

**Acceptability and Feasibility of Behavioural and Sweet-Tasting Solution Interventions for  
Procedural Pain Treatment in Neonatal Units in Kenya**

**by**

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**A thesis submitted in conformity with the  
requirements for the degree of Doctor of Philosophy**

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**2016**

**Abstract**

**Background**

Although, over the last decade, the frequency of procedures has decreased and pain treatment practices have improved in high-income countries, in most low- and middle-income countries (LMICs), the burden of pain remains very high and procedural pain is severely undertreated. The nature and frequency of procedures and pain treatment practices has not been comprehensively examined in Kenya. Additionally, acceptability and feasibility of behavioural and sweet-tasting solution interventions has not been comprehensively examined.

**Objectives**

To determine the: (a) nature and frequency of painful procedures, (b) use of behavioural and sweet-tasting solution pain treatment interventions and (c) acceptability and feasibility of behavioural and sweet-tasting solution interventions and factors influencing their acceptability and feasibility in Kenya.

**Methods**

A three-phase sequential mixed-methods study involving (a) review of medical charts, (b) prospective observations and (c) photo-elicitation semi-structured interviews was conducted in

two neonatal units in Kenya. Descriptive analysis, t-tests, Mann-Whitney *U* test, chi-square tests, multiple regression and ecological comparative analysis were used to describe the frequency of procedures, use of pain treatment interventions and factors predicting frequency of procedures and use of interventions. Inductive content analysis was conducted for qualitative data.

## **Results**

Neonates experienced 1.6 (SD = 1.1, range 1-12) painful procedures per day; more tissue-damaging ( $1.2 \pm 1.7$ ) than non tissue-damaging procedures ( $0.3 \pm 0.6$ ) were performed ( $p = .03$ ). Term neonates were less likely to undergo procedures (RR 0.85, 95% CI [0.76, 0.95],  $p = .003$ ) while neonates were 1.8 times and 1.6 times more likely to undergo procedures during the 3<sup>rd</sup> - 7<sup>th</sup> day of life and if admitted in the Level II unit respectively ( $p < .001$ ). Only eight procedures were accompanied by pain treatment interventions. Breastfeeding, kangaroo care and facilitated tucking were acceptable and feasible for pain treatment. Availability of resources, safety and practice culture influenced acceptability and feasibility of interventions.

## **Conclusion**

Neonates underwent few but highly invasive procedures without adequate pain treatment. Behavioural but not sweet-tasting solution interventions were acceptable and feasible but rarely used for pain treatment. Future research should focus on facilitating implementation and routine use of these interventions for procedural pain treatment in the neonatal units.

## **Acknowledgments**

I am immensely indebted to my PhD supervisor Dr. Bonnie Stevens for the support and mentorship she accorded me throughout my PhD program. More specifically, I am extremely thankful to her for discovering the research potential in me, and for selflessly mentoring me into the field of neonatal pain research. I am also very grateful to my PhD committee members Dr. Denise Gastaldo and Dr. Julia Songok for their invaluable support and mentorship during the conceptualization, conduct, data analysis and write up of my research project.

My research work, and the academic program, would not have been successful without the financial support from numerous entities and institutions; the University of Toronto, Pain in Child Health: An innovative, International, Transdisciplinary Research Training Consortium (PICH), Canadian Institutes of Health Research (CIHR), Bertha Rosenstadt Trust and Moi University, Kenya. I am very grateful to each of these sources of funding. I would also like to acknowledge the immense support and cooperation extended to me by the hospital administration, the unit management, health care professionals and mothers in the study units. I am also greatly thankful to Ms. Charity Obwamo for executing her duties as a research assistant with extreme due diligence and commitment.

Lastly, I am very grateful to my family for their support, encouragement and inspiration during my PhD studies. Most importantly, I am deeply indebted to my sons, Brian and Bradley, for their understanding and selflessness, at a very young age, which enabled me to pursue my academic dreams.

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## **CHAPTER ONE**

### **Background and Problem Statement**

Over the last two decades, neonatal care has witnessed massive technological advancements resulting in smaller and more preterm neonates, including those born with life-threatening medical conditions, surviving beyond the neonatal period (Anand et al., 2005; Grunau, Holsti, & Peters, 2006; Ward-Larson, Horn, & Gosnell, 2004). During their hospitalization, these neonates, particularly the sicker and preterm neonates, undergo many diagnostic and care-related painful procedures such as heel sticks, venepuncture, intramuscular injections, suctioning, intravenous cannulation and lumbar puncture (Carbajal et al., 2008; Chen et al., 2012; Jeong, Park, Lee, Choi, & Lee, 2014; Kyololo, Stevens, Gastaldo, & Gisore, 2014).

Epidemiological studies in high-income countries estimate that neonates undergo an average of 4-16 painful procedures per day (Carbajal et al., 2008; Cignacco et al., 2009; Johnston, Barrington, Taddio, Carbajal, & Fillion, 2011; Roofthoof, Simons, Anand, Tibboel, & Van Dijk, 2014; Stevens et al., 2011). Neonates in low- and middle-income countries (LMICs) in South America (Linhares et al., 2012), Asia (Britto et al., 2014; Chen et al., 2012; Jeong et al., 2014) and Africa (Kyololo et al., 2014) also undergo high number of painful procedures. In Asia, neonates are estimated to undergo 5-8 painful procedures per day (Britto et al., 2014; Chen et al., 2012; Jeong et al., 2014). A nationwide survey in seven regional and academic hospitals in Kenya showed that neonates were undergoing relatively fewer painful procedures per day than reported in many countries (mean  $4.3 \pm 2.01$ ; range 1-12) (Kyololo et al., 2014). The retrospective design in the Kyololo and colleagues' (2014) study might not have resulted in a true reflection of the nature and frequency of painful procedures in Kenyan neonatal units.

Pain associated with these procedures, if not treated, has immediate complications, including oxygen desaturation, increased heart rate, respiratory variability and increased intracranial pressure (Bellieni et al., 2009; Cignacco et al., 2007; Grunau et al., 2006). In the long-term (a) development of hypersensitivity to future painful stimuli including usually non-painful stimuli (Grunau et al., 2006), (b) impaired neuro-anatomical development and (c) behavioural, emotional and learning disabilities (Abdulkader, Freer, Garry, Fleetwood-Walker, & McIntosh, 2008; Brummelte et al., 2012; Ranger & Grunau, 2014; Schwaller & Fitzgerald, 2014; Vinall & Grunau, 2014; Vinal et al., 2014; Zwicker et al., 2013) could occur. Procedural pain treatment should form a core component of neonatal care globally to minimize and prevent these consequences (American Academy of Pediatrics [AAP], 2016).

### **Neonatal Pain Treatment Practices**

Generally, procedural pain is under-prioritized and sub-optimally treated in neonatal units worldwide (Chen et al., 2012; Johnston et al., 2011; Kyololo et al., 2014). Better pain treatment practices exist in high-income countries largely from sustained use of behavioural and sweet-tasting solution interventions. Roofthoof et al. (2014) reported that 36.6% of the 175 neonates in Dutch NICUs received some form of analgesics for procedural pain during the first 14 days of hospitalization. Similarly, in France, 20.6% of the 42,413 painful procedures in 430 neonates over a 2-week period were accompanied with some form of pain relief; 2% with pharmacological interventions, 3.5% with sweet-tasting solution interventions, 10.4% with non-nutritive sucking (NNS), 4.7% with a combination of sweet-tasting solution interventions and NNS, and less than 0.1% with kangaroo care (KC) (Carbajal et al., 2008) (*All terms are defined in the Glossary – Appendix A*).

In North America, Johnston and colleagues (2011) reported that slightly more than half of the tissue-damaging procedures were performed with some form of pain treatment; 16% with pharmacological analgesia, 14.3% with sweet-tasting solution interventions, 16.3% with NNS and 5.2% with swaddling. Analgesia was sub-optimally used for non-tissue damaging procedures with 18% being accompanied by NNS, 9% each with swaddling or a combination of NNS and swaddling, and less than 2% with positioning, kangaroo care and breastfeeding.

Procedural pain is severely under-treated in LMICs compared to high-income countries (Chen et al., 2012; Kyololo et al., 2014). In Brazil, neonates rarely received any pharmacological or nonpharmacological pain treatment interventions during painful procedures (Linhares et al., 2012). Additionally, in China, procedures performed on neonates during hospitalization were not accompanied by any form of analgesia (Chen et al., 2012). Procedural pain treatment practices were very poor in neonatal units in Kenya where none of the painful procedures (404 procedures performed on 95 neonates in 24 hours) were accompanied by any form of analgesia (Kyololo et al., 2014). The Kenyan study involved review of medical records which may not have accurately captured the use of behavioural and sweet-tasting solution interventions that are notoriously poorly documented in medical records (Stevens et al., 2010). A conclusive examination of the nature and frequency of use of behavioural and sweet-tasting solution interventions is a critical first step towards changing the poor procedural pain treatment practices in neonatal units in Kenya.

### **Factors Influencing Neonatal Pain Treatment Practices**

The influence of neonatal, situational and organizational factors on procedural pain treatment in neonates has been reported in several studies (Carbajal et al., 2008; Guedj et al., 2014; Johnston et al., 2011; Stevens et al., 2010).

**Neonatal factors.** Gestational age (GA) at birth, severity of illness and day of life have been shown to influence analgesic use in neonates during procedures (Carbajal et al., 2008; Johnston et al., 2011). Neonates born less than 28 weeks GA and those most critically ill at birth are more likely to receive pain treatment interventions during procedures (Carbajal et al., 2008; Johnston et al., 2011). Behavioural and sweet-tasting solution interventions are more likely to be used on critically ill neonates (Johnston et al., 2011; Stevens et al., 2010). Procedures are more likely to be performed with analgesia during the first 2-7 days of life (Carbajal et al., 2008; Stevens et al., 2003).

**Situational factors.** Time of the day, number and invasiveness of procedures determines whether a neonate receives specific analgesia for procedural pain (Carbajal et al., 2008; Guedj et al., 2014; Stevens et al., 2003). Daytime procedures (7am to 6pm) are more likely to be accompanied with specific analgesia (Carbajal et al., 2008; Guedj et al., 2014). Neonates who experience the greatest number and the most invasive painful procedures are more likely to be given analgesia (Carbajal et al., 2008; Stevens et al., 2003). Similarly, inborn neonates and those accompanied by a parent during procedures are more likely to be given some form of pain treatment (Carbajal et al., 2008; Johnston et al., 2011). It is unclear whether parents request interventions during procedures or whether their presence acts as a prompt for health care professionals (HCPs) to give a pain relief during procedures. As many behavioural and sweet-tasting solution interventions are mother-driven (Campbell-Yeo, Fernandes, & Johnston, 2011; Johnston et al., 2014; Shah, Herbozo, Alowalas, & Shah, 2012), it would be prudent to explore the influence of these situational factors on use of the interventions in neonatal units in Kenya.

**Organizational factors.** Neonates admitted in higher levels of neonatal care (e.g., Level III - NICUs) are given pharmacological analgesia more often, or are more likely to receive



behavioural interventions, during painful procedures than those admitted in Level II neonatal units (Porter, Wolf, Gold, Lotsoff, & Miller, 1997; Stevens et al., 2011). Significant site differences in analgesic use exist even in hospitals offering the same level of neonatal care (e.g., Level III units) (Kahn et al., 1998; Stevens et al., 2003). The influence of organizational factors on the use of behavioural and sweet-tasting solution interventions for procedural pain treatment in resource-limited settings warrants exploration.

### **Challenges to Optimal Pain Treatment in Neonates**

Sub-optimal treatment of procedural pain in neonates has been a subject of concern to researchers, clinicians and the public over the last three decades (De Lima & Carmo, 2010). Poor procedural pain treatment practices have been associated with (a) misconceptions about perception and processing of nociceptive stimuli in neonates (Mathews, 2011) and (b) lack of knowledge and poor attitudes towards neonatal pain among HCPs (Akuma & Jordan, 2012; Twycross, 2006). Misconceptions about neonates' ability to process nociceptive stimuli and to remember painful experiences have been attributed to their immature nervous system (Akuma & Jordan, 2012; Sharek, Powers, Koehn, & Anand, 2006; Twycross, 2006) even though multiple studies have shown that neonates have the capacity to process nociceptive stimuli and are more sensitive to painful stimuli than infants and older children (Fitzgerald, 2005; Lee, Ralston, Drey, Partridge, & Rosen, 2005).

Fear among clinicians about adverse effects of analgesics, particularly opioids, has also hampered effective treatment of pain in neonates (Wong, Lau, Palozzi, & Campbell, 2012). These fears exist notwithstanding the empirical evidence that opioids are safe and widely recommended for procedural pain treatment in neonates (AAP, 2016; Lee, Yamada, Kyololo, Shorkey, & Stevens, 2014). Safety concerns have been raised about repeated administration of

analgesics and sweet-tasting solutions during painful procedures (Holsti & Grunau, 2010; Johnston et al., 2002; Johnston et al., 2007). Recent studies have, however, shown that sweet-tasting solutions are safe for procedural pain treatment in neonates as long as recommended doses are used (Linhares, Gasparado, Souza, Valeri, & Martinez, 2014; Stevens, Yamada, Lee, & Ohlsson, 2013).

### **Barriers to Neonatal Pain Treatment in sub-Saharan Africa**

Although barriers to optimal procedural pain treatment are somewhat similar globally, sub-Saharan African (SSA) countries face very unique challenges (Albertyn, Rode, Millar, & Thomas, 2009; Molyneux, 2012). Due to the high neonatal morbidity and mortality rate (Lawn et al., 2013), neonatal units prioritize reduction in morbidity and mortality over procedural pain treatment (Albertyn et al., 2007; Madadi et al., 2012). Additionally, socio-cultural beliefs and myths among HPCs and parents that (a) pain is an expected consequence of treatment and (b) analgesia could interfere with healing, impact negatively on neonatal pain treatment in SSA (Rampanjato, Florence, Patrick, & Finucane, 2007; Walters, 2009). These beliefs pose significant challenges to optimal pain treatment practices; procedures are performed without treatment even when analgesics are prescribed (Albertyn et al., 2007; Rampanjato et al., 2007; Thiadens Vervat, Albertyn, Van Dijk, & Van As, 2011).

Lack of access to pharmacological analgesics has been extensively cited as the major challenge to optimal pain treatment in SSA (International Association for the Study of Pain [IASP], 2011; Molyneux, 2012). Due to the low per capita income, pain treatment must compete for the limited financial resources (Albertyn et al., 2009) with other region-specific health care priorities such as the high neonatal morbidity and mortality (Lawn et al., 2013; Madadi et al., 2012; Taylor, Gostin, & Pagonis, 2008). Consequently, analgesics including opioids and local

anaesthetics such as lidocaine-prilocaine cream are nonexistent in many neonatal units in SSA (Batton et al., 2006; Cignacco et al, 2010; IASP, 2011). A survey in Kenya showed that unavailability of analgesics contributed to the lack of pain treatment during procedures (Kyololo et al., 2014). However, alternative low-cost, safe and effective pain treatment strategies, including behavioural and sweet-tasting solution interventions exist (Bueno et al., 2013; Pillai Riddell et al., 2015; Stevens et al., 2013).

### **Behavioural Interventions**

Behavioural interventions are believed to relieve pain by modulating pain impulses, activating the attention of neonates and distracting them from the noxious event (Johnston, Campbell-Yeo, Fernandes, Inglis, Streiner, & Zee, 2014; Pillai Riddell et al., 2015; Shah et al., 2012). These interventions include; (a) kangaroo care (KC) (skin-to-skin, chest-to-chest contact between a baby and mother) (Johnston et al., 2014); (b) containment which includes swaddling and facilitated tucking (FT) (Fernandes, Campbell-Yeo, & Johnston, 2011; Pillai Riddell et al., 2011); (c) NNS with or without adjuvant nonpharmacological sweet-tasting solution (Badr, 2012; Campbell-Yeo et al., 2011; Pillai Riddell et al., 2015); and (d) breastfeeding (Shah et al., 2012; Zhu et al., 2015). Many systematic reviews and reviews of systematic reviews have reported the safety and effectiveness of these interventions for pain relief from commonly performed care-related and diagnostic procedures in preterm and term neonates (Johnston et al., 2014; Pillai Riddell et al., 2015; Shah et al., 2012; Yamada et al., 2008).

### **Sweet-tasting Solution Interventions**

Oral sucrose and other non-sucrose sweet-tasting solutions (predominantly glucose) are the most extensively studied interventions for procedural pain treatment in neonates (Bueno et al., 2013; Linhares et al., 2014; Stevens et al., 2013). The analgesic and calming effects of sweet-

tasting solutions are thought to be mediated by endogenous opioid pathways activated by the sweet taste (Gibbins & Stevens, 2001; Harrison, Beggs, & Stevens, 2012). Despite the extensive research on sweet-tasting solution interventions for pain treatment in neonates, the evidence on safety of repeated administration during procedures remains somewhat inconclusive (Johnston et al., 2002; Stevens et al., 2013). Nonetheless, when safety is assessed and synthesized in systematic reviews, sweet-tasting solution interventions are reported as safe and efficacious for relieving pain from single painful events in neonates (Bueno et al., 2013; Stevens et al., 2013).

