.55 seconds) than in infants in the control group (24.61 seconds) (Kashaninia et al., 2008).

Kostandy et al. (2008) tested the effect of kangaroo care on a preterm infant’s crying response to a heel stick procedure in comparison to infants receiving only incubator care (control group). The study, conducted in Richland, Washington, was a prospective crossover study with random assignment (Kostandy et al., 2008). A total of 10 premature infants between 30-32 weeks gestational age were included in the sample; the mean age was 6 days old (Kostandy et al., 2008). Infants were eligible to participate if they met the following criteria: 30-32 weeks gestational age, within 2 to 9 days of birth, no signs of heel tissue inflammation, NPO/bolus feed,
incubator care (Kostandy et al., 2008). Infants were ineligible to participate if they had any or all of the following: known drug exposure, tissue breakdown/inflammation of heel(s) (Kostandy et al., 2008).

Audible crying time was measured using a stopwatch, while inaudible crying time was measured using the ABSSS tool (Kostandy et al., 2008). The specific behaviors characterized during inaudible crying were: grimacing, eye squeezing, and brow bulge (Kostandy et al., 2008). Researchers included inaudible crying in the total crying time value because, “some preterm and acutely ill infants may not cry...due to depleted energy reserves...[or] the presence of an endotracheal tube” (Kostandy et al., 2008, p. 57). Therefore, strictly measuring audible crying was not a reliable indicator of pain.

Freire, Garcia, and Lamy (2008) evaluated the effect of kangaroo care as analgesia during heel stick procedures, compared to the effect of oral glucose. The study, conducted in Brazil, was arranged as a single-blind study with random assignment (Freire, Garcia, & Lamy, 2008). A total of 95 preterm infants between 28-36 weeks gestational age were included in the sample (Freire et al., 2008). Infants were ineligible to participate if they had any or all of the following: invasive or non-invasive ventilation, a chest drain, oxygen therapy or tracheotomy, hemodynamic instability, analgesia or sedative medications 48 hr prior to the study, congenital abnormalities, chromosomal syndrome, ventricular hemorrhage, or mother taking illicit drugs (Freire et al., 2008).

Infant pain during a heel stick was evaluated using the PIPP scoring system (Freire et al., 2008). Transcutaneous oxygen saturation and changes in heart rate were measured 15 seconds before and 30 seconds after the painful procedure, and behavioral indicators (brow bulge, eye squeeze and nasolabial furrowing) were evaluated 30 seconds after a heel stick (Freire et al.,
2008). Results of the study indicate that kangaroo care produces an analgesic effect in preterm newborns during a painful heel stick procedure, as evidenced by reduced variation in heart rate and oxygen saturation (Freire et al., 2008). Additionally, overall PIPP scores in infants receiving kangaroo care were lower compared to infants in the oral glucose and incubator care (control) groups (Freire et al., 2008). Infants in the kangaroo care group also exhibited shorter-lasting changes in facial actions, indicating less pain, than the control group participants (Freire et al., 2008).

Castral, Warnock, Leite, Haas, and Scochi (2007) examined the effect of kangaroo care as a method of non-pharmacological pain reduction in preterm infants undergoing a painful procedure. The study, conducted in Clinics Hospital at the Ribeirao Preto School of Medicine (University of São Paulo) in São Paulo, Brazil, included 59 preterm infants; 28 infants were assigned to the control group and 31 infants were assigned to the treatment group (Castral et al., 2007).

Infants of 30 weeks gestational age (minimum) with an APGAR score of at least 6 points at 5 min were eligible to participate (Castral et al., 2007). APGAR scores are measured at 1 min and 5 min after birth, and are used to determine how well the infant tolerated the birthing process, and how the infant is adjusting to extrauterine life (U.S. National Library of Medicine, 2013b). Total scores are calculated by assigning a value of 0 to 2 in the following five categories: breathing effort, heart rate, muscle tone, reflex irritability and skin color (U.S. National Library of Medicine, 2013b). A total APGAR score of 7 or greater is satisfactory, and indicates that the infant is in good health (U.S. National Library of Medicine, 2013b). A score less than 7 indicates that the infant needs prompt medical attention; low scores are typically caused by a difficult birth, a cesarean section, or fluid in the baby’s lungs (U.S. National Library
of Medicine, 2013b). Infants were ineligible to participate in the study if they had or were receiving any or all of the following: assisted ventilation, intraventricular hemorrhage, congenital nervous system diseases, malformations, neurological damage, or opioid analgesics (Castral et al., 2007).

Throughout the procedure, changes in behavioral state, crying and heart rate were assessed, while changes in facial action were evaluated using the NFCS (Castral et al., 2007). Infants assigned to the treatment group were subjected to a total of 15 min of kangaroo care beginning before, and continuing after the painful procedure (Castral et al., 2007). Results of the study demonstrate a progressive decline in NFCS scores from initial heel puncture to the recovery period (2 min immediately following the procedure) in infants receiving kangaroo care (Castral et al., 2007). This suggests that kangaroo care has an analgesic effect on infants during painful procedures. In addition, researchers found that heart rate in infants receiving kangaroo care increased by 19 bpm during the procedure, compared to 23 bpm in the control group (Castral et al., 2007). On average, decrease in infant heart rate during the recovery phase was greater in the treatment group (19 bpm) than in the control group (11 bpm) (Castral et al., 2007).