### **Acceptability and Feasibility of Behavioural and Sweet-tasting Solution Interventions**

Behavioural pain treatment interventions are reported as acceptable and feasible in few high-income countries (Axelin, Lehtonen, Pelander, & Salantera, 2010; Axelin, Salantera, & Lehtonen, 2006; Johnston et al., 2011; Reis, Roth, Syphan, Tarbell, & Holubkov, 2003). Two separate studies in Canadian NICUs (Johnston et al., 2011; Johnston et al., 2012) showed that fathers and mothers had positive views about providing KC during procedures and wanted to comfort their neonates. Similarly, containment and NNS have been reported as acceptable and feasible among HCPs and mothers of neonates undergoing painful procedures in Europe and North America (Axelin et al., 2006; Axelin et al., 2010; Reis et al., 2003).

We found no studies reporting on the acceptability and feasibility of sweet-tasting solution interventions. Nonetheless, we speculate that these interventions are both acceptable and feasible for procedural pain treatment in neonates. Our view is informed by the (a) number of systematic reviews reporting on their safety and efficacy (Bueno et al., 2013; Shah et al., 2012; Stevens et al., 2013) and (b) wide repertoire of national and international clinical practice guidelines (CPGs) recommending their use for procedural pain treatment (AAP, 2016; Lee et al., 2014).

## **Problem Statement**

The nature and frequency of painful procedures and use of behavioural and sweet-tasting solution interventions for procedural pain treatment in neonatal units in Kenya has not been comprehensively investigated. Similarly, little is known about consistency between (a) documented and observed practices regarding nature and frequency of procedures and use of pain treatment interventions and (b) factors influencing procedures and use of interventions. Moreover, minimal insight exists on the acceptability and feasibility of behavioural and sweet-tasting solution interventions and factors influencing their acceptability and feasibility from the perspectives of HCPs, administrators and parents.

## **Study Purpose**

The purpose was to determine (a) the nature and frequency of painful procedures and use of behavioural and sweet-tasting solution interventions, (b) factors that influence nature and frequency of procedures and use of behavioural and sweet-tasting solution interventions, (c) acceptability and feasibility of behavioural and sweet-tasting solution interventions and (d) factors that influence acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain treatment in two neonatal units in Kenya.

## **CHAPTER TWO**

### **Literature Review**

This chapter provides a critical review of the literature on behavioural interventions and sweet-tasting solution interventions for procedural pain treatment in neonates. The current literature will be critically appraised under the following headings: (a) nature and frequency of painful procedures; (b) nature and frequency of use of pain treatment interventions in neonates; (c) factors influencing analgesic use on neonates undergoing painful procedures; and (d) consequences of untreated pain in neonates. Current empirical evidence on (a) effectiveness and safety and (b) acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain treatment in neonates will be discussed.

#### **Nature and Frequency of Painful Procedures in Neonatal Units**

Despite the effort by national (Lago et al., 2009; Spence et al., 2010) and international professional associations (AAP, 2016) to reduce the burden of procedural pain in neonates, the frequency of procedures remains dishearteningly high (Britto et al., 2014; Carbajal et al., 2008; Johnston et al., 2011; Stevens et al., 2011). Most of the burden of pain in neonates emanates from routinely performed diagnostic or care-related procedures, including heel lancing, venepuncture, intramuscular injections, suctioning, intravenous cannulation and lumbar puncture (Carbajal et al., 2008; Jeong et al., 2014; Johnston et al., 2011; Kyololo et al., 2014; Stevens et al., 2011).

Epidemiological studies in high-income countries estimate that neonates undergo 4-16 painful procedures per day (Carbajal et al., 2008; Cignacco et al., 2009; Johnston et al., 2011, Roofthoof et al., 2014; Stevens et al., 2011). In Europe, Roofthoof and colleagues (2014)

reported that Dutch neonates underwent 11.4 painful procedures per day over the first 2 weeks of hospitalisation while in French (Carbajal et al., 2008) and Swiss (Cignacco et al., 2009) NICUs neonates underwent 16-18 painful procedures per day. In North America, Johnston et al. (2011) and Stevens et al. (2011) reported slightly less procedures than reported in Europe with neonates undergoing 4-6 painful procedures per day.

Surveys in South America (Linhares et al., 2012), Asia (Britto et al., 2014; Chen et al., 2012; Jeong et al., 2014) and Africa (Kyololo et al., 2014) indicate that the burden of pain in neonates in LMICs is equally very high. In China, preterm neonates underwent 6 painful procedures with term neonates undergoing 5 painful procedures per day (Chen et al., 2012); which is more comparable to the 7.5 and 8.1 painful procedures per day reported in South Korean (Jeong et al., 2014) and Indian NICUs (Britto et al., 2014) respectively. A recent nationwide survey in Kenya showed that neonates were undergoing relatively fewer painful procedures per day (mean 4.3, SD = 2) (Kyololo et al., 2014). The retrospective design adopted for the Kenyan study may not have accurately captured the frequency of painful procedures considering that procedures might not be fully documented in medical records.

### **Nature and Frequency of Use of Pain Treatment Interventions**

For hospitalized neonates, the neonatal experience is characterized by many painful and traumatic procedures (Carbajal et al., 2008; Chen et al., 2012). Sadly, although the pain associated with these procedures may be harmful to the neonate (Brummelte et al., 2012; Zwicker et al., 2013), use of pain treatment interventions during procedures remains sub-optimal in neonatal units globally (Johnston et al., 2011; Kyololo et al., 2014; Roofthoof et al., 2014).

Roofthoof et al. (2014) prospectively assessed the frequency of use of analgesics for painful procedures in 175 neonates during the first 14 days of admission to a Level III NICU.

Analgesic therapy was rarely used for invasive procedures with pre-emptive analgesia being given in fewer than 40% of the neonates. A majority of these neonates (27.4%) were receiving continuous morphine infusion at the time of the procedure.

Johnston and colleagues (2011) conducted a prospective observational survey in 14 Canadian NICUs to determine the use of pain treatment interventions for tissue-damaging and non tissue-damaging procedures. A total of 3, 508 tissue-damaging and 14, 085 non tissue-damaging procedures were performed on 582 neonates over a one week period. Forty-six percent of the tissue-damaging and 57% of the non tissue-damaging procedures were unaccompanied by any intervention. Pharmacological analgesia, specifically for a procedure or as continuous infusion, was recorded for 16% of the tissue-damaging procedures, while sweet-tasting solutions were used for 14.3% of the procedures (Johnston et al., 2011). There was wide variability in the use of behavioural interventions for tissue-damaging procedures; NNS (16.3%), swaddling (5.2%), combination of NNS and swaddling (9%), positioning (1.2%) and KC and breastfeeding (< 1%). A small proportion (0.7%) of non tissue-damaging procedures, including tracheal aspiration, catheter removal and radiological examinations, were performed with continuous opioid infusion. Behavioural interventions such as NNS (17.9%), swaddling (9.4%) and a combination of swaddling and NNS (9.3%) were used for non tissue-damaging procedures. Positioning (1%), rocking (0.7%), KC (0.4%) and breastfeeding (0.2%) were infrequently used (Johnston et al., 2011).

Carbajal and colleagues (2008) followed 430 neonates admitted in 13 French NICUs to determine the extent of use of analgesics for painful and stressful procedures during the first 14 days of admission. Of the 42, 413 painful procedures, 79.2% were performed without specific analgesia; 2.1% with pharmacological-only therapy; 3.5% with sweet-tasting solutions; 18.2%



with behavioural interventions; and 20.8% with some form of analgesia (pharmacological, behavioural, or both). Pharmacological interventions included intravenous morphine (1.2%), fentanyl (0.3%) and lidocaine-prilocaine cream (0.4%). Of the behavioural interventions, NNS alone (10.4%) was the most frequently used strategy while a combination of NNS and sweet-tasting solution (4.7%) and skin-to-skin contact ( $< 0.1\%$ ) were used less often.

Of the 18, 556 procedures categorized as stressful, 93.4% were performed without specific pre-procedural analgesia, 0.7% with pharmacological, 5.8% with behavioural interventions and  $< 0.1\%$  with both pharmacological and behavioural interventions. Similar to the painful procedures, NNS (4.7%) was the most frequently used behavioural intervention for stressful procedures with combination of NNS and sweet-tasting solutions (0.6%) and KC ( $< 0.1\%$ ) being used less often (Carbajal et al., 2008).

Cignacco et al. (2009) conducted a retrospective cohort study to determine the use of pre-procedural analgesia in ventilated preterm neonates ( $n = 120$ ) during the first 14 days of life. All except one neonate (99.2%) received one or more (pharmacological or nonpharmacological) pain treatment interventions. A majority of the neonates (70.8%) received oral glucose for the 38, 626 painful procedures. Although these results suggest exceptional pain treatment practices, the retrospective design adapted biases the results to documentation practices of HCPs. Furthermore, the ambiguous categorization of interventions (i.e., pharmacological and non-pharmacological) makes it impossible to discern which specific interventions were used.

Most recently, Guedj and colleagues (2014) conducted a prospective observational survey in 13 NICUs and paediatric intensive care units in France to determine analgesic use for painful procedures performed on neonates. A total of 430 neonates were followed during the first 14 days of admission to the units. Overall, only 7, 724 of the 38, 012 (20.3%) painful procedures,

that constituted the five most frequently performed procedures, were accompanied by a specific pain treatment intervention; a significant improvement from previous studies in the same setting (Carbajal et al., 2008). However, the analysis did not include all the procedures performed during the study period thus significantly biasing the study results (Guedj et al., 2014).

Self-report surveys in the United Kingdom (Rennix, Manjunatha, & Ibhanesebho, 2004; Robins, 2007), Italy (Codipetro, Bailo, Nangeroni, Ponzone, & Grazia, 2011; Lago et al., 2013), Austria (Rohrmeister et al., 2003), Sweden (Eriksson & Gradin, 2008) and Australia (Foster et al., 2013) have reported significantly better procedural pain treatment practices. In Italy (Lago et al., 2013), 85% of the neonatal units reported using behavioural interventions, including swaddling, FT, NNS, breastfeeding and KC for heel stick and venepuncture. Additionally, more than 81% of the units reported using pharmacological interventions regularly for more invasive procedures such as intubations, lumbar puncture and pleural drainage. Other researchers (Eriksson & Gradin, 2008; Foster et al., 2013; Rennix et al., 2004; Rohrmeister et al., 2003) reported that up to 90% of the units were using behavioural and sweet-tasting solution interventions for commonly performed painful procedures such heel sticks, intravenous cannulation, venepuncture, eye examination and intramuscular and subcutaneous injections. Pharmacological analgesia was predominantly used for most invasive procedures. Although these results are laudable, the methodology greatly biases the findings. It is possible that the respondents (unit managers and chief neonatologists) may have over-reported use of pain treatment interventions in their units; and in the absence of observational data or review of medical records, it is difficult to ascertain the accuracy of these results since self-report may not reflect the actual pain treatment practices.

Procedural pain treatment practices remains very poor in neonatal units in LMICs compared with high-income countries (Finley & Forgeron, 2006). A review of medical records in a public teaching hospital in Brazil showed that neonates were unlikely to receive pharmacological interventions even with a medical order; behavioural and sweet-tasting solution interventions were also rarely used during painful procedures (Linhares et al., 2012). Chen and colleagues (2012) conducted a prospective case series study to assess treatment of procedural pain in a Chinese NICU. None of the 10, 633 painful procedures performed on 108 neonates during the hospitalization period was accompanied by any form of pain treatment intervention.

In the sub-Saharan African region, Kyololo and colleagues (2014) conducted a survey in seven regional and academic hospitals in Kenya to determine procedural pain treatment practices. None of the 404 procedures performed on 95 neonates over a 24-hour period were accompanied by any pain treatment intervention. These results should be interpreted with caution. Data were collected through review of medical records thus biasing the study results to the documentation practices of HCPs. Review of medical records may not have captured the use of non-pharmacological pain treatment interventions such as behavioural and sweet-tasting solution interventions that are usually poorly documented (Linhares et al., 2012; Stevens et al., 2010). Prospective and observational designs may provide more comprehensive evidence of the nature and frequency of analgesic use, including behavioural and sweet-tasting solution interventions in neonatal units in Kenya. A comprehensive understanding of the nature and frequency of use of analgesia would be a critical first step in developing strategies to improve pain treatment practices in neonatal units in Kenya.

## Factors Influencing Use of Procedural Pain Interventions in Neonates

Numerous factors have been associated with the use of interventions during painful procedures in neonates. The influence of (a) neonatal factors, including gestational age (GA) at birth, severity of illness and day of life; (b) situational factors, including place of birth, time of the day when procedures are performed, presence of parents and number and invasiveness of procedures; and (c) level of care as an organizational factor have been documented in multiple studies (Carbajal et al., 2008; Guedj et al., 2014; Johnston et al., 2011; Kahn et al., 1998; Stevens et al., 2010).

### **Neonatal factors.**

***Gestational age at birth.*** Johnston et al. (2011) demonstrated that GA significantly influenced use of interventions for both tissue-damaging and non tissue-damaging procedures in a prospective observational study in Canadian NICUs. Neonates born less than 28 weeks GA were more likely to receive both pharmacologic (OR = 8.867, 95% CI [6.082, 12.929],  $p < .001$ ) and behavioural (OR = 1.512, 95% CI [1.070, 2.138],  $p = .019$ ) interventions for tissue-damaging procedures. Use of sweet-tasting solution interventions for tissue-damaging procedures was not influenced by GA. Conversely, neonates born before 28 weeks GA were 9 times and 1.5 times more likely to receive pharmacological analgesia ( $p < .001$ ) and behavioural interventions ( $p < .001$ ) respectively, for non tissue-damaging procedures (Johnston et al., 2011).

Carbajal and colleagues (2008) showed that prematurity was associated with greater use of specific pre-emptive and non-specific concurrent analgesia. Neonates born before 32 weeks GA were more likely to receive specific analgesia (OR = 1.57, 95% CI [1.43, 1.74],  $p < .001$ ) or some form of pain treatment interventions (OR = 1.26, 95% CI [1.17, 1.35],  $p < .001$ ) during painful procedures compared with late preterm (33-36 weeks GA) and term counterparts. Kahn

and colleagues (1998) also found that neonates ( $N = 1,171$ ) who received interventions during painful procedures were more premature (mean GA =  $27.5 \pm 2.6$  weeks) than those who did not ( $28.5 \pm 2.8$ ),  $p < .001$ . In this UK study GA was not clearly defined making it difficult to interpret the results.

Cignacco et al. (2009) reported that neonates born at the lowest GA (up to 28 weeks,  $n = 49$ ) received the least analgesia (mean of 6.53 mL) over the hospitalization period compared with those born at 28-32 weeks GA ( $n = 37$ ) (45.56 mL) and 32-37 weeks GA ( $n = 34$ ) (138.97 mL) ( $p < .001$ ). Analgesic use was reported in form of volumes administered making it impossible to interpret the results considering that many procedural pain treatment interventions, including KC, containment, NNS and breastfeeding are not quantifiable. Additionally, the sample consisted of ventilated preterm neonates only thus limiting generalizability of these findings to other groups of neonates.

**Severity of illness.** Johnston et al. (2011) reported that less acutely ill neonates (low Clinical Risk Index for Babies [CRIB] score - The International Neonatal Network, 1993) were less likely to receive pharmacological (OR = 0.984, 95% CI [0.885, 0.986],  $p < .001$ ) and sweet-tasting solution (OR = 0.939, 95% CI [0.891, 0.990],  $p = .005$ ) interventions for tissue-damaging procedures. Low CRIB scores were also associated with less use of pharmacological (OR = 0.933, 95% CI [0.906, 0.961],  $p < .001$ ) and behavioural (OR = 0.973, 95% CI [0.963, 0.983],  $p < .001$ ) interventions for non tissue-damaging procedures. Similar findings were reported by Carbajal et al. (2008) where low CRIB scores (The International Neonatal Network, 1993) were associated with less use of specific analgesia (OR = 0.93, 95% CI [0.92, 0.95],  $p < .001$ ) for both tissue-damaging and non tissue-damaging procedures. Conversely, higher CRIB scores were associated with greater use of some form of analgesia (specific analgesia, non-specific

concurrent continuous analgesia or both) (OR = 1.05, 95% CI [1.04, 1.06],  $p < .001$ ) for tissue-damaging and non tissue-damaging procedures (Carbajal et al., 2008).

Kahn and colleagues (1998) examined the influence of severity of illness on analgesic use in neonates during days 1, 3, and 14 of hospitalization in the NICU. Using the Score for Neonatal Acute Physiology (SNAP) (Richardson et al., 1993) as the measure of illness severity, they reported that pain interventions were likely to be used most frequently for the smallest and sickest neonates (SNAP  $\geq 20$ ) (OR = 8.3, 95% CI [4.5, 15.2],  $p < .05$ ) and the moderately ill neonates (SNAP 10-19) (OR = 2.3, 95% CI [1.5, 3.6],  $p < .05$ ) compared with the mildly ill neonates (SNAP 0-9). Although Kahn and colleagues (1998) studied a large sample of neonates, the study is nearly two decades old; thus the results may not reflect current practices.

Stevens et al. (2010) prospectively observed 114 neonates in three Canadian NICUs to determine the influence of risk for neurological impairment (NI) on use of interventions during painful procedures. Neonates at the highest risk for NI (e.g., severe intrapartum asphyxia) received behavioural interventions more often than those at moderate risk (e.g., persistent pulmonary hypertension of the newborn, severe meconium aspiration, meningitis, hydrocephalus, necrotizing enterocolitis) ( $\chi^2_{2252} = 6.16$ ,  $p < .05$ ). However, neonates at moderate risk for NI received pharmacological interventions most frequently ( $\chi^2_{2252} = 7.55$ ,  $p < .05$ ) and the most pharmacological interventions for the most invasive procedures compared with neonates at high- and low-risk for NI (e.g., respiratory distress, sepsis) (Stevens et al., 2010). The high frequency of interventions for neonates at moderate risk for NI could be explained by the fact that these neonates are often acutely ill and on treatment protocols (e.g., mechanical ventilation) that include continuous morphine infusion, a pharmacological analgesia (Stevens et al., 2010).

***Days of life.*** Multiple studies have found that painful procedures are mostly accompanied by interventions during the first week of life (Carbajal et al., 2008; Simons et al., 2003; Stevens et al., 2003). Stevens et al. (2003) compared analgesic use on 194 neonates at different levels of risk for NI during the first 5 days of life. Although continuous opioid infusion was administered to 15-25% of the neonates during the five days, most was administered during the first 2 days of life. When opioid use was compared by risk for NI and day of life, more neonates (20-30%) at moderate-to-low risk for NI were receiving bolus analgesia during the first 2 days of life suggesting a decline in use of analgesics over the hospitalisation period notwithstanding the neonates' severity of illness.

Carbajal et al. (2008) found that neonates were likely to be given specific analgesia between the second and 14<sup>th</sup> day of admission (OR = 2.06, 95% CI [1.85, 2.29],  $p < .001$ ). More specifically, neonates were more likely to receive any form of pain treatment intervention for tissue-damaging and non tissue-damaging procedures between day 2 and day 14 of admission (OR = 1.98, 95% CI [1.84, 2.14],  $p < .001$ ) compared with day 1. A major limitation of Carbajal and colleagues' (2008) results is that analgesic use at day 1 was compared with the rest of the study period (2<sup>nd</sup> -14<sup>th</sup> day) thus making it difficult to interpret the results. Considering that most painful procedures in neonates are performed during the first 3 days of life (Chen et al., 2012), the authors may have found different results if they had compared the first 3 days of admission with the rest of the hospitalization period.

### **Situational factors.**

***Parental presence.*** A large multicenter study in France (Carbajal et al., 2008) showed that neonates who underwent procedures in the presence of parents were more likely to receive specific analgesia before a procedure (OR = 1.24, 95% CI [1.1, 1.41],  $p < .001$ ). Similarly,

Johnston and colleagues (2011), in 14 NICUs in Canada, reported that neonates whose parents were present during procedures were more likely to receive behavioural interventions, including NNS (16.3%), swaddling (5.2%), or a combination of strategies (9%) (OR = 1.581, 95% CI [1.058, 2.373],  $p = .026$ ); and sweet-tasting solution interventions for tissue-damaging procedures (OR = 2.261, 95% CI [1.414, 3.616],  $p = .001$ ). Parental presence had no impact on frequency of use of pharmacological interventions for tissue-damaging procedures ( $p = .09$ ). Behavioural interventions were more likely to be used for non tissue-damaging procedures in presence of a parent (OR = 1.386, 95% CI [1.265, 1.517],  $p < .001$ ). Presence of parents did not influence use of pharmacological (OR = 0.696, 95% CI [0.493, 0.981],  $p < .001$ ) and sweet-tasting solution interventions (OR = 0.971, 95% CI [0.701, 1.347],  $p < .862$ ) for non tissue-damaging procedures. Although it is unclear why parental presence increases use of interventions, it is hypothesized that parents' presence may influence use of interventions by (a) being involved in implementation of some of the behavioural interventions (e.g. breastfeeding, KC), (b) advocating for their neonates' pain treatment or (c) prompting HCPs to use interventions during painful procedures.

***Number and invasiveness of procedures.*** In a retrospective multisite Canadian study (N = 3, 822 children), Stevens et al. (2011) found that the proportion of neonates who were given pharmacological and behavioural interventions during procedures increased with increasing number of procedures performed. Of the 1, 498 neonates who underwent 1-3 painful procedures in a 24 hour period, 15.1% received pharmacological interventions compared with 30.8% of the 539 who underwent 4-6 procedures and 42% of the 950 neonates who had more than six painful procedures ( $p < .001$ ). Only 1.4% (21/1498) of the neonates who underwent 1-3 painful procedures received a behavioural intervention during procedures compared with 3.9% (21/539)



of those who had 4-6 procedures and 4% (38/950) of those who had more than 7 procedures ( $p < .001$ ).

Carbajal et al. (2008) showed that, compared with insertion of tubes in natural cavities (e.g. nasogastric tube), the odds ratios (OR) for use of specific analgesia were 43.22 (95% CI [38.43, 48.6],  $p < .001$ ) for needle stick; 12.57 (95% CI [8.06, 19.6],  $p < .001$ ) for tracheal intubation; and 52.55 (95% CI [20.93, 131.96],  $p < .001$ ) for chest tube insertion. Similarly, needle stick for vascular access (OR = 13.57, 95% CI [11.58, 14.79],  $p < .001$ ), tracheal intubation (OR = 5.85, 95% CI [3.73, 9.16],  $p < .001$ ), and chest tube insertion (OR = 10.72, 95% CI [1.4, 82.35],  $p < .001$ ) were more likely to be performed with some form of analgesia compared with nasogastric tube insertion (Carbajal et al., 2008).

***Place of birth.*** Only one study investigating the influence of place of birth on use of pain treatment interventions during procedures was identified (Johnston et al., 2011). Neonates born at the hospital (in-born) were less likely to be given pharmacological interventions (OR = 0.523, 95% CI [0.358, 0.765],  $p = .001$ ) but more likely to receive behavioural (OR = 2.306, 95% CI [1.82, 2.923],  $p < .001$ ), and sweet-tasting solution interventions (OR = 1.778, 95% CI [1.293, 2.445],  $p < .001$ ) for tissue-damaging procedures compared with outborn neonates. Inborn neonates were less likely to receive pharmacological interventions (OR = 0.187, 95% CI [0.15, 0.234],  $p < .001$ ) but more likely to be given behavioural interventions (OR = 2.008, 95% CI [1.869, 2.156],  $p < .001$ ) for non tissue-damaging procedures (Johnston et al., 2011). Although it is unclear what predisposes outborn neonates to more use of pharmacological interventions and less use of behavioural interventions, it is highly likely that they would be on continuous opioid infusion on account of their high level of acuity (Palmer et al., 2005).

***Time of day.*** Carbajal et al. (2008) demonstrated that night time (7 p.m. to 6 a.m.) procedures were less likely to be accompanied with specific (OR = 0.80, 95% CI [0.75, 0.85],  $p = .001$ ) or any form of analgesia (OR = 0.93, 95% CI [0.89, 0.97],  $p = .001$ ) compared with those performed during daytime (7 a.m. – 6 p.m.). Guedj and colleagues (2014) prospectively observed 430 neonates in 13 NICUs in France undergoing the five most frequently performed procedures ( $n = 38,012, 90\%$ ) during the first two weeks of admission. For all painful procedures taken together and for tissue-damaging procedures, analgesic use was higher in the morning, decreasing during the day to the lowest rate of use of interventions late at night. More specifically, 25.8% of painful procedures performed during morning hours (07:00 to 12:59) were performed with analgesia compared with 18.9% in the afternoon (13:00 to 18:59), 18.3% of the procedures during early night (19:00 to 00:59), and 18% during late night times (1:00 to 06:59;  $p < .001$ ). When time of the day was broadly categorized as day and night, pain treatment interventions were more likely to be used for procedures performed during daytime than those performed during night time (OR = 2.25, 95% CI [1.1, 4.6],  $p < .05$ ) (Guedj et al., 2014).

***Socio-economic status.*** No studies examining the influence of socio-economic status (SES) on use of pain treatment interventions on neonates were found. We hypothesize that the lack of studies was due to the fact that most of the research on procedural pain treatment has been conducted in high-income countries; a majority that provide universal health care with better access and quality of health care services (Ekman, 2004; Hsiao & Cheng, 2013). The proposed study was conducted in a LMIC setting where disparities in access and quality of health care services exist on account of SES (Peter et al., 2008). Therefore, it was prudent to explore the influence of SES on nature and frequency of use of behavioural and sweet-tasting solution interventions for procedural pain treatment.

### **Organizational factors.**

*Study site and level of care.* Carbajal et al. (2008) reported significant differences in use of specific ( $p < .01$ ) and non-specific analgesia ( $p < .001$ ) during procedures across 13 NICUs in the Paris region. Similar findings were reported in surveys in Canada (Johnston et al., 2011) and the United Kingdom (Kahn et al., 1998) where a 28.6% difference in opioid use among 6 NICUs was reported. While it is crucial to examine differences in use of interventions across hospital units, explaining such results is always challenging due to the number of confounding variables that cannot be accounted for (e.g., differences in training, policy and care priorities between units). Additionally, differences in practice culture exist across units, including units within the same hospital, which shape procedural pain treatment practices (Stevens et al., 2011).

There are inconsistent reports on the influence of level of neonatal care on use of pain treatment interventions. Some researchers have reported that neonates in Level III neonatal units (NICUs) are given pharmacological analgesia more often, or are likely to receive behavioural interventions during painful procedures than neonates admitted in Level II neonatal units (Porter et al. 1997; Stevens et al., 2011). However, significant differences also exist among units offering the same level of neonatal care (Stevens et al., 2003).

Overall, the nature and frequency of use of pain treatment interventions in neonates during procedures is influenced by neonatal, situational and organizational factors. Whether these factors would also influence the nature and frequency of use of behavioural and sweet-tasting solution interventions for pain treatment in neonatal units in Kenya remains unknown. Knowledge on the factors influencing use of pain treatment interventions in Kenya is critical when developing strategies to improve pain treatment practices in neonatal units in the country and, by extension, other LMICs.

## Consequences of Untreated Pain in Neonates

Multiple lines of evidence show that repeated and untreated pain in neonates has both short- and long-term consequences (Bartocci, Bergqvist, Lagercrantz, & Anand, 2006; Brummelte et al., 2012; Buskila et al., 2003; Grunau, Holsti, & Peters, 2006; Grunau, Weinberg, & Whitfield, 2004; Ranger & Grunau, 2014; Ranger et al., 2013; Vinall & Grunau, 2014). *In the short-term*, untreated pain in neonates is associated with increase in metabolic rate and oxygen demands, decrease in oxygen saturation and increase in intracranial pressure (Bellieni et al., 2003; Mitchell, Brooks, & Roane, 2000; Slater et al., 2012). *In the long term*, repeated and untreated pain in neonates has been associated with altered pain sensitivity, exaggerated pain responses and impaired neuro-anatomical development (Abdulkader et al., 2008; Brummelte et al., 2012; Buskila et al., 2003; Grunau, Weinberg, & Whitfield, 2004; Grunau et al., 2006; Ranger et al., 2013; Walker, 2013). Moreover, empirical evidence indicates that untreated pain affects behavioural, emotional and cognitive development of the neonate into infancy and childhood periods (Anand & Scalzo, 2000; Grunau, Holsti, & Peters, 2006; Grunau et al., 2009; Vinall et al., 2014).

Although complications of untreated pain affect all neonates, preterm neonates are more at risk owing to their immature and rapidly growing brain that is highly vulnerable to noxious injury (Grunau et al., 2006; Slater et al., 2010). Additionally, preterm neonates are more critically ill (Stevens et al., 2010) and are likely to experience the highest number of painful procedures often without any form of analgesia (Chen et al., 2012; Cignacco et al., 2009).

Abdulkader et al. (2008) investigated the medium- and long-term effects of pain on the developing nervous system in preterm neonates. They studied 13 healthy preterm neonates (29-35 weeks GA) who underwent heel pricks on one foot. On the third day of life (T1), after at least

a heel prick since birth, pressure force (using Von Frey Filaments) was applied on both the pricked (ipsilateral) heel and the unaffected (contralateral) heel to examine the threshold for flexion withdrawal reflex, gross body movements, and grimacing. The measurement of pain threshold was repeated 3-5 weeks following the last heel prick (T2). At T1, withdrawal reflex, gross body movement, and grimace occurred at a significantly lower threshold at the ipsilateral foot compared to the contralateral foot ( $p = .002, .005, .007$  respectively) indicating heightened sensitivity to pain on the pricked foot. The heightened sensitivity was also noted at T2. In the same study, the authors also followed 61 ex-preterm neonates who had undergone an average of 8 heel pricks and 63 full term neonates who had had one heel prick in the course of hospitalization to compare their pain sensitivity. Pain threshold remained significantly lower in neonates born preterm compared to term neonates throughout the first year of life. The authors concluded that pain in preterm neonates result in long lasting changes to pain pathways as well as pain processing at the cortical level of the central nervous system (Abdulkader et al., 2008).

Brummelte and colleagues (2012) prospectively examined the relationship between procedural pain and early brain development in 86 very preterm neonates (24-32 weeks GA). Using magnetic resonance imaging (MRI), 3-D magnetic resonance spectroscopic imaging (MRSI), and diffusion tensor imaging (DTI) the authors reported an inverse relationship between neonatal procedural pain and brain development. More specifically, higher numbers of painful procedures were significantly associated with reduced white matter ( $p = .028$ ) and sub-cortical grey matter maturation ( $p = .004$ ) in preterm neonates even after adjusting for multiple confounding clinical factors (e.g., infection, illness severity).

Ranger and colleagues (2013) used 3-D magnetic resonance imaging (MRI) to evaluate the effect of neonatal pain-related stress, defined as number of tissue-damaging procedures, on

brain development in very preterm neonates at school age. The cortical thickness of 42 children, who were born at 24-32 weeks GA, was evaluated at an average age of 8 years. Pain-related stress was found to be associated with a significantly thinner brain cortex in at least a third of the 66 cerebral cortex regions ( $p$ -values ranging from  $< .0001$  to  $.014$ ) even after adjusting for neonatal clinical factors, including illness severity, infections, mechanical ventilation, history of surgery and morphine use.

Vinall et al. (2014) followed 55 children to determine whether the number of invasive procedures during the neonatal period was associated with white matter microstructure at the age of seven years and whether the number of invasive procedures and measure of brain microstructure interact to predict cognitive outcome in children born very preterm (24-32 weeks GA). The researchers used magnetic resonance diffusion tensor sequences to measure fractional anisotropy (FA) as an index of brain maturation from seven anatomically defined white matter regions. Children exposed to a greater number of invasive procedures in the NICU had lower FA values at age 7 years (effect size =  $-0.02$ ; 95% CI  $[-0.04, -0.005]$ ,  $p = .01$ ) even after adjusting for neonatal factors such GA, severity of illness, days of mechanical ventilation and gender. Similarly, greater number of invasive procedures and lower FA of the white matter were associated with lower intellectual quotient (IQ).

Valeri, Holsti and Linhares (2015) conducted a systematic review (13 studies,  $N = 1,411$  neonates) to determine the association between early painful experiences in preterm neonates and later childhood developmental outcomes. Pain experiences during the neonatal period were associated with delayed postnatal growth, diminished focused attention, arousal and reflexes, as well as impaired cortical activation and neuro-development. Additionally, repeated pain

experiences during the neonatal period were associated with poor cognitive and motor development and exaggerated temperaments during infancy and early childhood period.

These studies provide empirical evidence that repeated and untreated pain in neonates has serious health complications that persist beyond infancy and early childhood. Investigating the consequences of untreated pain in neonates was beyond the scope of this study. Nonetheless, the need to minimize the risk for neonates in Kenya from developing these deleterious complications informed our decision to explore the acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain treatment in neonatal units in the country.