Cong, Cusson, Hussain, Zhang, and Kelly (2012a) evaluated pain responses of preterm twins during 15 min and 30 min of kangaroo care, compared to incubator care, during a painful heel stick procedure. The case study, conducted in Connecticut, was part of a larger randomized crossover trial (Cong et al., 2012a). The infants included in the study were delivered prematurely by cesarean section at 28 weeks gestation (Cong et al., 2012a).

Pain responses and changes in the infants’ behavioral states were assessed using the ABSSS and PIPP tools while also measuring the infants’ crying time (Cong et al., 2012a). The results of the study demonstrate that both longer (30 min) and shorter (15 min) kangaroo care
before and throughout painful procedures can reduce behavioral and physiologic pain responses in preterm infants (Cong et al., 2012a). In addition, Cong et al. (2012a) found that the infants cried more, were tachypneic, and had higher PIPP scores during heel stick in the incubator care (control) condition, compared to the kangaroo care study condition (Cong et al., 2012a).

**Facilitated Tucking and Non-Nutritive Sucking**

Liaw et al. (2012), compared the effectiveness of two non-pharmacological pain relief strategies (non-nutritive sucking and facilitated tucking) with routine care, on pain, behavioral and physiological responses before, during and after heel stick procedures (Liaw et al., 2012). The study was a prospective, randomized controlled crossover trial, and was conducted in Taipei, Taiwan (Liaw et al., 2012). A total of 34 premature infants between 29 and 37 weeks gestational age were included in the sample; among the 34 participants, 52.9% were male and 47% were female (Liaw et al., 2012). Infants were eligible to participate if they met the following criteria: 3-28 days post-birth, and stable health condition (Liaw et al., 2012). Infants were ineligible to participate if they had any or all of the following: congenital anomalies, neurologic impairment, documented congenital or nosocomial sepsis, history of surgery, severe growth restriction at birth, substance-abusing mother, severe medical condition requiring sedatives, muscle relaxants, antiepileptic or analgesic drugs (Liaw et al., 2012).

Pain response was measured using PIPP scores, and physiologic variables such as; heart rate, respiratory rate, and oxygen saturation (Liaw et al., 2012). Behavioral responses to pain included, “grimace; jerk, tremor; finger or foot splay, fisting; limb extension, arching, squirming; hand to mouth or face; fussing or crying” (Liaw et al., 2012, p. 303). Both behavioral and physiologic responses were considered when evaluating an infant’s overall response to the painful heel stick procedure.
Results of the study indicate that infants receiving non-nutritive sucking (without sucrose) and facilitated tucking had significantly lower mean pain scores during the painful procedure (Liaw et al., 2012). Furthermore, “Infants’ pain after receiving the non-nutritive sucking and facilitated tucking interventions decreased 61% and 66% respectively, vs. routine care” (Liaw et al., 2012, p. 306). Interestingly, however, non-nutritive sucking reduced pain more effectively than facilitated tucking, while facilitated tucking showed a broader effect on enhancing behavioral and physiological stability during the heel stick procedure (Liaw et al., 2012). These results suggest, that because non-nutritive sucking and facilitated tucking have different effects on behavioral and physiological variables in infants, combining the two interventions may produce more significant calming effects during painful procedures.

Sundaram et al. (2013) evaluated the effect of facilitated tucking as analgesia in preterm infants during heel sticks. The study, conducted in India, was designed as a randomized controlled crossover pilot study (Sundaram et al., 2013). A total of 20 preterm infants between the ages of 28 and 36 weeks gestation were included in the sample (Sundaram et al., 2013). Infants were eligible to participate if they met the following criteria: between 28 and 36 weeks gestational age, breathing unassisted, not receiving paralytic, analgesic or sedative medications within the last 48 hr, without major congenital abnormalities, not suffering from grade III or IV intraventricular hemorrhage, has not undergone surgery and had parental consent (Sundaram et al., 2013).

Infant pain response during the heel stick procedure was analyzed using the PIPP tool (Sundaram et al., 2013). Pain response in an infant receiving facilitated tucking was compared to the infant’s response during a painful procedure (heel stick) without receiving the facilitated tucking intervention; infants acted as their own control group (Sundaram et al., 2013). Results of
the study showed that infants receiving facilitated tucking had lower PIPP scores at 30, 60 and 120 seconds during the painful procedure, and their heart rate was lower compared to infants in the control group (Sundaram et al., 2013). The study concluded that facilitated tucking is effective in reducing both behavioral and physiological pain throughout the heel stick procedure (Sundaram et al., 2013).

Axelin, Salantera and Lehtonen (2005) evaluated the effectiveness of facilitated tucking, by parents, as a non-pharmacological method of pain management in preterm infants during endotracheal suctioning. The study, conducted at Turku University Hospital in Turkey, was designed as a randomized crossover trial (Axelin, Salantera, & Lehtonen, 2005). A total of 20 infants between the ages of 24 and 33 weeks gestation (median 28 weeks) were included in the sample (Axelin et al., 2005). Infants were eligible to participate if they met the following criteria: 24 to 33 weeks gestational age no major congenital abnormalities, a need for endotracheal suctioning, and no analgesics 4 hr prior to procedure (Axelin et al., 2005).