### **Behavioural Interventions for Procedural Pain Treatment**

Interventions that relieve pain by optimizing the neonate's regulatory and coping abilities are categorized as behavioural strategies (Mathew & Mathew, 2003; Obeidat et al., 2009). Although behavioural interventions have been the subject of neonatal pain research for nearly three decades (Johnston et al., 2007), the last decade has witnessed an exponential increase in number of studies investigating their efficacy and safety (Bueno et al., 2013; Johnston et al., 2014; Pillai Riddell et al., 2015; Shah et al., 2012). Pillai Riddell and colleagues (2015) conducted a systematic review (63 trials, 4, 905 infants) to determine the efficacy of containment (i.e., swaddling and FT) and NNS for procedural pain relief in neonates and infants. Efficacy and safety of kangaroo care (Johnston et al., 2014) and breastfeeding and breast milk (Shah et al., 2012) have been addressed in separate systematic reviews. Results of these reviews and other empirical studies on efficacy and safety of behavioural interventions are summarized below.

**Kangaroo care.** Johnston and colleagues (2014) conducted a systematic review with meta-analyses to determine the efficacy and safety of KC (also known as skin-to-skin contact) on neonates undergoing painful procedures in the NICU. Nineteen studies ( $n = 1, 594$  term and

preterm neonates); 15 on heel lance, two on intramuscular injection and one each for venepuncture and vaccination were included in the review. Compared to no-treatment control conditions, KC resulted in significantly reduced Premature Infant Pain Profile – PIPP (Stevens et al., 1996) scores at 30 seconds (mean difference [MD] = -3.21, 95% CI [-3.94, -2.48]), 60 seconds (MD = -1.85, 95% CI [-3.03, -0.68]) and 90 seconds (MD = -1.34, 95% CI [-2.56, -0.13]) but not at 120 seconds following the procedure. There was no significant difference in PIPP scores (Stevens et al., 1996) at 30, 60, 90 and 120 seconds post-procedure when KC was provided by the mother compared with other providers (e.g., fathers, related caregivers). Additionally, there were no adverse events of KC reported in any of the studies included in the review. Although the high heterogeneity of outcome measures in the studies included in the review limited the number of meta-analyses that could be conducted, the results of the review indicated that KC is safe and effective for treating pain from single procedures such as heel lance and venepuncture (Johnston et al., 2014).

Olsson, Ahlsén and Eriksson (2015) conducted a cross-over trial to determine whether KC was effective in relieving pain during venepuncture in premature neonates ( $n = 10$ ; 26-35 GA). Near-infrared spectroscopy was used to measure the haemodynamic changes in cortical parts of the brain during the procedure. All neonates received oral glucose prior to the procedure as per the NICU's pain treatment guidelines. There was a significantly higher increase in oxygenated haemoglobin when the procedure was performed with the neonate in the standard care (lying in the incubator or in the crib) compared to when the neonate was in KC ( $p = .016$ ) suggesting an increase in cortical activity in standard care condition. There was no significant difference in premature infant pain profile-revised (PIPP-R) scores (Stevens et al., 2014) between KC and standard care conditions. Despite the small sample size and the lack of



significant differences in validated pain scores between KC and routine care, the authors commented that KC had pain-relieving effects on preterm neonates undergoing venepunctures. (See Appendix B for summary of studies on KC).

**Containment.** During containment the neonate is either securely wrapped using a blanket to minimize movement of limbs and position limbs near the midline (*swaddling*) or a caregiver holds the neonate's extremities flexed and positioned close to the trunk (*facilitated tucking*) to mimic *in utero* posture (Fernandes, Campbell-Yeo, & Johnston, 2011). The Cochrane systematic review by Pillai Riddell (2015) included nine RCTs (373 preterm infants and neonates) on containment (both swaddling and FT) for procedural pain treatment. Containment was effective in reducing pain reactivity (SMD = -0.89, 95% CI [-1.37, -0.40]) and immediate pain regulation (SMD = -0.71, 95% CI [-1.00, -.43]) and pain reactivity in neonates (SMD = -1.26, 95% CI [-1.92, -.60]). Of methodological concern is that results of both swaddling and FT were pooled together thus making it impossible to discern the efficacy of individual interventions. Additionally, only one study involving term neonates was included; thus, further limiting the strength of the evidence.

Kucukoglu, Kurt and Aytekin (2015) conducted a randomized controlled trial to evaluate the effectiveness of FT in relieving pain from routinely administered hepatitis B (HBV) vaccine. Term neonates were randomized to either undergo the procedure in FT (n = 30) or in standard care – classical supine with extended lower limb position (n = 30). The mean Neonatal Infant Pain Scale (NIPS) scores (Lawrence et al., 1993) were significantly lower in neonates who underwent the procedure in FT ( $2.83 \pm 1.18$ ) compared with the standard care ( $6.47 \pm 1.07$ ,  $p < .001$ ). Additionally, 50% of the neonates in the FT group had no pain compared with 93.4% of the neonates in the standard care group who had severe pain as per NIPS scores (Lawrence et al.,

1993). There was no significant difference in pulse rate, respiration rate and oxygen saturation levels between FT and standard care groups during and after the procedure. The fact that (a) study sample had sufficient power, (b) all procedures were performed by one clinician and (c) the pain intensity was rated by four independent researchers who were blinded to group allocation puts credence to the authors' conclusion that FT is more effective than standard care in relieving pain from HBV vaccination in term neonates (Kucukoglu, Kurt, & Aytekin, 2015). (*See Appendix C for summary of studies on containment*).

**Non-nutritive sucking.** Non-nutritive sucking refers to giving a neonate a pacifier to suck during a painful procedure (Badr, 2012; Campbell-Yeo et al., 2011). NNS has been used extensively for pain relief in neonates undergoing commonly performed therapeutic and diagnostic procedures, including heel lancing, venepuncture, endotracheal suctioning, peripheral venous cannula insertion and subcutaneous and intramuscular injection (Kristoffersen, Skogvoll, & Hafström, 2011; Pillai Riddell et al., 2015)

Pillai Riddell et al. (2015) systematic review (*previously described*) included 13 RCTs (364 preterm infants and 260 neonates) on NNS for procedural pain treatment. NNS reduced pain-related reactivity in neonates (SMD = -1.20, 95% CI [-2.01, -0.38]) but not in preterm infants (SMD = -0.31, 95% CI [-0.65, 0.04]). Conversely, NNS significantly improved immediate regulation (e.g., crying) in preterm (SMD = -0.43, 95% CI [-0.63, -0.23]) and term neonates (SMD = -0.90, 95% CI [-1.54, -0.25]). Pillai Riddell et al. (2015) concluded that there is sufficient evidence that NNS is efficacious in reducing pain-related distress reactivity and regulation in preterm and term neonates when initiated at least three minutes prior to the painful procedure. Pillai Riddell's (2015) conclusion of effectiveness of FT could, however, be

questioned on account of the poor quality studies that informed them. (*See Appendix D for summary of the systematic review*).

**Breastfeeding/breast milk.** Shah and colleagues (2012) conducted a comprehensive Cochrane systematic review to evaluate the effectiveness of breastfeeding or supplemental breast milk in reducing procedural pain in neonates. The review included 20 RCTs (2014 term infants); 10 each evaluating breastfeeding and supplemental breast milk. Compared with other non-pharmacological pain treatment interventions such as oral sucrose, containment, maternal holding and NNS, neonates on breastfeeding had (a) lower pain scores, (b) reduced proportion of time crying and duration of crying and (c) delayed time to first cry. Supplemental breast milk significantly reduced duration of crying and Neonatal Facial Coding System (NFCS) pain scores (Grunau & Craig, 1987) compared with placebo. The authors concluded that breastfeeding and breast milk are as effective as oral sucrose/glucose in alleviating procedural pain in neonates undergoing single painful procedures (Shah et al., 2012). None of the studies in the systematic review included preterm neonates. This omission could be related to the immaturity of preterm neonates to mount robust reflexes required for effective breastfeeding at birth.

Since Shah et al.'s (2012) review, few additional studies on effectiveness of breastfeeding and breast milk have been published. Bueno and colleagues (2012) conducted a non-inferiority RCT to compare the effectiveness and safety of expressed breast milk (EBM) and 25% glucose in reducing pain in neonates (N = 113; 34-36 weeks GA) during heel lancing. Both interventions were administered via a needleless syringe to the anterior portion of the tongue two minutes before the procedure. Neonates receiving EBM had higher mean PIPP scores (Stevens et al., 1996) at 30 seconds ( $7.54 \pm 3.61$ ) and 60 seconds ( $4.55 \pm 3.17$ ) after the procedure compared with 25% glucose ( $6.26 \pm 4.09$  and  $3.06 \pm 3.02$ ;  $p < .001$ ). Neonates receiving EBM had higher

incidence of cry compared with those who received 25% glucose (78.6% versus 42.2%;  $p < .001$ ) and spent a higher proportion of time crying ( $32.02\% \pm 29.02$ ) than those who received oral glucose ( $14.53\% \pm 19.98$ ,  $p = .014$ ). There was no difference in the incidence of adverse events between EBM and oral glucose groups (5 versus 4,  $p = .74$ ) with a majority of the adverse events being desaturation (2 episodes) and nausea and regurgitation (2 episodes). Bueno and colleagues concluded that EBM was safe but less effective compared with 25% glucose for procedural pain relief during heel lancing.

Ou-Yang et al. (2013) conducted a placebo-controlled trial to determine whether EBM reduces procedural pain associated with heel lancing in preterm neonates ( $N = 123$ ). Neonates were randomized to receive 5ml of either distilled water ( $n = 44$ ), 25% glucose water ( $n = 39$ ) or EBM ( $n = 40$ ) via a syringe inserted into the oral cavity prior to a clinically indicated heel lance. The mean ( $\pm$ SD) Neonatal Pain, Agitation and Sedation Scale (N-PASS) scores (Hummel et al., 2008) were significantly lower in the EBM and glucose groups ( $5.83 \pm 2.77$  and  $5.55 \pm 3.29$  respectively) compared with the placebo group ( $7.66 \pm 3.24$ ;  $p < .05$ ). There was no significant difference in pain scores between EBM and glucose group. The glucose group had a longer latency period to cry after heel lance (median = 122 sec, IQR: 4-180) and shorter duration of cry (median = 2 sec, IQR: 0-45) compared with EBM (latency, 55.5sec, IQR: 0.5-180; duration of cry, 29.5 sec, IQR: 0-65) and placebo (latency 7.5, IQR: 1.5-64; duration of cry, 70.5, IQR: 5.5-104.5) -  $p = .007$  and  $p = .01$  respectively. There was no significant difference in physiological parameters (i.e., HR, RR and  $\text{SaO}_2$ ) between treatment groups before and up to three minutes after the heel lance. Although the number of participants was relatively low, which limited the power to detect significant effects on physiological parameters and crying time, the authors

concluded that EBM is as effective as glucose in reducing pain associated with heel lancing in preterm neonates.

Marin and colleagues (2013) compared the analgesic effect of breastfeeding plus KC with other behavioural and sweet-tasting solution interventions. Healthy term neonates (N = 136) were randomized to breastfeeding and KC (n = 35), sucrose and KC (n = 35), KC (n = 33), or sucrose (n = 33) during a heel lance. NIPS scores (Lawrence et al., 1993) were significantly lower for neonates who were on breastfeeding and KC (median = 1, IQR: 0-3) compared with those who received sucrose and KC (median = 2, IQR: 2-4), KC alone (median = 4, IQR: 2-6), and sucrose alone (median = 4, IQR: 2-5),  $p \leq .01$ . Similarly, crying time (seconds) was less for the breastfeeding and KC group (median = 2, IQR: 0-25) compared with the sucrose and KC group (median = 5, IQR: 0-26), the KC group (median = 26, IQR: 1-62), and sucrose group (median = 13, IQR: 2-74),  $p = .01$ . There was no significant difference in changes in heart rate during procedure in either of the intervention groups. Breastfeeding plus KC was more effective than a combination of sucrose and KC, sucrose alone, or KC alone (Marin et al., 2013).

Zhu et al. (2015) compared the effectiveness of breastfeeding, music therapy (MT) and a combination of breastfeeding and MT for pain relief during heel lancing. Healthy term neonates (N = 250) were randomized to breastfeeding (n = 64), MT (n = 62), breastfeeding and MT (n = 63) and routine care as control (n = 61). The MT entailed playing three classical music pieces (55-60 decibel range) on a loop at least five minutes before and during the procedure. NIPS scores (Lawrence et al., 1993) during the procedure were significantly lower in the breastfeeding group ( $3.08 \pm 1.88$ ) compared with the group that received both breastfeeding and MT ( $4.38 \pm 2.2$ ), MT alone group ( $6.06 \pm 0.22$ ) and control group ( $6.43 \pm 0.23$ ),  $p < .001$ . The NIPS scores were also lower in the breastfeeding ( $0.35 \pm 0.27$ ) and breastfeeding and MT conditions ( $0.24 \pm$

0.28) compared with MT alone ( $1.98 \pm 0.29$ ) and control conditions ( $2.34 \pm 0.29$ ) 1 minute after the procedure ( $p < .001$ ). Moreover, the latency to first cry (seconds) was longer for breastfeeding ( $13.65 \pm 2.34$ ) and breastfeeding and MT ( $14.89 \pm 2.37$ ) compared with MT alone ( $5.03 \pm 2.41$ ) and control groups ( $4.83 \pm 2.45$ ;  $p < .001$ ) while the duration of first cry (seconds) was shorter for breastfeeding ( $27.32 \pm 9.01$ ) and breastfeeding and MT groups ( $27.17 \pm 9.12$ ) compared with MT alone ( $90.86 \pm 9.27$ ) and control groups ( $101.61 \pm 9.43$ ;  $p < .001$ ). Research on effectiveness and safety of breastfeeding and breast milk is summarized in *Appendix E*.

### **Sweet-tasting Solution Interventions**

Oral sucrose and other sweet-tasting solution interventions are arguably the most extensively studied pain treatment strategies to date. Stevens et al. (2013) conducted a Cochrane systematic review with meta-analyses to determine the efficacy and safety of oral sucrose for procedural pain treatment in neonates. Fifty-seven studies (4, 730 neonates) were included in the review. Sucrose reduced pain scores and duration of crying in neonates undergoing painful procedures. When PIPP scores (Stevens et al., 1996) were pooled in a meta-analysis, sucrose groups had significantly lower scores at 30 seconds (4 studies, 264 neonates; weighted mean difference [WMD] = -1.76, 95% CI [-2.54, -0.97]) and 60 seconds (3 studies, 195 neonates; WMD = -2.05, 95% CI [-3.08, -1.02]) following heel lance. When results of two trials (88 neonates) were pooled together, sucrose significantly reduced duration of total crying time (WMD = -39 seconds, 95% CI [-44, -34]) but not duration of first cry during heel lance (3 studies, 192 neonates; WMD = -9 seconds, 95% CI [-20, 2]). During eye examinations, sucrose did not significantly reduce PIPP scores (Stevens et al., 1996) (3 studies, 82 neonates; WMD = -0.65, 95% CI [-1.88, 0.59]) although oxygen saturation (%) was significantly lower in neonates given sucrose compared to controls (2 studies, 62 neonates; WMD = -2.6, 95% CI [-4.9, -0.2]).

There were no differences in adverse effects between sucrose and control groups. Results of this systematic review and meta-analyses showed that oral sucrose is safe and effective for treating procedural pain from single painful events such as heel lancing. Safety and effectiveness of the repeated use of sucrose during procedures, however, remains inconclusive (Johnston et al., 2007; Stevens et al., 2005).

Dilli et al. (2014) conducted a prospective randomized and placebo-controlled study among preterm neonates (N = 64, 28-36 weeks GA) to evaluate the efficacy of oral sucrose combined with NNS for pain treatment during screening for retinopathy of prematurity. Neonates were randomized to receive either 24% oral sucrose followed by a pacifier or sterile water followed by pacifiers 2 minutes prior to the procedure. PIPP scores (Stevens et al., 1996) were significantly lower for the sucrose-pacifier group ( $13.7 \pm 2.1$ ) compared with neonates who were given sterile water followed by a pacifier ( $16.4 \pm 1.8$ ;  $p = .001$ ). Additionally, crying time (seconds) was shorter in the sucrose-pacifier group ( $58.7 \pm 16.6$ ) compared with the sterile water-pacifier group ( $79.8 \pm 30.4$ ;  $p = .001$ ). There was no difference in number of neonates who developed adverse events (i.e., tachycardia, bradycardia and desaturation) between intervention groups ( $p > .05$ ). Although the authors concluded that sucrose combined with pacifier was effective in reducing pain from screening for retinopathy of prematurity (Dilli et al., 2014), the PIPP scores (Stevens et al., 1996) indicated that neonates were still experiencing moderate to severe pain; suggesting that sucrose was not sufficient for reducing pain during this procedure.

Bueno and colleagues (2013) conducted a systematic review to determine efficacy and safety of nonsucrose sweet-tasting solutions for pain relief during painful procedures in neonates. Thirty eight RCTs (3, 785 neonates; 35 investigated glucose) were included in the systematic review. Heel lancing was performed in 19 studies, venepuncture in 10, intramuscular (IM)

injection in three, and one study each for sub-cutaneous injection, peripherally inserted central catheter (PICC), eye examination and circumcision. Due to heterogeneity in intervention and outcome measures, meta-analysis was only possible for heel lancing and venepuncture. A 3.6-point reduction in PIPP scores (Stevens et al., 1996) during heel lance was observed in studies comparing 20-30% glucose with no intervention (2 studies, 124 neonates; MD = -3.6, 95% CI [-4.6, -2.6],  $p < .001$ ). Glucose solution significantly reduced incidence of cry after venepuncture compared to water or no intervention (three studies, 130 neonates; risk difference [RR] = -0.18, 95% CI [-0.31, -0.05],  $p = .008$ ). Single trials demonstrated significant reduction in pain scores during IM injections, PICC placement, eye examination and circumcision. Although there were no differences in rate of adverse events between glucose and control groups, two studies that enrolled very preterm neonates reported short-lasting episodes of bradycardia and desaturation. These minor side effects could be associated with the neonate's ability to swallow rather than the intervention. Results of this meta-analysis show that 20-30% glucose solutions have analgesic effects on both term and preterm neonates undergoing a single heel lance and venepuncture.

Uzelli and Güne (2015) conducted a prospective randomized controlled trial to investigate the effectiveness of 5% oral glucose solution in reducing pain in preterm neonates during IM injection. Neonates ( $N = 80$ ) were randomized to receive 5% glucose or nothing during the procedure. NIPS scores (Lawrence et al., 1993) were significantly higher in the control group than in the oral glucose group ( $5.6 \pm 0.6$  vs.  $4.2 \pm 0.7$ ;  $p < .001$ ) while crying time was significantly shorter in the glucose group than in the control group ( $10.9 \pm 3.1$  vs.  $16.9 \pm 3.0$ ;  $p < .001$ ). Oxygen saturations of the glucose group were higher than those of the control group during the procedure ( $p < .001$ ) and after the procedure ( $p < .001$ ). The mean HR was also significantly different between groups during the procedure ( $p = .03$ ) and after the procedure ( $p =$



.02). The results may be biased by the use of widely varied doses of glucose (0.2-2mls) and the fact that investigators were not blinded to treatment intervention. The authors concluded that 5% glucose was effective in reducing distress and physiological indicators of pain in preterm neonates IM injections (Uzelli & Güne, 2015). *(See Appendix F for summary of studies on oral sucrose and non-sucrose sweet-tasting solution interventions).*

### **Acceptability and Feasibility of Behavioural and Sweet-tasting Interventions**

A comprehensive review of the literature revealed no studies exclusively examining the acceptability and feasibility of behavioural interventions for procedural pain treatment. Multiple authors have, however, alluded to acceptability and feasibility of behavioural interventions for procedural pain treatment through effectiveness studies (Axelin et al., 2006; Axelin et al., 2010; Johnston, Campbell-Yeo, & Filion, 2011; Reis et al., 2003).

In a study on use of FT by parents (FTP) during endotracheal suctioning, Axelin et al. (2006) interviewed Finnish parents (17 mothers and 3 fathers) to determine their perception regarding participation in comforting their neonates through FT. Nearly all the parents (95%) preferred to be involved in their neonates' pain treatment by performing FT over passive observation. Although some parents (20%) felt uncomfortable with FT, they still wanted to comfort their neonates during the procedure. Axelin and colleagues (2010) also conducted post-intervention interviews with 23 Finnish mothers to explore their perceptions regarding comforting preterm neonates during painful procedures using FT. Mothers perceived FT positively and wanted to use it routinely during procedures.

Cignacco and colleagues (2010) questioned the feasibility of using FT routinely for procedural treatment on account of resource constraints, particularly staffing, in most NICUs. They argued that performing a painful procedure with FT takes longer to complete (up to 10

minutes). The authors were concerned that doing FT during procedures would require 2 HCPs: one to tuck the neonate and the other to perform the painful procedure which may not be feasible in most neonatal units (Cignacco et al., 2010).

Following Cignacco and colleagues' (2010) study, Herrington and Chiodo (2014) evaluated the efficacy and feasibility of using FT on preterm neonates during heel sticks (*study described above*). The authors observed that FT was quick and easy to use during procedures. Furthermore, they argued that FT was more practical to use during frequently performed procedures than KC (for instance) since FT does not limit access to the procedure site during heel sticks. Herrington and Chiodo (2014) also argued that FT would be more feasible to use for pain treatment from routinely and repeatedly performed procedures such as heel lancing since it does not require a medical order to implement.

Johnston, Campbell-Yeo and Filion (2011) interviewed mothers and fathers who had participated in a RCT to determine their perceptions about the KC process during procedures. Parents were asked (a) how they felt when providing KC during a heel lance, (b) whether they would do the KC again and (c) whether they would recommend it to other parents. All fathers (n = 36) and mothers (n = 69) reported feeling positive about providing KC during procedures, they would do KC again and they would recommend it to other parents. The authors concluded that using KC for procedural pain treatment was feasible in clinical practice and acceptable to parents. Results of this study should be interpreted cautiously. Only parents who had been enrolled in, and participated in the study involving KC, were interviewed. Thus, the findings may not necessarily reflect the views of parents of neonates admitted in the NICU.

Reis and colleagues (2003) assessed the effectiveness, feasibility and parental acceptance of a simple combination of pain management interventions used on 116 neonates receiving

multiple immunization injections. Neonates were randomized to NNS (oral sucrose and a pacifier) while being held by their parents or standard care (placing on the examination table without any specific comfort measure). Acceptability was indicated by parents' preference for future use of the injection technique on a visual analogue (0-100) scale while feasibility was measure by nurse-rated ease of vaccine administration. Parents of neonates in the intervention group reported a stronger preference (median = 97.0, IQR: 82.0-100.0) for future use of NNS and parental holding during injection procedure compared to the standard care (median = 44.0, IQR: 5.0-77.2,  $p < .001$ ). Although the median vaccination time was slightly longer for the intervention group (65.0 vs. 60.0 seconds;  $p = .01$ ), nurses rated the ease of vaccine administration the same in both treatment groups (Reis et al., 2003). Although it is impossible to discern which components of the intervention (i.e. oral sucrose, pacifier, or maternal holding) were preferred by the parents, it is logical to assume that these interventions were both acceptable and feasible for procedural pain treatment.

No studies on acceptability and feasibility of breastfeeding, breast milk, oral sucrose and other sweet-tasting solutions for procedural pain treatment were identified. Nevertheless, from the number of systematic reviews reporting on their safety and efficacy (Bueno et al., 2013; Shah et al., 2012; Stevens et al., 2013) and the wide repertoire of national and international clinical guidelines recommending their routine use for procedural treatment in high-income countries (AAP, 2016; Lee et al., 2014), we hypothesize that these interventions are equally acceptable and feasible in clinical settings. Additionally, most of the behavioural interventions are mother-derived (e.g., KC, breastfeeding and breast milk) while sweet-tasting interventions are low-cost and can be used by HCPs during painful procedures without a significant strain in healthcare resource (Cignacco et al., 2010; Franck et al., 2012; Johnston et al., 2014; Shah et al., 2012).

These observations augment our belief that sweet-tasting solution interventions are acceptable and feasible for procedural pain relief in high-income countries.

In summary, acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain relief has not been thoroughly explored. Few researchers conducting effectiveness studies in high-income countries have attempted to demonstrate the acceptability and feasibility of the interventions. Availability of resources (e.g., staffing, time) has been alluded to as a key determinant of acceptability and feasibility of these interventions. Given that these low-cost interventions are highly desirable for resource-limited settings, it is necessary to investigate the acceptability and feasibility, and factors that influence these implementation outcomes, from the perspective of critical stakeholders in neonatal care, including HCPs, administrators and parents.

### **Summary of the Literature Review**

Minimal empirical evidence exists on the nature and frequency of painful procedures; and use of behavioural and sweet-tasting solution interventions for procedural pain treatment in LMICs such as Kenya. No research has examined the factors that influence the nature and frequency of procedures and use of behavioural and sweet-tasting solution interventions in LMICs. More specifically, no researcher has explored whether neonatal, situational or organizational factors influence the nature and frequency of procedures and use of behavioural and sweet-tasting solution interventions for procedural pain treatment in neonatal units in Kenya.

Very few researchers have explored the acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain treatment in neonates (Axelin et al., 2010; Johnston et al., 2011; Reis et al., 2003). None of these studies was conducted in LMICs where implementation of these interventions may significantly change the undertreatment of

procedural pain. Similarly, no researchers have comprehensively explored the perceptions of HCPs, administrators and parents regarding acceptability and feasibility of behavioural and sweet-tasting solution interventions. Factors influencing the acceptability and feasibility of these interventions remain largely unknown. The perspectives of HCPs, administrators and parents will provide crucial information necessary for developing strategies to improve procedural pain treatment practices in neonatal units in Kenya and other LMICs.

## **CHAPTER THREE**

### **Conceptual Framework**

In this chapter, a description of the conceptual framework, the Promoting Action on Research Implementation in Health Services – PARiHS (Kitson, Harvey & McCormack, 1998; Kitson et al., 2008; Rycroft-Malone et al., 2001; Stetler, Damschroder, Helfrich, & Hagedorn, 2011) that was adapted for the study will be presented. The first two sections will address (a) components of the framework and (b) evidence on utilization of the framework in research studies. In the last section of the chapter, I will describe how the framework was applied in this study.

### **The PARiHS Framework**

The PARiHS is a multidimensional framework that posits that successful implementation of research evidence into practice is a product of a dynamic interplay and interdependence between three elements; namely (a) *evidence* (E), (b) *context* (C) and (c) *facilitation* (F) (Kitson et al., 2008; Rycroft-Malone et al., 2013). The three components have sub-elements whose interplay drive the process of implementation of research evidence into practice (Kitson, et al., 2008). Each of the three elements is measured on a high-to-low continuum.

Implementation of evidence into practice is most successful when all the elements are situated towards the ‘high’ end of the continuum, that is, when the evidence is strong, the context is receptive to change and when the implementation is appropriately facilitated (McCormack et al., 2002; Rycroft-Malone, 2004). More specifically, a successful translation of research into practice is expected when the evidence is scientifically robust and consistent with professional beliefs and patient preferences, the context has a strong, approachable and supportive leadership,

and when the process is spearheaded by reliable internal and external facilitators (Hutchinson, Wilkinson, Kent, & Harrison, 2012; Rycroft-Malone et al., 2004). For instance, implementation of behavioural and sweet-tasting solution interventions for procedural pain treatment in neonatal units in Kenya would be most successful when (a) there is high quality evidence on their efficacy, safety, acceptability and feasibility, (b) the hospital/unit is supportive of change and (c) effective strategies are used to facilitate their uptake and support their routine use during painful procedures.

## **Evidence**

Evidence is defined as any form of knowledge derived from scrutinized and credible sources (Kitson et al., 2008; Rycroft-Malone et al., 2004). Evidence comprises four sub-elements, corresponding to four possible sources of evidence, namely (a) research evidence and practice guidelines, (b) clinical experience and related clinician knowledge, (c) patient preferences and experiences and (d) local data and/or information including quality improvement projects (Helfrich et al., 2010; Kitson et al., 2008).

**Research evidence.** Historically, research evidence has been viewed as the best form of evidence to inform clinical practice. The pre-eminence of research over other sources of evidence is rooted in the evidence-based medicine (EBM) movement (Rycroft-Malone et al., 2004), widely described as “conscientious, explicit and judicious use of current evidence in making decisions about the care of individual patients” (Sackett, 1997, p.3). The principle of research-based practice has been extended from medicine to other health professions including nursing (Ciliska, Pinelli, DiCenso, & Cullum, 2001). The evidence-based practice is pegged on the view that clinical decisions based on best evidence, from research and clinical experience, improves quality of care and patients’ quality of life (Hughes, 2008). The EBM movement has

propagated the assumption that only quantitative studies can provide credible evidence to inform practice (Rycroft-Malone et al., 2004) to the extent that evidence from quantitative methods including systematic reviews and meta-analyses are ranked high in the hierarchy of evidence (Evans, 2003). In this regard, systematic reviews and randomized controlled trials (RCTs) are considered ‘high’ in the continuum of evidence in the PARiHS framework particularly when the clinical question is about effectiveness of a treatment (Rycroft-Malone et al., 2002). Clinicians, however, do not always encounter clinical problems about effectiveness of treatment. Therefore, other paradigms and designs can, equally, serve as sources of research evidence (Kitson et al., 1998). For instance, a researcher interested in exploring perceptions of clinicians, administrators, and mothers regarding the acceptability and feasibility of using behavioural and sweet-tasting solution interventions for procedural pain treatment in neonates would carry out interviews within a qualitative paradigm rather than a RCT. Therefore, the clinical question ought to dictate the type of research evidence required, as long as the research evidence (quantitative or qualitative) is rigorously collected and synthesized and consensus built around it (Rycroft-Malone, 2004; Rycroft-Malone et al., 2004).

**Clinical experience.** Health care professionals accrue knowledge during their clinical practice and through their own life experiences (Rycroft-Malone et al., 2004). This knowledge, often intuitive and tacit, has been described variably including ‘professional craft knowledge’ and ‘practical know-how’ (Rycroft-Malone et al., 2002). Apart from being a source of evidence, craft knowledge is critical for rationalization and decision-making regarding how to integrate all forms of evidence within a clinical context (Rycroft-Malone et al., 2004). Clinical experience is considered ‘high’ in the evidence continuum when it is explicit, reflected upon and critiqued (Rycroft-Malone, 2004). Thus, like any other source of evidence, clinical experience requires



scrutiny for credibility through explication and appraisal by peers (Rycroft-Malone et al., 2002; Rycroft-Malone et al., 2004).

**Patient experience.** Patients' experiences and preferences also constitute an important source of evidence for clinical practice (Rycroft-Malone et al., 2002). These patient experiences may emanate from previous encounters with care or from the patients' understanding of themselves, their bodies and their social lives (Rycroft-Malone et al., 2004). In the evidence continuum, patient experience is rated 'high' when patient preferences are used as part of the decision-making process, and when patient narratives and experiences are seen as a valid source of evidence (Rycroft-Malone, 2004). It is imperative that clinicians consider the patient's experiences and the value and meanings they attach to their experiences as a credible source of evidence (Rycroft-Malone et al., 2004). In special circumstances such as those involving non-verbal patients (e.g., neonates) the experiences and preferences of their parents and/or caregivers would constitute a critical source of evidence.

**Local data/information.** The context in which care is rendered serves as a valuable source of evidence to inform practice change (Rycroft-Malone et al., 2004). Local information gathered through clinical audits, studying organizational and individual culture, social and professional networks, and local and national policies serve as sources of 'internal' evidence (Rycroft-Malone et al., 2004; Stetler, 2003). Local evidence is considered to be of high quality if it is systematically collected and rigorously evaluated at individual and organizational levels (Rycroft-Malone, 2004). For instance, data collected in neonatal units in Kenya using different methods (i.e., review of medical records, observations) would provide the best local evidence on nature and frequency of use of behavioural and sweet-tasting solution interventions for procedural pain treatment in a resource-limited setting.

## **Context**

Context, which refers to the environment in which people receive health care services, is a potent catalyst to implementation of evidence into practice. The care environment can be a simple, single-system or a complex and turbulent environment consisting of multiple systems that interact to shape the total environment (McCormack et al., 2002; Rycroft-Malone, 2004). The interplay between 4 contextual factors, namely (a) culture, (b) leadership, (c) evaluation and (d) resources demonstrate the complexity of context and its potency as a catalyst to successful implementation of evidence into practice (McCormack et al., 2002; Rycroft-Malone et al., 2001; Rycroft-Malone, 2004).

**Culture.** Culture has been described as the way individuals, teams and organizations normally execute their daily activities (McCormack et al., 2002). Each context consists of multiple cultures, each with fundamentally distinctive values, beliefs and assumptions (McCormack et al., 2002). Thus, to change practice, organizations should be prepared to invest in changing the prevailing culture at the individual and group levels. The institutions should strive to create a learning culture, embrace all-inclusive decision-making processes, and adapt a facilitative rather than a directive management style (McCormack et al., 2002; Rycroft-Malone et al., 2004). Additionally, the institution should promote a culture that values individual contributions, group processes and organizational systems that foster good relationships between managers and employees (McCormack et al., 2002; Rycroft-Malone, 2004). Institutions implementing evidence into practice would also benefit from full participation of workers, a stable workforce capable of building trusting relationships and networking with other organizations (McCormack et al., 2002).