Infant pain response during the painful procedure (endotracheal suctioning) was analyzed using the NIPS tool (Axelin et al., 2005). Results of the study suggest that facilitated tucking by parents is an effective and safe method of pain management during endotracheal suctioning (Axelin et al., 2005). In addition, the study found that there is a statistically significant difference in NIPS scores between infants receiving facilitated tucking (NIPS = 3) and those who are not (NIPS = 5) (Axelin et al., 2005). However, no statistically significant differences in heart rate or oxygen saturation were found between infants receiving facilitated tucking and those in the control group (Axelin et al., 2005). Overall, infants receiving facilitated tucking calmed down more quickly (5 seconds) compared to infants in the control group (17 seconds) (Axelin et al., 2005).
Ward-Larson, Horns and Gosnell (2004) compared the efficacy of facilitated tucking with standard care for pain reduction in low birth weight infants undergoing endotracheal suctioning. The study, designed as a prospective randomized crossover trial, included 40 infants between 23 and 32 weeks gestational age; 55% of participants were male, while 45% were female (Ward-Larson, Horns, & Gosnell, 2004). To be included in the sample, infants needed to weigh between 560 and 1498 g (Ward-Larson et al., 2004). Infants were not eligible to participate if they had or were receiving any or all of the following: congenital abnormalities, intraventricular hemorrhage greater than grade II, major physiologic stress within 12 hr of data collection, opioid or non-opioid analgesia or sedatives within 12 hr before data collection (Ward-Larson et al., 2004).

Infant pain response was measured during the 30-second observation period immediately following endotracheal suctioning using the PIPP tool (Ward-Larson et al., 2004). Results of the study indicate that infants receiving facilitated tucking had significantly lower PIPP scores compared to infants not receiving facilitated tucking during the painful procedure (Ward-Larson et al., 2004).

Elserafy, Alsaedi, Louwrens, Sadiq and Mersal (2009) assessed the effectiveness of sucrose and non-nutritive sucking on pain relief in preterm infants during heel sticks. The study, conducted at King Faisal Specialist Hospital in Jeddah, Saudi Arabia, was designed as a double-blind, randomized controlled study (Elserafy, Alsaedi, Louwrens, Sadiq, & Mersal, 2009). A total of 36 infants, less than 37 weeks gestational age, were included in the study (Elserafy et al., 2009). Infants were not eligible to participate if they had or were exposed to any or all of the following: antepartal maternal sedation, exposure to (maternal) general anesthesia during birth,
neurologic abnormalities, APGAR scores at 5 min of less than 5 points, necrotizing enterocolitis, NPO status, hyperglycemia (Elserafy et al., 2009).

Physiologic (heart rate, oxygen saturation, blood pressure and blood glucose) and behavioral (crying time) parameters of pain were evaluated on six different occasions: immediately prior to the heel stick procedure, during the heel stick, 1 min after the procedure, 3 min after the procedure, 5 min after the procedure, and 10 min after procedure; crying time was assessed at 0, 1, 3, 5 and 10 min during the procedure (Elserafy et al., 2009). Infant pain response was assessed using the PIPP tool (Elserafy et al., 2009).

Participants were exposed to six different treatment interventions including: sterile water with pacifier; sterile water without pacifier, sucrose with pacifier, sucrose without pacifier, pacifier alone, and standard care (control group); each infant served as their own control (Elserafy et al., 2009). Results of the study demonstrate significant differences in crying time and pain scores among intervention groups (Elserafy et al., 2009). Sucrose and non-nutritive sucking with a pacifier reduced mean crying time to 4.6 seconds compared to the control group (17.4 seconds), suggesting that the combination of sucrose and non-nutritive sucking is an effective method of pain control in preterm infants during procedural pain (Elserafy et al., 2009). In addition, the study found that the lowest PIPP pain scores occurred with the combined use of sucrose and a pacifier. The use of sterile water with or without a pacifier or the use of a pacifier alone were found to be no more effective than the control group in reducing pain (Elserafy et al., 2009).

Liaw, Yang, Ti, Blackburn, Chang and Sun (2010) assessed the effectiveness of non-nutritive sucking (without sucrose) on pain, changes in behavior, and frequency of abnormal physiological signals in preterm infants during heel stick. The study, conducted in Taiwan, was
designed as a randomized controlled trial (Liaw, Yang, Ti, Blackburn, Chang, & Sun, 2010). A total of 104 infants between the ages of 27 and 37 weeks gestational age were included in the sample (Liaw et al., 2010). Infants were eligible to participate if they were between 27 and 37 weeks gestational age, post-birth age between 3 and 28 days, and in stable condition (Liaw et al., 2010). Infants were excluded from the study if they had any or all of the following: congenital, chromosomal or neurological anomalies, neonatal seizures, congenital or nosocomial sepsis, surgery, severe growth restriction, substance-abusing mother, medical conditions requiring sedatives, or muscle-relaxants, or greater than a grade II intraventricular hemorrhage (Liaw et al., 2010).

Infant pain response was evaluated before, during and after the painful procedure using the PIPP scoring system (Liaw et al., 2010). Changes in behavioral (jerk, tremor; limb extension, arching; finger or foot splay, fisting; grimace; hand to mouth or face; squirming; eyes closed; eyes open; fussy or crying) and physiological (heart rate, oxygen saturation and respiratory rate) responses were also measured during the course of the procedure (Liaw et al., 2010). Overall, the study found that PIPP scores with non-nutritive sucking were significantly lower than those without non-nutritive sucking (Liaw et al., 2010). Additionally, non-nutritive sucking alone reduced infant pain during the heel stick procedure; the use of sucrose was not necessary (Liaw et al., 2010). In general, infants receiving non-nutritive sucking showed ‘grimace’ and ‘hand-to-mouth’ behaviors less frequently than the control group infants, suggesting fewer episodes of pain (Liaw et al., 2010).