**Leadership.** Organizational leadership fundamentally shapes the context in which research is translated into practice (Rycroft-Malone, 2004). Effective leadership is defined by clear role definition and effective teamwork and organizational structures (Kitson et al., 1998; McCormack et al., 2002). For a successful implementation of evidence into practice the leadership must be transformational and pragmatic; capable of challenging the prevailing organizational culture and creating a context that is receptive to integration of new evidence into practice (McCormack et al., 2002). Transformational leaders create conducive environments that recognize the potential of everybody as a leader; and guides staff into a shared vision and teamwork (McCormack et al., 2002; Rycroft-Malone, 2004). Moreover, implementation of research evidence into practice is likely to be successful in contexts where the role of each individual is clearly defined, decision-making is decentralized, and where innovative ideas are encouraged and valued (Rycroft-Malone, 2004).

**Evaluation.** Evaluation is used as a measure of the extent to which change is appropriate, effective and efficient (McCormack et al., 2002; Rycroft-Malone, 2004). The evaluation process should make use of both ‘hard’ and ‘soft’ outcome data (McCormack et al., 2002). Whereas ‘hard’ data, mostly quantitative, is concerned with effectiveness of interventions, ‘soft’ data, mainly collected through qualitative inquiry, presents user-perceptions and experiences. The overarching aim of both forms of data is to inform decisions regarding individual and organizational effectiveness and efficiency (McCormack et al., 2002). To successfully implement research evidence into practice, clinical contexts should use multiple methods of evaluating effectiveness, use different sources of information with measurable outcomes, and provide feedback at individual, team and systems level (McCormack et al., 2002; Rycroft-Malone, 2004).

**Resources.** Resources, including finances, time, equipment and supplies and clinical skills constitute a critical sub-element of context (Rycroft-Malone et al., 2004). Without resources, implementation of evidence into practice would be impossible. For instance, clinicians require sufficient time to search and appraise the evidence they require to change practice. Clinicians would also require specific skills to effectively and safely carry out care activities related to the new knowledge. Moreover, institutions would require additional resources, including equipment, supplies and finances if new evidence is to be successfully implemented into practice.

A linear relationship between availability of these forms of resources and a successful implementation of evidence into practice does not exist. Instead, researchers concur that the nature of interaction among the different forms of resources is very complex, often requiring a judicious consideration when designing strategies to implement research evidence into practice (Rycroft-Malone et al., 2004; Squires et al., 2012). For instance, allocation of more financial and human resource may not necessarily result in better uptake of evidence into practice (Rycroft-Malone et al., 2004). However, there is consensus among implementation scientists that research evidence cannot be successfully implemented, no matter how robust it is, without sufficient time, finances, skills and equipment and supplies (Rycroft-Malone et al., 2004; Squires et al., 2012).

### **Facilitation**

Facilitation is the process by which an individual enables others, individually or in a group, to understand the processes they have to go through to change aspects of their behaviour or attitudes towards themselves, their work, or other individuals (Harvey et al., 2002; Rycroft-Malone, 2004). In the PARiHS framework facilitation denotes the process of enabling the implementation of evidence into practice by helping individuals and teams understand what

needs to be changed and how it can be changed (Harvey et al., 2002); and preparing the environment and practitioners for the change (Rycroft-Malone, 2004).

To be effective, facilitation should be preceded by evaluation of the context into which the new evidence is to be introduced as well as assessment of clinicians' understanding and acceptance of the evidence itself (Kitson et al., 2008). Evaluation of the context is critical in determining the most appropriate facilitation approach to use; and in informing development of multi-faceted, flexible and context-specific interventions (Kitson et al., 2008). The interventions developed could draw from task-oriented (e.g. planned change programme) or more experiential approaches such as action learning processes. On the other hand, data on individual and teams' understanding and receptiveness to the new knowledge is crucial in determining how much new learning and change is required.

Facilitating translation of evidence into practice should be led by those who clearly understand their roles and possess appropriate skills and knowledge to help individuals, teams and organizations apply the evidence into practice. The facilitation process is anchored on three facets namely (a) purpose, (b) role and (c) skills and attributes (Harvey et al., 2002; Rycroft-Malone, 2004).

**Purpose.** The purpose of facilitation during implementation of evidence into practice ranges from providing help and support to achieve set goals to a more complex and holistic process of enabling individuals and teams to analyse, reflect upon and change their attitudes, beliefs and behaviours towards new practices (Harvey et al., 2002; Rycroft-Malone, 2004). Facilitation is critical in assisting individuals and teams of practitioners to use new theoretical knowledge, transforming self and social systems that hinder implementation of evidence; and ensuring achievement of set practice goals (Harvey et al., 2002). Thus, to succeed in enabling

implementation of evidence into practice, the facilitation process should focus on addressing the inherent barriers to uptake of evidence at individual and institutional levels (Harvey et al., 2002).

**Role.** The role of a facilitator in changing practice ranges from the practical hands-on role of assisting to bring about change to a more complex, multidimensional role of transforming the context to make it conducive for change (Harvey et al., 2002; Rycroft-Malone, 2004). The differences in facilitator roles largely depend on the nature and scale of the intended practice change. For instance, in practice development and quality improvement initiatives the facilitator is concerned with addressing issues related to resistance to change as well as changing the organizational culture; and by helping individuals and teams to analyse and challenge existing standards of practice (Harvey et al., 2002). Regardless of the extent of facilitation, whether internally or externally sourced, the primary role of a facilitator remains providing support and advice, and identifying the needs of individuals and teams targeted for change. Moreover, the facilitator plays a critical role of evaluating achievement of goals set by individuals and implementation teams (Harvey et al., 2002; Kitson et al., 2008).

**Skills and attributes.** To successfully support practitioners to change their practice, a wide repertoire of facilitation skills and attributes is required (Harvey et al., 2002; Rycroft-Malone, 2004). These skills include interpersonal, communication, critical reflection skills and ability to create an environment of high support and high challenge (Harvey et al., 2002). Although the relative importance or the right mix of the skills and attributes that is required for a successful facilitation of implementation of evidence into practice remains largely unknown (Rycroft-Malone, 2004), the facilitator should, at the very least, possess some strong personal attributes as well as personal, interpersonal and group management skills (Harvey et al., 2002). To be

effective, facilitators must possess a toolkit of skills and personal attributes that they can apply when facilitating implementation of evidence into practice in diverse contexts.

### **Use of PARiHS Framework in Research Studies**

The PARiHS framework has been widely used in qualitative (Stetler, Damschroder, Helfrich, & Hagedorn, 2006; Ullrich, Sahay, & Stetler, 2014; Wallin, Rudberg, & Gunningberg, 2005), quantitative (Cummings, Estabrooks, Midodzi, Wallin, & Hayduk, 2007; Estabrooks, Midodzi, Cummings, & Wallin, 2007) and mixed methods studies (Conklin & Stolee, 2008) to guide data analysis and interpretation of results. Researchers have also used the framework prospectively to design and implement interventional projects to improve clinical practice (Botti et al., 2014; Obrecht, Van Hulle, & Ryan, 2014; Rycroft-Malone et al., 2013; Stevens et al., 2013).

A systematic review with critical synthesis of literature on the PARiHS framework resulted in 13 published empirical works using the framework, including case reports, qualitative, quantitative, and mixed methods studies (Helfrich et al., 2010). Of the 13 studies, five used the PARiHS framework either conceptually or to guide the study methodology. Two studies were quantitative surveys exploring predictors of utilization of research evidence among nurses (Cummings et al., 2007; Estabrooks et al., 2007); one was a case report exploring the influence of context and facilitation on successful implementation of evidence into practice (Ellis, Howard, Larson, & Robertson, 2005); one a qualitative study exploring the perceptions and experiences of change teams and staff regarding implementation of neonatal guidelines into practice (Wallin et al., 2005); and a mixed methods study evaluating knowledge transfer strategies at hospital and unit levels (Conklin & Stolee, 2008).

Since Helfrich and colleagues' (2010) review, numerous clinical studies using the PARIHS framework have been published. Rycroft-Malone and colleagues (2013) used the framework to prospectively guide decisions about design, data collection, and analysis process in an intervention to reduce peri-operative fasting times in 19 hospitals in across England, Wales, Scotland, and Northern Ireland. Additionally, the framework has been used to guide development, implementation and evaluation of an algorithm designed to provide decision-making support on pain treatment among orthopaedic patients (Botti et al., 2014); and to evaluate implementation on an evidence-based intervention to reduce the impact of delirium among hospitalized, elderly orthopaedic patients (Powrie, Danly, Corbert, Purath, & Dupler, 2014). The framework has been used in studies to guide development and organization of educational programs aimed at promoting integration of empirical evidence into clinical decision-making among HCPs (Tilson & Mickan, 2014); and to explain attitudes of patients, clinicians and administrators towards structure and mode of delivery of interventions (Hagedorn et al., 2014).

In neonatal pain research, the PARIHS framework has been used in studies exploring how organizational context at the unit level affects pain practices in the NICU (Stevens et al., 2011). The framework has also been used to guide implementation and evaluation of interventions to improve pain assessment (Obrecht, Van Hulle, & Ryan, 2014) and pain treatment practices and pain outcomes (Stevens et al., 2013) in neonatal and paediatric units.

Although the framework reflects the complexities involved in implementing evidence into practice (Rycroft-Malone et al., 2004) and can be used by both researchers and knowledge users as a practical and pragmatic tool to guide project activities, a number of challenges to its utility have been noted (Helfrich et al., 2011; Kitson et al., 2008; Ullrich, Sahay, & Stetler, 2014). The major challenge to using the framework has been the lack of clarity on how the elements



(evidence, context, and facilitation) and sub-elements interact with each other at different organizational levels; and the relative weighting of the elements and sub-elements in influencing translation of evidence into practice (Kitson et al., 2008; Ullrich, Sahay, & Stetler, 2014). There remains pertinent concern about whether the PARiHS framework can be used to accurately predict and/or explain barriers to implementation and whether it can be applied at the individual, unit, and organizational levels of the implementation process (Kitson et al., 2008; Ullrich, Sahay, & Stetler, 2014).

### **Application of the PARiHS Framework**

In line with the interpretive approaches upon which the PARiHS framework is anchored (Kitson et al., 2008; Weaver & Olson, 2006), the aim of this study was to determine the nature and frequency of procedures and use of interventions; and to explore the acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain treatment in a specific context (i.e. neonatal units in Kenya) from the perspectives of HCPs, administrators and parents. The interplay and interdependence of the elements of PARiHS framework, and how they were integrated into the study, are described below (*see Figure 1*).

**Evidence.** Research evidence and local data, both quantitative and qualitative, were generated and used in this study. A comprehensive review of research evidence on effectiveness and safety of behavioural sweet-tasting solution interventions and factors that influence the nature and frequency of use of the interventions for procedural pain treatment was conducted. Local data from review of medical records and observational surveys was used to determine: (a) the nature and frequency of painful procedures and use of behavioural and sweet-tasting solution interventions and factors that influence nature and frequency of procedures and use of interventions for pain treatment in neonatal units in Kenya. Perceptions of HCPs, administrators

and mothers regarding acceptability and feasibility of behavioural and sweet-tasting solution interventions and the factors influencing the acceptability and feasibility of the interventions constituted local evidence from a qualitative paradigm.

**Context.** In this study, context denotes the neonatal units where neonates are admitted and where behavioural and sweet-tasting solution pain treatment interventions are expected to be used. Additionally, context refers to the circumstances (i.e., neonate- and situation-specific conditions) under which the interventions are used for procedural pain treatment. The study was conducted in 2 neonatal units purposively selected to provide different levels of neonatal care (i.e. Level I and Level II). Acceptability and feasibility of behavioural and sweet-tasting solution interventions were explored at the contextual level of the unit and the neonate. Interprofessional collaboration is a critical contextual factor when changing neonatal pain treatment practices (Stevens et al., 2013). Therefore, views of different categories of HCPs were explored to determine acceptability and feasibility of interventions. Administrators were interviewed to determine the receptiveness of the unit and hospitals' leadership towards implementation of pain treatment interventions in neonatal units in Kenya.

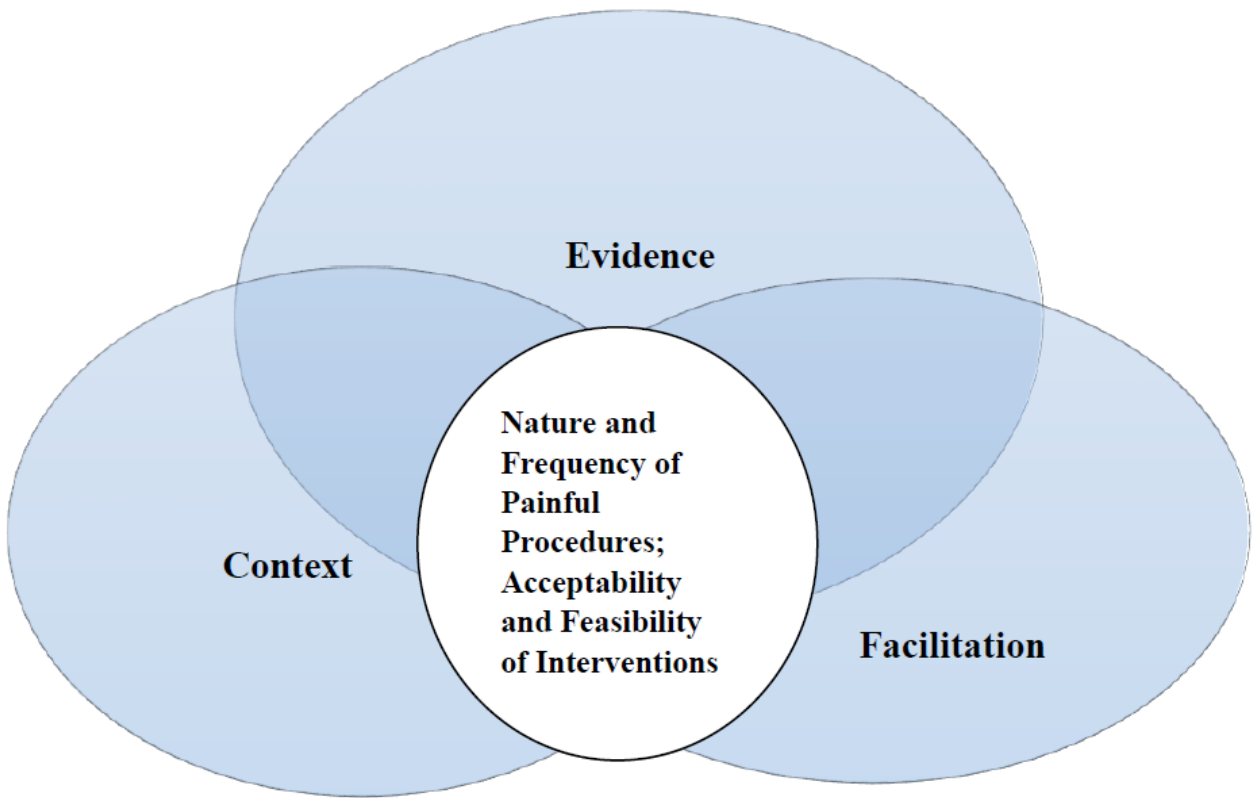
**Facilitation.** Conducting facilitation activities was beyond the scope of this study. It is, however, probable that conducting the study, and particularly the use of photographs of interventions during interviews, may have acted as a form of passive facilitation (Harvey et al., 2002) among participants. The impact of this form of facilitation, if any, was not evaluated. Nonetheless, it is anticipated that results will inform development of strategies to facilitate implementation of the acceptable and feasible behavioural and sweet-tasting solution interventions for procedural pain treatment in neonatal units in Kenya.

## **Summary**

Changing clinical practice is a complex and painstaking process that requires coherent and sensible integration of robust evidence at the local context (Rycroft-Malone et al., 2004).

Implementation of safe, effective and low-cost behavioural and sweet-tasting interventions for procedural pain treatment in a resource-limited setting is no exception. Guided by the PARIHS framework (Kitson et al., 2008; Stetler et al., 2011), review of medical records and observational data provided local evidence on the nature and frequency of, and contextual factors that influence use of interventions for procedural pain treatment in neonatal units in Kenya.

Additional local evidence on acceptability and feasibility of behavioural and sweet-tasting solution interventions were generated through interviews with stakeholders involved in neonatal care, including front line staff, administrators and mothers.



*Figure 1.* Conceptual framework for the study (Adapted from: Kitson et al., 2008; Kitson et al., 1998)

## **CHAPTER FOUR**

### **Methods**

A sequential mixed methods study consisting of three phases (Creswell & Plano Clark, 2011) was conducted. In this chapter, the research methods and ethical considerations for each phase will be described.