Boyle, Freer, Khan-Orakazai, Watkinson, Wright, Ainsworth and McIntosh (2006) evaluated the use of oral sucrose with and without non-nutritive sucking to reduce pain in infants during an eye examination; the study was designed as a prospective, randomized, placebo
controlled study. A total of 40 infants between the ages of 24 and 34 weeks were included in the study (Boyle, Freer, Khan-Orakazai, Watkinson, Wright, Ainsworth, & McIntosh, 2006). Infants were not eligible to participate if they met any of the following criteria: mechanical ventilation, NPO, receiving concurrent analgesic medication (Boyle et al., 2006). Participants were randomly assigned to one of four intervention groups: sterile water (placebo, n = 10), sucrose (n = 10), sterile water with a pacifier (n = 9), sucrose with a pacifier (n = 11) (Boyle et al., 2006). All interventions were implemented 2 min prior to the start of the heel stick procedure.

To measure procedural pain response using the PIPP scoring system, infants were video recorded during the painful procedure; recording terminated 2 min after the completion of the eye examination (Boyle et al., 2006). Results of the study show significantly lower PIPP scores in infants who received a pacifier, suggesting that non-nutritive sucking reduced distress in infants (Boyle et al., 2006). In addition, mean PIPP scores were lower in infants receiving non-nutritive sucking with sucrose (12.1) compared to infants receiving the placebo intervention (15.3) (Boyle et al., 2006). The study claims that, “no synergistic effect of sucrose and pacifier was apparent in this group,” however the authors mention that infants were only given one dose of sucrose throughout the procedure (Boyle et al., 2006, p. 166). It is possible that multiple doses of sucrose with non-nutritive sucking could have produced a greater, combined analgesic effect (Boyle et al., 2006).

Liu, Lin, Chou and Lee (2010) compared the efficacy of glucose water and non-nutritive sucking as pain relief in infants during heel sticks. The study, conducted in Taiwan, was designed as a randomized, parallel-group trial (Liu, Lin, Chou, & Lee, 2010). A total of 105 infants, who met the following criteria, were included in the study: at least 32 weeks gestational age, medically stable, scheduled to undergo newborn screening in the next 1 to 7 days, APGAR
scores greater than 7 at 1 and 5 min after birth and not crying 5 min before the heel stick procedure (Liu et al., 2010). Infants were not eligible to participate if they had an infection, congenital or neuromuscular disease, had undergone surgery, had been sedated in the past 12 hours, or were receiving oxygen treatment (Liu et al., 2010).

Pain was evaluated, using the NIPS tool, at 1 min intervals for 2 min in the preparation, heel stick and recovery phases of the study (Liu et al., 2010). The entire procedure (preparation phase [2 min], prepuncture phase [3 min], heel stick phase [2 min], and recovery phase [2 min]) lasted 9 min, and was recorded for scoring purposes (Liu et al., 2010). Results of the study demonstrate that non-nutritive sucking or glucose water alone can effectively reduce pain during a painful procedure; the study found non-nutritive sucking to be more effective than glucose water (Liu et al., 2010). On average, NIPS scores were higher among infants in the control group compared to non-nutritive sucking and glucose water intervention groups (Liu et al., 2010).

**Literature Review Summary and Limitations**

Reducing and/or relieving the pain of premature infants during their critical time in the NICU may lead to fewer developmental deficits, consequently increasing overall quality of life as the infant continues to mature (Liaw et al., 2012). The research articles reviewed in this paper evaluated the analgesic effects of non-pharmacological interventions in infants. Each study differed slightly in regard to inclusion/exclusion criteria, age range, variables, methods, etc., however, the results of each study concluded that pain in infants (very premature, premature and full term) was significantly reduced during invasive procedures when infants were participating in either non-nutritive sucking, facilitated tucking, or kangaroo care. Limitations of the studies include: small sample size, extensive exclusion criteria related to infants with congenital
abnormalities, breathing devices, history of surgery, etc., possible bias of the observer during pain assessment, and weakened generalizability due to regional/global differences in healthcare systems.

Finally, though the results of the research studies presented in this literature review provide promise for enhanced wellness in premature infants, there are still many aspects of non-pharmacological pain interventions that are unknown. Little research has been conducted to compare the efficacy of maternal-infant kangaroo care versus paternal-infant skin-to-skin contact. Furthermore, additional research is indicated to discover the effects of non-pharmacological pain reduction in neonates with severe illness, congenital abnormalities, or assisted breathing.

**Conclusion**

Current research supports the use of non-pharmacological pain reduction in preterm infants. Methods of pain reduction such as kangaroo care, facilitated tucking and non-nutritive sucking should be implemented in infants over 28 weeks gestational age, during painful procedures including, but not limited to: heel stick, endotracheal suctioning, eye examination and intramuscular injections. Chapter 3 will present a proposal for implementing a protocol for use of non-pharmacological pain management (kangaroo care, facilitated tucking and non-nutritive sucking) in the NICU at St. Joseph’s Hospital in Tucson, AZ.
CHAPTER 3

A BEST PRACTICE PROTOCOL: POLICIES AND PROCEDURES FOR NON-PHARMACOLOGICAL PAIN MANAGEMENT IN THE NICU

The recent advancement in perinatal and neonatal care and technology allows for increasingly premature infants to survive in the NICU. Unfortunately, caring for these fragile infants often involves many painful procedures; many of which can be alleviated or palliated through use of non-pharmacological methods of pain management such as kangaroo care, facilitated tucking and non-nutritive sucking. Identifying at risk infants will provide healthcare providers, particularly NICU nurses, opportunities to intervene using the pain management techniques previously described in Chapters 1 and 2. The purpose of this thesis was to propose a best practice protocol to implement non-pharmacological pain management interventions for a NICU in a local Tucson Hospital. Chapter 3 describes the inclusion criteria used to identify the target population of infants, in addition to outlining the circumstances under which the non-pharmacological interventions may be implemented, and by whom they can be implemented. This chapter also presents the proposed policies and procedures (Appendix A) intended to serve as a guide for standardizing patient care.

Target Population

Pain management interventions including kangaroo care, facilitated tucking and non-nutritive sucking, will be applied (if/when appropriate) to infants who are undergoing a painful procedure and satisfy the following criteria: greater than 28 weeks gestational age, breathing unassisted, not receiving paralytic, analgesic or sedative medications, not suffering from grade III or IV intraventricular hemorrhage, and without major congenital abnormalities or neurologic impairments. Infants will be deemed eligible at the discretion of their primary provider (bedside
nurse, nurse practitioner, or doctor). All infants who satisfy the outlined criteria will be eligible for the aforementioned interventions, regardless of gender, race or socioeconomic status of the family.

**Interventions**

The cumulative results of the studies provided in Chapter 2 indicate that kangaroo care, facilitated tucking and non-nutritive sucking are effective in managing the pain associated with procedures including heel sticks, eye examinations, endotracheal suctioning and intramuscular injections. In the hospital setting, specifically in the NICU, nurses are the most appropriate candidates to receive training on evidence-based, non-pharmacological pain management techniques. The policies and procedures for each of the three interventions (see Appendix A) provide essential information for NICU nurses, including special considerations and contraindications associated with each intervention, and a detailed outline of each intervention process.

In order to effectively implement these techniques, NICU nurses must receive formal training including skill acquisition and application to the clinical setting. Proper training will ensure that nurses are comfortable and confident when executing each skill or while educating the patient’s family about the interventions. Proper training and education will also allow the nurse(s) to understand the advantages and rewards of encouraging the infant’s parent(s) to participate in the pain management interventions when appropriate.

Though kangaroo care, facilitated tucking and non-nutritive sucking have been shown to be effective in managing pain, each intervention may not be appropriate for all painful procedures. Appropriateness of each intervention depends on the environmental circumstances of the infant, and other potential barriers such as inadequate time or assistance; parental
assistance should be promoted when appropriate and safe. Parental fears and concerns should be discussed prior to participation to prevent unforeseen complications or negative consequences either to the infant or to the parent. Proper implementation of the interventions may require the assistance of another healthcare professional, however these interventions were chosen based on their simplicity and, ideally, can be performed quickly and with minimal aid.

**Summary**

Chapter 3 presented the proposed policies and procedures, including a description of the inclusion criteria used to identify the target population of infants, while outlining the circumstances under which the non-pharmacological interventions may be implemented, and by whom they can be implemented. In addition to receiving a detailed outline of the steps involved with each intervention, NICU nurses will receive supplemental instruction on and demonstration of each technique in order to ensure skill competency and adequate understanding of each intervention.

Consistent and successful implementation of kangaroo care, facilitated tucking and non-nutritive sucking will decrease an infant’s exposure to pain during his/her time in the NICU. Hypothetically, reducing an infant’s exposure to pain during a critical time of brain development and maturation will reduce the likelihood of maladaptive alterations in nociceptive circuitry (Grunau, Holst, & Peters, 2006). Ultimately, these advances in patient care may lead to more positive behavioral and neurological outcomes for premature infants.
Appendix A

Kangaroo Care for Pain Management in Neonates

I. POLICY STATEMENT
Untreated, early exposure to pain can have long-term consequences on the development of an infant's brain due to its effect on nociceptive neural circuits; premature infants are particularly susceptible (Kashaninia, Sajedi, Rahgozar, & Noghahi, 2008). These alterations of the pain system during early development can lead to lower pain thresholds, in addition to cognitive and behavioral deficits as the infant matures (Kashaninia et al., 2008). Stress reduction and pain management, therefore, are essential components of neonatal care. When initiated 30 minutes prior to a painful or uncomfortable procedure, and continued for 10 minutes after the procedure has ended, kangaroo care is an effective method of non-pharmacological pain management (Akcan, Yigit, & Atici, 2009).

II. PURPOSE
To describe the guidelines for the use of kangaroo care for procedural pain management.

III. DEFINITIONS
Kangaroo Care -- Skin-to-skin contact between an infant and a caregiver, usually the infant’s mother (Cong, Ludington-Hoe, & Walsh, 2008).

IV. ROLES AND RESPONSIBILITIES
Physician, Neonatal Nurse Practitioner (NNP), RN, LPN may facilitate kangaroo care.
Other personnel may facilitate kangaroo care when overseen/instructed by an RN, NNP or Physician.
The infant’s guardian(s) and other persons approved by the infant's guardian(s) may participate in kangaroo care.

V. SPECIAL CONSIDERATIONS
Kangaroo care may be contraindicated in infants under the following circumstances:

- Less than 28 weeks gestational age
- Mechanical ventilation
- Treatment with sedative, paralytic or analgesic medications
- Grade III or IV intraventricular hemorrhage
- Major congenital abnormalities
- Neurologic impairment

Kangaroo care is intended to provide non-pharmacologic pain relief during procedures including: heel sticks, eye examinations, endotracheal suctioning, and intramuscular injections. Although this intervention is effective in reducing pain, the positioning of the infant during kangaroo care may not be appropriate for all of the aforementioned procedures. If using this intervention for pain management, the infant's pain assessment should be documented before the procedure begins.