### **Research Questions**

#### **Phase 1**

In two neonatal units in Kenya:

1. What is the nature and frequency of painful procedures?
2. What is the nature and frequency of use of behavioural (i.e., KC, FT, swaddling, NNS, breast feeding and breast milk) and sweet-tasting solution interventions for procedural pain treatment?
3. What are the neonatal, situational and organizational factors that influence the use of behavioural and sweet-tasting solution interventions for procedural pain treatment?
  - i) Neonatal factors: GA, severity of illness, days of life
  - ii) Situational factors: place of birth (inborn or outborn), socio-economic status, time of day, presence of parent(s), number and invasiveness of procedures
  - iii) Organizational factor: level of care (Level I and Level II)

## **Phase 2**

In two neonatal units in Kenya:

1. Is there consistency between documented and observed practices regarding (a) nature and frequency of painful procedures and (b) use of behavioural and sweet-tasting solution interventions for pain treatment?
2. What are the neonatal, situational and organizational factors that influence the use of behavioural and sweet-tasting solution interventions for procedural pain treatment?

## **Phase 3**

In two neonatal units in Kenya:

From the perspectives of health care professionals (HCPs), administrators and mothers:

1. What is the acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain treatment?
2. What are the factors that influence the acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain treatment?

## **Phase 1**

### **Study Design**

A quantitative descriptive study was conducted in two neonatal units in Kenya. Medical records of neonates were reviewed, over the first seven days of hospitalization to document all painful procedures and pain treatment interventions accompanying every painful procedure.

## Setting

The study was carried out in (a) a university affiliated Level II and (b) a regional Level I neonatal unit in Kenya (American Academy of Pediatrics [AAP], 2012). Level I neonatal units in Kenya admit neonates more than 32 weeks' GA at birth and less critically ill neonates; they only have the capacity to provide oxygen therapy via nasal cannula. Level II units admit less gestationally mature (> 26 weeks GA) and sicker neonates, and provide oxygen nasal cannula as well as continuous positive airway pressure (CPAP). The study sites were purposively selected to explore the nature and frequency of use of behavioural and sweet-tasting solution interventions from two different clinical contexts, and to investigate the influence of organizational contextual factors on use of pain treatment interventions (Rycroft-Malone, 2004). The study units admit both inborn and outborn neonates. The Level II neonatal unit has a bed capacity of 70 and is staffed with 41 HCPs while the Level I neonatal unit has a total of 45 beds and is staffed with 14 HCPs (*Table 1*).

Table 1

### *Bed Capacity and Staffing in Study Sites<sup>a</sup>*

Study Site	Bed Capacity	Number of HCPs <sup>b</sup>
Level II	70	28 Nurses 15 Doctors <sup>c</sup> 2 COs <sup>d</sup> 1 Nutritionist
Level I	45	8 Nurses 5 Doctors 1 CO

<sup>a</sup> Statistics as at October 2015. <sup>b</sup> HCP – Health Care Professionals. <sup>c</sup> Include physicians, residents, and interns. <sup>d</sup> COs – Clinical Officers (also called physician assistants)

## **Study Sample and Inclusion/Exclusion Criteria**

**Inclusion criteria.** Term and preterm neonates who were admitted in the two study units within the first day of life were included in the study.

**Exclusion criteria.** Neonates born with medical conditions known to be incompatible with life (e.g. anencephaly, acardia) and terminally ill neonates that were not expected to survive beyond the immediate postnatal period – the first 24 hours after birth (World Health Organization, 2010) – were excluded from the study.

## **Sample Size**

Since this was an exploratory study intended to generate rather than to test hypotheses, sample size was not calculated based on predetermined power. Instead, the number of neonates to be recruited was dependent on the number of predictors (10) that were to be included in the regression model. With limited published evidence on which factors may influence use of behavioural and sweet-tasting solution interventions, the factors that had been shown to influence analgesic use in neonates during painful procedures (Carbajal et al., 2008; Guedj et al., 2014; Johnston et al., 2011) were included in the model. Three neonatal factors, including (a) days of life, (b) GA at birth, and (c) severity of illness; six situational factors, including (a) place of birth, (b) time of day, (c) presence of parent(s), (d) number of procedures, (e) invasiveness of procedures and (f) socio-economic status; and one organizational factor, level of care of care, were included. The rule of thumb was used to calculate the number of neonates for the study (Bartlett, Kotrlik & Higgins, 2001). Using an observation to predictor ratio of 1 to 10, 100 neonates were required. However, to account for dummy coding of categorical predictors (e.g., socio-economic status, invasiveness of procedures) and an attrition rate of 10% (Bennet et al., 2001), a total of 200 neonates (100 neonates from each neonatal unit) were recruited.



## Study Measures

A checklist used in previous prospective studies to document painful procedures and pain treatment practices in NICUs (Carbajal et al., 2008; Johnston et al., 2011) was used to conduct chart audits in the units. The original checklist was slightly modified to reflect the typical type of painful procedures in Kenyan neonatal units (Kyololo et al., 2014). The final checklist (*Appendix G*) consisted of sections on demographic characteristics, including time and place of birth, day of hospitalization, GA at birth, and highest educational level attained by the mother (i.e., primary, secondary and tertiary as per local educational system) as a univariate proxy measure of socioeconomic status (Oakes & Rossi, 2003).

Severity of illness was measured using the Clinical Risk Index for Babies II (CRIB II) score (Parry et al., 2003; *Appendix H*) which is an updated version of the original CRIB score (The International Neonatal Network, 1993). To minimize treatment bias, the severity of illness is estimated using data collected immediately after birth (Parry et al., 2003). The severity of illness is estimated using six neonatal characteristics namely; (a) sex, (b) birthweight (in grams), (c) GA at birth (weeks) calculated using first day of the last menstrual period as reported by the mother (Opara, 2009), (d) temperature at admission (°c) and (e) maximum base excess during the first 12 hours of admission (Dorling, Field, & Manktelow, 2005; Gagliardi et al., 2004; Parry et al., 2003).

Base excess, derived from blood monitoring, measures the amount of acid required to normalize serum Power of Hydrogen (PH) (Verma & Roach, 2010). Blood gas analysis was not routinely ordered in any of the study units. Similarly, due to resource constraints to the researcher and the hospitals, it was not feasible to request blood gas analysis for the study. Similar to other researchers (Gagliardi et al., 2004), we made an *apriori* assumption that

neonates had the worst possible base excess on admission ( $Be < -26$ , score = 7) (Parry et al., 2003).

Additionally, the audit tool included sections on the nature of painful procedures performed, time of the day when the procedure was performed and invasiveness of the procedure. Procedure invasiveness was determined using a widely used schema (Porter et al., 1999; Stevens et al., 2010) that categorizes procedures as mild, moderate or highly invasive. The checklist allowed for recording of the category of HCP who performed the procedure, number of attempts made to complete each procedure, if parents were present, and any pain treatment interventions accompanying the procedures. The checklist had previously been used for retrospective chart audits in the neonatal units in Kenya and had face and content validity (Kyololo et al., 2014). During the previous study in Kenya, the instructions on how to complete the checklist were found to be clear and concise, the checklist was easy to complete and the procedure nomenclature was typical of the type performed in Kenyan settings. Given these feasibility results, the checklist was not pilot-tested prior to being used in this study. A summary of the study outcomes is presented in Table 2.

### **Training of a Research Assistant**

To ensure consistency in data collection the researcher identified and trained a research assistant (RA), prior to commencement of the study, to assist with data collection in the Level I unit. The RA was a baccalaureate prepared RN intern working in the paediatric unit of the hospital. Through oral presentations and one-on-one bedside training, the researcher demonstrated to the RA how to conduct comprehensive chart audits and how to document the information on the study checklist. During the training sessions, specific emphasis was put on how to (a) cross-audit records – e.g. medical orders, nursing notes and treatment records, and (b)

use codes for the painful procedures and interventions as per the checklist (*Appendix G*). The significance of recording all painful procedures and the accompanying interventions was also emphasized.

As part of the training, the researcher and the RA independently audited medical records of two neonates who met the study criteria. Thereafter, the two completed checklists were compared. Generally, documentation was consistent for both the researcher and the RA except on two aspects, namely (a) number and type of procedures and (b) timing of the procedure. Regarding number and procedure type, the RA had not captured IM injections which had been performed during administration of medications that had been ordered to be given intravenously. To avoid missing these IM injections, and since nurses' progress notes would always indicate the route used for all medications, it was agreed that when in doubt about how the medication was administered, the RA would document what was recorded in nurses' notes.

There were also inconsistencies in the recording of the time when IM vitamin K and intravenous cannulation procedures were performed on admission, between the researcher and the RA. The inconsistency arose from the procedures being indicated to have been performed at different times in the admission notes (*a form completed immediately the neonate arrives in the unit*) and the nurses' progress notes. To address the inconsistency, considering that the admission notes are documented at the bedside when the procedures are performed, it was logical that the time reflected in the admission notes would be taken as more accurate of the two.

Table 2

*Study Outcomes and Measures*

Study Outcomes	Definition	Measurement	Instrument	Psychometric Properties
Nature and frequency of procedures	Medical, nursing, diagnostic and care-related procedures performed on a neonate each day and over the hospitalisation period.	(a) Review of medical records to manually count documented procedures and number of attempts for each procedure, over the previous 24 hours. (Phase 1) (b) Real time observation of HCPs <sup>b</sup> during procedures (Phase 2)	(a) The EIPPAIN <sup>a</sup> chart audit tool (Carbajal et al., 2008). (b) Bedside observational checklist (Stevens et al., 2010)	- Audit tool pilot-tested in study sites prior to the study (Kyololo et al., 2014). - Observational checklist developed by neonatal pain experts and previously used in similar observational studies (Stevens et al., 2010)
Nature and frequency of interventions	Pain treatment strategies accompanying procedures, and how often strategies were used.	Same as for nature of procedures	Same as for nature of procedures	As described for nature of procedures
GA at birth	Length of pregnancy from the first day of the woman's last menstrual cycle to the date of delivery	Calculated at admission and reported in weeks.	Review of nursing and medical records of neonates.	
Severity of illness	Degree of illness and risk for mortality in neonates within one hour of admission (Zahraa et al., 2015).	Plotting GA <sup>c</sup> (wks) and birthweight (grams) against gender, body temperature at admission, and worst base excess for a score of 0 to 27. 0-5 (Mildly ill) 6-10 (Mild to moderate)	CRIB II <sup>d</sup> score (Parry et al., 2003)	AUC <sup>e</sup> of 0.89 - 0.92 for term and preterm neonates (Gagliardi et al., 2004; Parry et al., 2003; Rastogi, Sreenivas & Kumar, 2010).

Day of hospitalisation	The length of time spend in the hospital to the nearest 24-hours	11-15 (Moderate to severe) > 15 (Severe) Counting 24 hours from the recorded time of admission.	(a) The EIPPAIN chart audit tool (Carbajal et al., 2008). (b) Bedside observational checklist (Stevens et al., 2010) As for day of hospitalisation	As previously described
Place of birth	Description of where the neonate was born – in the study hospital or elsewhere	Review of neonates' medical records on which place of birth is documented.	As for day of hospitalisation	As previously described
Time of day	Denotes whether the procedure was performed at daytime or night time.	Exact hour and minute when each procedure was performed. Procedures performed between 7 a.m. and 6.59 p.m. were categorized as daytime procedures and the rest night time procedures.	As for day of hospitalisation	As previously described
Invasiveness of procedures	Extent to which a procedure penetrates or causes tissue damage. Described in terms of mild, moderate or severe.	Mildly invasive: - Involving a break in the skin surface (e.g., removal of adhesives, wound dressing, NGT insertions, nasal cannulation, suctioning). Moderately invasive: - involving a break in the skin integrity but with no tissue damage beyond the epidermis (e.g., venous puncture, heel sticks, iv cannulation). Severely invasive: -	Procedure invasiveness categorization schema (Porter et al., 1999; Stevens et al., 2010)	Categorization schema was developed and used by scientists with extensive experience in neonatal pain research (Porter et al., 1999; Stevens et al., 2010)

Presence of parent(s)	Denotes whether a mother or father was by the bedside when a procedure was performed	involving the dermis and muscles with a possibility of damage to nerves and blood vessels (e.g., lumbar puncture, IM injection). Documentation that a parents was present, or a description in nursing notes implying a strong possibility that the parents was present during the procedure (e.g. <i>mother held the baby as the wound was cleaned and dressed</i> )	(a) The EPIPAIN chart audit tool (Carbajal et al., 2008). (b) Bedside observational checklist (Stevens et al., 2010)	As previously described
Level of care	Description of complexity of neonatal care for which neonates were hospitalized in.	Classified as either Level I (newborn nursery) or Level II (special care nursery) according to the American Academy of Pediatrics' criteria (APA, 2012)	(a) The EPIPAIN chart audit tool (Carbajal et al., 2008). (b) Bedside observational checklist (Stevens et al., 2010)	As previously described

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<sup>a</sup>EPIPAIN – Epidemiology of Procedural Pain in Neonates. <sup>b</sup>HCPs – Health Care Professionals. <sup>c</sup>GA - Gestational Age. <sup>d</sup>Clinical Risk Index for Babies II. <sup>e</sup>Area Under the Curve.

## Data Collection Procedures

Ethics approval was sought and granted by research ethics boards (REBs) of The Hospital for Sick Children and University of Toronto in Canada, the Moi Teaching and Referral Hospital and Moi University and the Jaramogi Oginga Odinga Teaching and Referral Hospital in Kenya. Permission to collect data was then sought from the hospitals' chief executive officers. Letters of invitation to participate in the study, detailing the purpose and significance of the study, were sent to the chief executives of the two hospitals (*Appendix I*). Upon receipt of administrative permission, the unit manager was approached as the first point of contact between the researcher and HCPs. The researcher explained to the unit managers about the purpose, procedures and potential significance of the study. Subsequently, the managers introduced the study to the staff working in the neonatal units using a standardized study information leaflet (*Appendix J*). This process of gaining entry had previously been tested in a nationwide pilot study in neonatal units in Kenya in 2012 and was found to be efficient (Kyololo et al., 2014). Following introduction of the study by the unit managers, at pre-arranged days and times, the researcher met with HCPs and provided them with more information about the study. At least two oral presentations about the study were made in each unit, during nursing meetings and change-of-shift report times, over a one week period.

The researcher collected data in the Level II unit while the research assistant (RA) collected data in Level I unit. Medical records of neonates admitted in the units were reviewed on a daily basis to document all painful procedures and interventions used prior to, during or immediately following each painful procedure. The review of medical charts started on the neonates' second day of admission (to capture data for first day of admission); and continued until the eighth day of the neonates' admission to the neonatal unit (for the seventh day of

admission). For neonates discharged before the seventh day, chart audits occurred up to the last day of hospitalisation. To ensure consistency in data collection, the researcher trained the RA on how to conduct a comprehensive chart audit as well as how to document the procedures and interventions on the audit checklist (*training process described above*).

For each procedure, information was collected on; (a) the type of procedure, (b) time of the day performed, (c) category of professional performing it (e.g., physician, CO, RN), (d) number of attempts made to complete and (e) pain treatment interventions used. A new checklist was completed for each neonate for each day of hospitalization. To ensure accuracy and completeness of data extraction, medical and nursing records were cross-audited. For instance, if medical records indicated a painful procedure (e.g., IV cannulation) was required, nurses' progress notes were audited to determine whether the procedure had been performed while treatment charts were checked to determine if any form of pain relief had been given around the time the procedure was performed.

**Reliability of data collection.** The researcher reviewed medical charts of every neonate in Level II, for each day, at least twice to ensure that all painful procedures, their timing and any interventions accompanying the procedures were captured. To maintain inter-rater reliability (Hallgren, 2012) in Level I where the RA collected the data, the researcher visited the study site fortnightly, 4-6 hours each day, in the course of the 2 months data collection period. During each visit, the researcher randomly selected five completed checklists from the previous day and reviewed the medical charts of the corresponding neonates to establish accuracy and completeness of recording.

Through the cross-audit process, few (6 out 666, 0.9%) inconsistencies were noted: two venepunctures were missing and four incorrectly timed procedures (2 each for intravenous



cannulation and NGT insertion). The two missed venepunctures were for monitoring of bilirubin levels. These venepunctures had not been documented, either in the physicians' notes or in the nurses' progress notes, when the RA was doing the chart audit the day before. The researcher was, however, able to capture them from laboratory results (paper-based laboratory request and reporting is used in Kenya) which had been included in the medical charts in the morning of the researcher's audit. The identified inconsistencies were discussed with the RA and corrected.