VI. PROCESS

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<th>STEPS</th>
<th>KEY POINTS</th>
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<tr>
<td>1. Prepare the guardian for kangaroo care by ensuring that he/she is dressed appropriately with a front-opening gown or garment, and that he/she is comfortably positioned in a semi-reclined posture.</td>
<td>1. Advise the guardian to use the restroom prior to beginning the kangaroo care session.</td>
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<tr>
<td>2. Examine the infant to ensure that he/she is safe to participate in kangaroo care. Monitor vital signs and hemodynamic parameters (if applicable).</td>
<td>- Reduce environmental stimuli, and provide for privacy.</td>
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<td>- Use of electronic devices is ill-advised.</td>
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<td>2. Remove infant's clothing (diaper and hat should remain in place).</td>
<td>- There should be no clothing or material between guardian and baby.</td>
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3. Transfer infant to kangaroo care position. Place the prone infant on the guardian's bare chest, between the nipples, in a flexed position, with head turned to one side.

4. Monitor the infant's vital signs throughout the kangaroo care session.

3. Cover the infant with a blanket to maintain normothermia, and secure any tubing, if necessary.

4. Sessions should last at least 1 hour, if possible. Longer sessions are encouraged.

-Record the start and end time of the kangaroo care session in the patient's record.

VII. DOCUMENTATION
A complete pain assessment is done after each invasive or potentially painful procedure. Start and end time of kangaroo care should be documented in the patient's record. Documentation may be written or electronic. Unit specific forms and graphic records may be used.

VIII. REFERENCES


Facilitated Tucking for Pain Management in Neonates

I. POLICY STATEMENT
Untreated, early exposure to pain can have long-term consequences on the development of an infant’s brain due to its effect on nociceptive neural circuits; premature infants are particularly susceptible (Kashaninia, Siedad, Rahgozar, & Noghabi, 2008). These alterations of the pain system during early development can lead to lower pain thresholds, in addition to cognitive and behavioral deficits as the infant matures (Kashaninia et al., 2008). Stress reduction and pain management, therefore, are essential components of neonatal care. When implemented during a painful or uncomfortable procedure, facilitated tucking is an effective method of non-pharmacological pain management, shown to successfully reduce the deterioration of physiological parameters such as heart rate and oxygen saturation (Liaw et al., 2012).

II. PURPOSE
To describe the guidelines for the use of facilitated tucking for procedural pain management.

III. DEFINITIONS
Facilitated Tucking -- A nursing intervention that involves positioning one hand under the infant’s head and the other hand under the infant’s buttocks to gently hold or cradle the infant in a flexed posture (Liaw et al., 2012).

IV. ROLES AND RESPONSIBILITIES
Physician, Neonatal Nurse Practitioner (NNP), RN, or LPN may implement facilitated tucking. Other personnel may implement facilitated tucking when overseen/instructed by an RN, NNP or Physician. The infant’s guardian(s) and other persons approved by the infant’s guardian(s) may participate in facilitated tucking, if appropriate.

V. SPECIAL CONSIDERATIONS
Facilitated tucking may be contraindicated in infants under the following circumstances:
- Less than 28 weeks gestational age
- Treatment with sedative, paralytic or analgesic medications
- Grade III or IV intraventricular hemorrhage
- Major congenital abnormalities
- Neurologic impairment

Facilitated tucking is intended to provide non-pharmacologic pain relief during procedures including: heel sticks, eye examinations, endotracheal suctioning, and intramuscular injections. This intervention, because it involves minimal repositioning and no transfer of the infant, is ideal for infants that are mechanically ventilated. If using this intervention for pain management, the infant’s pain assessment should be documented before the procedure begins.

VI. PROCESS

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<th>STEPS</th>
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<td>1. If available, enlist the help of an additional nurse, or the infant's guardian, if they are willing to participate.</td>
<td>1. Additional assistance by a nurse and/or the infant's guardian is optimal, however this intervention can be performed using positioning aides when no additional help is available. The infant's guardian(s) may elect to not participate in this intervention in order to prevent the infant from associating him/her with pain.</td>
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<tr>
<td>2. Instruct the individual performing the intervention to place one of their hands, cupped, on the posterior side of the infant’s head, while placing the remaining hand, cupped, on the</td>
<td>2. When using positioning aides, use according to the manufacturer's instructions to maintain the infant in a flexed, or tucked, position during the painful or uncomfortable procedure.</td>
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infant’s buttocks. Using gentle pressure with both hands, the infant should be held in a flexed position for the entirety of the painful or uncomfortable procedure. -Facilitated tucking promotes infant comfort by simulating in-utero posture.

3. Monitor the infant’s vital signs, including but not limited to heart rate and respiratory rate, throughout the facilitated tucking intervention. 3. Record the start and end time of the facilitated tucking session in the patient’s record. -Any significant changes in the infant’s vital signs that occur during the painful procedure should also be noted in the patient’s chart.

VII. DOCUMENTATION
A complete pain assessment is done after each invasive or potentially painful procedure. Start and end time of facilitated tucking should be documented in the patient’s record. Documentation may be written or electronic. Unit specific forms and graphic records may be used.

VIII. REFERENCES

Non-Nutritive Sucking for Pain Management in Neonates

**I. POLICY STATEMENT**
Untreated pain in the neonate has both short- and long-term adverse effects on physical and developmental outcomes, which are more pronounced in the preterm neonate. Even full term infants experience painful procedures (AAP & ACOG, 2012, p.363). Oral administration of sucrose reduces pain associated with painful procedures. A sucrose and water solution, combined with non-nutritive sucking, is used in the Neonatal Care Unit (NICU), Newborn Nursery, and in Couplet Care, to calm and comfort babies during painful and/or uncomfortable procedures. An analgesic effect is provided when given 2 minutes before the procedure and administered in small doses throughout the duration of the procedure.

**II. PURPOSE**
To describe the guidelines for the use of non-nutritive sucking (with or without sucrose) for procedural pain management.

**III. DEFINITIONS**
**Non-Nutritive Sucking** – An analgesic nursing intervention that involves orotactile stimulation with or without added sucrose.

**IV. ROLES AND RESPONSIBILITIES**
Physician, Neonatal Nurse Practitioner (NNP), RN, LPN may facilitate non-nutritive sucking and administer prepackaged sucrose solution.
Other personnel may facilitate non-nutritive sucking and/or administer sucrose solution when overseen/instructed by an RN, NNP or Physician.

**V. SPECIAL CONSIDERATIONS**
Non-nutritive sucking may be contraindicated in infants under the following circumstances:
- Less than 28 weeks gestational age
- Mechanical ventilation
- Treatment with sedative, paralytic or analgesic medications
- Grade III or IV intraventricular hemorrhage
- Major congenital abnormalities
- Neurologic impairment
Non-nutritive sucking (with sucrose) is contraindicated in infants under the following circumstances:
- Existing hyperglycemia
- NPO status
- High risk for aspiration
- Esophageal atresia or tracheal esophageal fistula

Non-nutritive sucking is intended to provide non-pharmacologic pain relief during procedures including: heel sticks, eye examinations, endotracheal suctioning, and intramuscular injections. If using this intervention for pain management, the infant’s pain assessment should be documented before the procedure begins. If implementing non-nutritive sucking in conjunction with oral sucrose administration, avoid use of greater than 10 doses of sucrose in 24 hours, especially during the first week of life, due to developmental concerns.

**VI. PROCESS**

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<th>STEPS</th>
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<tr>
<td>1. Obtain a new or existing (clean) pacifier for use during this intervention, -If using sucrose in combination with non-nutritive sucking, please refer to steps 2-4, below.</td>
<td>1. Infants should be encouraged to suck on the pacifier during the painful procedure as a way of producing orotactile stimulation, and subsequent non-pharmacological pain management.</td>
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<tr>
<td>2. Obtain prepackaged sucrose solution</td>
<td>2. The prepackaged sucrose solution should be stored at room temperature, and must be</td>
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3. Administer the sucrose solution at least 2 minutes prior to the painful or uncomfortable procedure, and at 1 minute intervals, as needed.

4. For oral administration:
   - Apply 1 or 2 drops directly on tongue or buccal surface
   - Encourage sucking on the pacifier

Avoid shooting liquid into the infant's mouth in one bolus; this is more likely to result in aspiration or coughing, compared to slowly instilling the solution when the baby is sucking on a pacifier.

4. Babies generally need only 1 or 2 drops of sucrose solution.
   - Discard prepackaged sucrose solution after each use or procedure to prevent contamination and growth of bacteria.
   - If the baby continues to be agitated or irritable, due to pain, promote other non-pharmacological pain management interventions including:
     - Kangaroo care, facilitated tucking and/or breastfeeding (if applicable/appropriate)

VII. DOCUMENTATION
A complete pain assessment is done after each invasive or potentially painful procedure. If using sucrose in combination with non-nutritive sucking, administration of the sucrose slurry must be documented in the patient's record. Documentation may be written or electronic. Unit specific forms and graphic records may be used.

VIII. REFERENCES


CHAPTER 4:
IMPLEMENTATION AND EVALUATION

Chapter 4 describes the hypothetical implementation of non-pharmacological pain management interventions for a NICU in a local Tucson hospital; NICU nurses and associated NICU staff are the target population for the distribution of information. Establishing nurse and staff acceptance of the new policies is crucial to effective implementation of the interventions in the NICU setting. Therefore, to facilitate the diffusion of these new policies and ideas, the Theory of Diffusion of Innovations by Everett M. Rogers (2003) will be used. This theory will provide a strong framework for establishing acceptance and will be explained in detail below.

The adoption of a new idea or ideas occurs in five stages. The first three stages of the diffusion of innovation process, knowledge, persuasion, and decision, are essential to the acceptance or rejection of the new idea(s) (Rogers, 2003). A decision to accept the new idea often leads to successful implementation of the innovation, while a decision to reject the new idea typically leads to failed implementation (Rogers, 2003). If stage four of the theory (implementation), is successful, an individual will progress to stage five (confirmation/adoption) where he/she elects to continue implementing, or using, the innovation (Rogers, 2003). Collectively, these five stages illustrate the process through which an individual, or group of individuals, decides whether or not to accept the innovation, while also outlining the expected acceptance of and adherence to said innovation.

Prior to Implementation

The first stage in Rogers’ (2003) Diffusion of Innovations theory, knowledge, is necessary to assess the existing level of understanding among NICU nurses regarding kangaroo care, facilitated tucking and non-nutritive sucking. In this stage, an individual is exposed to an innovation, but lacks additional information about the new idea (Rogers, 2003). Rogers (2003)
states, "individuals generally tend to expose themselves to ideas that are in accordance with their interests, needs, or existing attitudes" (Rogers, 2003, p. 166). Therefore, prior to the implementation of an innovation, an individual must be aware of the need for the innovation, and he/she must acknowledge that the proposed innovation is feasible (Rogers, 2003). In the NICU setting, with extremely premature or otherwise fragile infants, nurses must acknowledge that early exposure to pain in these vulnerable patients may cause alterations in an infant’s synaptic development, potentially leading to long-term behavioral changes and changes in sensory perception (Lewis et al., 2011; Simmon, & Tobboel, 2006). In order to assess both the current level of understanding, and personal feelings towards implementation of the interventions, a brief survey of NICU staff and nurses will be conducted prior to implementation of the interventions.

In the second stage of Diffusion of Innovations, persuasion, an individual must be able to think in hypothetical terms in order to anticipate how the innovation will impact future situations; this stage of Rogers’ theory forces an individual to develop either a favorable or unfavorable attitude toward the new idea(s) (Rogers, 2003). In the NICU setting, nurses and staff must be able to anticipate that implementation of the interventions will have a positive effect on patient outcomes and pain management, while also acknowledging that they will have adequate time and assistance to perform the interventions, if necessary. Although anticipating the effects is helpful in predicting the type of attitude that will develop toward the innovation, an individual is more likely to adopt a new idea if he/she can participate in a trial with the innovation prior to implementation (Rogers, 2003). In fact, Rogers states, “most individuals who try an innovation then move to an adoption decision, if the innovation has at least a certain degree of relative advantage” (Rogers, 2003, p. 172). Therefore, if staff and nurses are able to
personally experience the positive effects of the interventions, they are more likely to choose to adopt the intervention(s) in stage three of Rogers’ theory (decision) (Rogers, 2003).

**Education and Training**

After a decision is made to adopt the innovation(s), NICU staff and nurses must receive training, including skill acquisition and application to the clinical setting, in order to effectively implement these techniques. Formal in-services, lasting no longer than 1 hour, will be scheduled to ensure that nurses are comfortable and confident when executing each intervention or while educating the patient’s family about the interventions. Proper training and education will also allow the nurse(s) to understand the advantages and rewards of implementing these pain management interventions, when appropriate. Informal training sessions will be conducted, as needed, if there are staff members who are unable to attend the formal in-services, or for those who require additional guidance.

**Implementation**

In the implementation stage of Diffusion of Innovations, although an individual or group of individuals may verbally adopt the innovation, they may fail to implement it due to unforeseen circumstances, or lack of continuity within the organization (Rogers, 2003). Rogers (2003) points out that in an organization, the individuals who make the decisions are often not the same individuals who will eventually implement the innovation. Discontinuity, miscommunication or misinterpretation of an organization’s or of individuals’ needs may lead to adoption of unrealistic or irrelevant innovations, ultimately resulting in failed implementation of the innovation(s).

In the last stage in Rogers’ theory, confirmation, an individual, or group of individuals seek to confirm the decision made to adopt or reject the innovation (Rogers, 2003). If during this
stage, conflicting information about the innovation is presented, and negative feelings develop, a
decision to renounce the adoption of the innovation may occur (Rogers, 2003).

**Evaluation**

The results of various scientific studies have shown kangaroo care, facilitated tucking,
and non-nutritive sucking to be effective, non-pharmacological pain management interventions.
Therefore, evaluation of the implemented interventions will focus primarily on the changes in
NICU staff and nurse knowledge and attitude regarding the interventions. An informal, written
questionnaire composed of four ‘yes’ or ‘no’ questions will be distributed to the participating
NICU staff and nurses in an effort to evaluate the ease of implementation and the effectiveness
of the interventions. Nurses will be asked if they received enough training to be able to
confidently implement the interventions, if they had adequate time to implement the
interventions, if they had adequate assistance to carry out the interventions (if applicable), and if
the interventions were successful. A value of 2 points will be assigned to each ‘yes’ answer,
while a response of ‘no’ will merit 1 point. The overall scores will range from 4 points to 8
points; a consistent questionnaire score of 8 points will indicate successful implementation of the
pain management intervention(s). The short-term goal is to have successful implementation of
the three interventions, demonstrated by a consistent score of 8 points on the survey. The long-
term goal, however, is to maintain staff acceptance of the interventions, and to have continued
success with the interventions over time; success of the interventions is evidenced by a lower
post-intervention infant pain scale score, compared to the infant’s pre-intervention, or baseline,
pain scale rating. Consistently lowered pain scores among infants after receiving a non-
pharmacologic intervention also indicate successful pain management.
Summary

The purpose of this thesis was to propose a best practice proposal for non-pharmacological pain management interventions for infants receiving care in a NICU at a local Tucson hospital. As the result of continued research, the scientific community has developed a greater understanding of the long-term consequences of prematurity and early exposure to pain. This understanding has generated an increased need for non-pharmacological pain management measures in the NICU setting in an effort to decrease the potentially unfavorable consequences of early exposure to pain. Policies for each of the three pain management interventions were developed and/or amended, and Everett M. Rogers’ (2003) Theory of Diffusion of Innovations was used as the framework to describe the adoption and implementation of these interventions in a local Tucson hospital. Success of the interventions may be evaluated using pre- and post-intervention surveys, completed by participating NICU staff and nurses.
References