### **Data Management**

To uphold the principles of confidentiality and anonymity, and to guarantee privacy of study participants, each checklist was assigned a three-part unique code representing the unit, phase of the study, and participant number for the neonate from the unit. For example, a complete code for the fifth neonate in the Level I unit for phase 1 of the study was 01-01-005. The code numbers were stored on a master file in a secure cabinet, observing the double-lock policy, in the researcher's office, separate from the completed checklists. Only the principal investigator had access to the keys to the separate lockable cabinets where the codes, and completed checklists were stored; only members of the PhD supervisory committee were allowed access to the data.

Data from the checklists were coded and entered into a Research Electronic Data Capture (REDCap – The Harvard Clinical and Translational Science Centre) database that was created specifically for this phase of the study. Categorical variables such as presence of parents, invasiveness of procedures, type of procedures and interventions were coded sequentially (e.g. for invasiveness of procedures the data were coded as mild = 1, moderate = 2, severe = 3). Continuous variables such as birth weight, day of life, and number of painful procedures were entered as discrete values. The REDCap database allowed for secure transfer of the data to The

Hospital for Sick Children for analysis. All completed checklists were transported to and stored in a secure office in a public university in Kenya where they will remain for the period required by individual hospital's "Records Retention and Destruction" policy (e.g. the Hospital for Sick Children's 7 year policy) and destroyed in accordance with the same policy (The Hospital for Sick Children, 2009). No completed checklists were transported out of Kenya.

Errors may occur during data entry into a database. Since these errors can affect the quality of data resulting in erroneous conclusions, they must be minimized, detected and corrected (Barchard & Pace, 2011). Completed checklists were visually checked for completeness and accuracy immediately after completion of data collection. To further minimize data entry errors, a double-entry process was used. Data were entered twice into the REDCap database followed by a comparison of the two entries. Any mismatches between the two entries were corrected using the completed checklists as a reference for the correct value (Barchard & Pace, 2011). Additionally, a field validation was created in the REDCap database for all data entry fields. The field validation ensured that entry of erroneous values (for either continuous or categorical data) was automatically detected and corrected. For instance, validation values for birth weight were set at 500-5000 grams. Any data values outside of this validation range were rejected and the researcher was automatically prompted to check the accuracy of the value.

**Missing data.** Missing data may occur as a result of incomplete documentation of painful procedures and use of pain treatment interventions, partial completion of sections of the checklist, or discharge of a neonate before the seventh day of hospitalisation (Schlomer, Bauman, & Card, 2010). In the database, all items with a missing response were coded and given a unique value (e.g. 999). Although a 10% rate of missing data per checklist is usually the cut-off for exclusion into analysis (Bennet, 2001), due to the exploratory nature of the study and the

relatively long length of neonatal admissions in Kenya (range 4-25 days) (Simiyu, 2003), the cut off rate was set at 20%. Neonates with missing data were included in the analysis and managed through pairwise deletion in descriptive analysis (Schlomer, Bauman & Card, 2010) and imputation in logistic regression analysis (Polit, 2010).

## **Data Analysis**

Descriptive statistics were computed for the demographic characteristics of the study sample. Independent samples t-test (for normally distributed data) and Mann-Whitney U test (for non-normally distributed data) were used to compare demographic characteristics between neonatal units. Means and their 95% confidence intervals (95% CIs), standard deviations (SDs), medians and interquartile ranges (IQR) were computed to describe the nature and frequency of painful procedures and use of behavioural and sweet-tasting solution interventions.

Chi-square, Mann-Whitney U test, and independent sample t-tests were used to compare the frequency of painful procedures by neonatal, situational, and organizational factors. One-way analysis of variance (ANOVA) with post-hoc analysis (least significant difference test) was used to compare the nature and frequency of painful procedures for multiple-level interval variables (i.e., day of hospitalisation, severity of illness).

Multiple regression analysis was used to explore the influence of factors on frequency of painful procedures. Beta coefficients with corresponding standard errors and relative risk with 95% CIs for each of the factors were computed. For all statistical analyses (a) population average models (Generalized Estimating Equations – GEE) were used to adjust for the lack of independence across observations (i.e. clustering of neonates within and across sites) (Hubbard et al., 2010) and (b) a significance value  $< .05$  was specified as statistically significant.

## **Ethical Considerations**

Since this was a prospective study with no changes in care practices, parental consent was not required; and waiver for written consent was sought from the local REBs. This ethical process had previously been used in a nationwide survey in neonatal units in Kenya and found to be acceptable (Kyololo et al., 2014).

To guarantee privacy, confidentiality and anonymity of neonates the data collection process was guided by the local policies and procedures governing handling of confidential patient information. Each checklist was allocated a unique code (*described above*). No identifiable information about the neonate or his/her family was collected and the data from the two study sites were aggregated into one data set making it impossible to link any data with a particular neonate, HCP or neonatal unit. The data were stored in a secure encrypted electronic database (REDCap) and transferred electronically to The Hospital for Sick Children for analysis.

## **Timelines**

The average daily admissions in Level I and Level II units are three and two neonates respectively (personal communication with unit managers). Assuming a modest admission rate of two neonates per day in each unit, 50 days were initially estimated to be sufficient time to recruit 100 neonates in each unit. However, initiation of data collection was staggered between the units. Data collection began in the Level II unit followed by the Level I unit approximately two weeks later. Due to the variability in length of admission (Simiyu, 2003), and due to the staggered data collection, data collection lasted 2 months in each unit (*Table 3*).

## **Significance of Phase 1**

Determining the nature and frequency of procedures and use of behavioural and sweet-tasting solution interventions; and exploring the influence of neonatal, situational and

organizational factors is a critical first step in developing approaches to facilitate routine use of interventions for procedural pain relief. Local data generated in Phase 1 provides evidence to benchmark and evaluate progress towards implementation of behavioural and sweet-tasting solution interventions for pain treatment, and overall improvement in neonatal pain treatment practices, in neonatal units in Kenya.

## **Phase 2**

### **Study Design**

A prospective observational design was used to establish the consistency between documented and actual practices regarding nature of procedures and use of behavioural and sweet-tasting solution interventions for procedural pain treatment in the two neonatal units in Kenya. The prospective design allowed for real time observation of use of the pain treatment interventions which are often poorly documented in medical records (Stevens et al., 2010).

### **Setting**

Phase 2 was conducted in the same two neonatal units where Phase 1 was conducted.

### **Study Sample and Inclusion/ Exclusion Criteria**

**Neonates.** The inclusion/ exclusion criteria were the same as for Phase 1.

**Health care professionals.** Three categories of HCPs; physicians, RNs and COs, who perform painful procedures in neonatal units in Kenya, were eligible to participate in the study. All licenced HCPs in the neonatal units were eligible for inclusion in the study.

**Exclusion criteria.** Trainees were excluded from the study.

## **Sample Size and Sampling Procedure**

**Neonates.** Convenience sampling was used to recruit neonates (Burns & Grove, 2005). The sampling technique allowed for observation of many neonates undergoing a variety of painful procedures associated with different levels of invasiveness (i.e., mild, moderate, and high) (Porter et al., 1999; Stevens et al., 2010) at different times of the day. Since the purpose of Phase 2 was to determine the consistency between the nature and frequency of documented and actual practices regarding use of behavioural and sweet-tasting solution interventions, all neonates undergoing painful procedures in the two neonatal units were observed more than once for 100 single painful events from each unit for a total of 200 observations for Phase 2 of the study.

**Health care professionals.** A purposive sampling technique was used to recruit HCPs. The aim was to observe a large variety of professional groups of HCPs, at different times of the day, on different days, performing different types of painful procedures. A minimum of 200 HCP-neonate observations were required to make reasonable comparisons with number of neonates recruited in Phase 1. Due to the small number of HCPs in the two neonatal units (*Table 1*), the sample constituted HCP-observations rather than individual HCPs. HCP-neonate dyads were observed multiple times up to a maximum of three observations. Multiple observation was based on the assumption that, the characteristics of the neonate (e.g., GA at birth, illness severity, day of life) and conditions during the procedure (e.g., presence of parent, invasiveness of procedures and time of the day) would vary with each HCP-neonate dyad and during each observation.

## Study Measures

A validated bedside observational checklist, used in previous research in North America (Stevens et al., 2010), was used to conduct real-time observations of procedures and pain treatment practices (*Appendix K*). The checklist consisted of a section to record the neonate's demographic characteristics (*previously described*) and situational contextual factors. The list of painful procedures, procedure invasiveness schema (*previously described*) and behavioural and sweet-tasting solution interventions contained in the audit tool for Phase 1 were also included in the checklist. See Table 2 for a summary of study outcomes and measures.

## Data Collection Procedures

Mothers of neonates who met the inclusion criteria were approached by a social worker in the hospital, who was not directly involved in the care of the neonates. Using a study information leaflet (*Appendix L*), the social worker explained to mothers the study purpose and the observational procedures. Initially, the social worker approached all mothers of eligible neonates who were in the unit at the beginning of the study and, subsequently, mothers of newly admitted neonates. The process of gaining entry for Phase 1 was used to contact HCPs for Phase 2. Concerns and questions regarding the study procedures were addressed. Information sessions continued for 1-2 weeks to ensure as many HCPs as possible, including those who were on night-shifts and weekends, were reached. It was emphasized to mothers and HCPs that their participation was voluntary and that they could decline participation (opt-out) at any time.

Over a two-week period in each study unit, the researcher observed, in real time, HCPs performing painful procedures on neonates. Observations were conducted in a non-intrusive, non-threatening and non-judgemental manner that did not disrupt clinical care. As many HCP-neonate dyads as possible were observed to capture diverse pain treatment practices on different

neonates in a variety of clinical situations. The data collection time transcended day and night shifts, with observations concentrated when routine painful procedures were likely to, or were known to occur. The observations were conducted during four time periods; 9 a.m. to 12 noon, 2-4 p.m., 7 p.m. to midnight, and 5-7:30 a.m.

Data collection started in the Level II neonatal unit. Using the bedside observation checklist (*Appendix K*), the researcher recorded the type of painful procedure and any interventions that occurred prior to, during or immediately following each procedure. The specific type of behavioural (i.e., KC, containment, NNS, breastfeeding/breast milk), sweet-tasting solution (i.e., oral sucrose or glucose), and other interventions; and the condition in which the intervention was used were recorded. Any unique events or situations related to the painful procedure or the HCPs' pain treatment practices (e.g., mother by the bedside but not involved, mother walking away when procedure was being performed) were also recorded. After the observation, medical records were reviewed to extract information on demographic characteristics of the neonate.

## **Data Management**

The data management process described for Phase 1 was also used in Phase 2. Data, entered in a ReDCap database created for Phase 2, were securely transferred to The Hospital for Sick Children for analysis as described in Phase 1.

## **Data Analysis**

The data analysis process used in Phase 1 was also used in Phase 2. Additionally, ecological comparative analysis with bonferroni correction was used to compare documented and observed (a) nature and proportion of procedures and (b) proportion of painful procedures performed with behavioural and sweet-tasting solution interventions.



## **Ethical Considerations**

Measures taken to uphold privacy, confidentiality and anonymity of participants during Phase 1 were also used in Phase 2. The voluntary nature of participation in the study; and the fact that HCPs would be included in the study unless one specifically declined to be observed (opt-out) were emphasized. (*Appendix L*). All observations were conducted in a non-intrusive, non-threatening, and non-judgemental manner and no attempt was made to link data from a particular neonate to a specific HCP.

## **Timelines**

Phase 2 commenced one month following completion of Phase 1 to allow for wash out. Observations were conducted in each unit over an intense two-week period starting with the Level II unit (*Table 3*).

## **Significance of Phase 2**

Real time observation of painful procedures and pain treatment practices is critical in understanding the actual practices regarding use of pain treatment interventions; and a first step in appreciating the factors that hinder or promote use of interventions for procedural pain treatment in neonatal units in Kenya. Establishing the consistency between documented and observed practices is important in conclusively determining the nature and frequency of procedures and pain treatment practices in neonatal units in Kenya. Furthermore, the findings informed development of interview questions for Phase 3 of the study.

### **Phase 3**

#### **Study Design**

A qualitative exploratory study was undertaken. Semi-structured interviews were conducted with HCPs, administrators and mothers to address the research questions.

#### **Setting**

Phase 3 was carried out in the Level I and Level II neonatal units where Phase 1 and 2 were conducted. Neonatal care in the units is modelled within a family-centred approach that aims at achieving parental competence in neonatal care prior to discharge. To facilitate family-centred care, mothers with neonates in the units are accommodated in postnatal wards or in semi-private lodge rooms adjacent to the units for the entire hospitalization period. Mothers are encouraged and gradually facilitated to actively participate in the care of their neonate(s). The responsibility of daily care of the neonate is progressively transferred from nurses to the mother as the neonate's condition improves. In the two study units, parents (mostly mothers) are allowed unrestricted access to the hospitalized neonate.

#### **Sample and Inclusion/Exclusion Criteria**

**Health care professionals.** The HCP categories included in Phase 2 (physicians, RNs and COs); and nutritionists who promote and support breastfeeding among mothers in neonatal units (Lessen & Kavanagh, 2015) were included in the study. HCPs who (a) had worked in the units as full-time employee for at least 6 months or as part-time employees for at least one year, and (b) could speak English or *Swahili* (the two national languages in Kenya) were included in the study. Trainees and HCPs on short orientation or secondment were not interviewed.

**Administrators.** Administrators performing managerial duties in the unit (head physician, nurse managers) and at the hospital level (director of nursing) on a full-time or part-time basis were eligible. Administrators serving in an acting capacity were not interviewed.

**Mothers.** Mothers of neonates admitted in the two neonatal units were eligible for individual interviews if they (a) were older than 18 years (legal age to give consent in Kenya), (b) had completed at least three postnatal days, (c) had a neonate eligible for discharge in the next 24 hours and (d) were able to speak either English or *Swahili*. Mothers of terminally ill neonates and those whose neonates were being discharged as a referral to another hospital for specialized treatment were not interviewed.

### **Sample Size and Sampling Procedure**

**Health care professionals.** Purposive sampling with maximum variation was used to select HCPs to be interviewed (Polkinghorne, 2005; Teddlie & Yu, 2007). The sampling technique enabled for recruitment based on (a) professional group, (b) years of experience in neonatal care, and (d) participation in Phase 2 of the study (i.e., those who participated and those who did not) (Teddlie & Yu, 2007). It was anticipated that interviewing this diverse sample would generate rich data to answer the research questions.

The number of HCPs interviewed was determined by the richness of data generated and the principle of data saturation (Curtis, Gesler, Smith, & Washburn, 2000; Francis et al., 2010; Sandelowski, 2000) in a heterogeneous sample of participants (Guest, Bunce, & Johnson, 2006; Morse, 2004). Interviews continued until no new meanings emerged from the data. In total, 13 interviews were conducted – 9 RNs, 3 physicians and 1 nutritionist.

**Administrators.** Because of the small number of administrators available (3 from each study unit), all who met the inclusion criteria and consented were interviewed. The two directors of nursing services, the two unit managers, and one head physician were interviewed.

**Mothers.** The same principle of purposive sampling with maximum variation adopted for sampling HCPs was used for mothers. Variability in the sample was based on (a) demographic characteristics (i.e., age, educational status, parity, socio-economic status) and (b) involvement in neonatal pain care. A total of 15 mothers were interviewed – seven in the Level I and eight in the Level II neonatal unit.

### **Data Collection Procedures**

Semi-structured individual interviews (DiCicco-Bloom & Crabtree, 2006) using photo elicitation technique (Harper, 2002; Hurworth, 2003) were conducted.

**Generation photographs.** Photo elicitation interviewing (also known as photo-interviewing) incorporates photographs into research interviews as a tool to expand on interview questions (Harper, 2002; Hurworth, 2003). The photographs were used to (a) facilitate communication between participants and the researcher, (b) give participants visual cues to reflect on during interviews and (c) make the interviews more detailed and friendlier by allowing participants to focus on the photographs rather than the researcher. Additionally, using photographs gave structure to the interview schedule and stimulated participants' memories of their experiences and perceptions regarding behavioural and sweet-tasting solution interventions (Clark-Ibáñez, 2004; Hurworth, 2003).

The source and content of photographs used in the interviews is critical to achieving the research objective (Clark-Ibáñez, 2004; Harper, 2002). Harper (2002) and others (Clark-Ibáñez, 2004; Epstein, Stevens, McKeever, & Baruchel, 2006) caution against the use of photos which

participants cannot relate to; observing that such images may not evoke deep reflections on participants (Harper, 2002). Researcher-generated (Clark-Ibáñez, 2004) coloured photographs of neonates engaged in various behavioural interventions in Kenya were incorporated into the interviews.

All the photographs were taken in the Level II neonatal unit. Prior to taking the photographs, a meeting was held between the researcher, legal officer and the head of public relations (PR) department of the hospital. In order to adhere to the hospital's policy and legal procedures, and to protect privacy of the mothers and neonates, the researcher was assigned a professional photographer, a member of the PR department to take the photographs. The head of the PR department organized a meeting between the researcher and the photographer to discuss (a) individual roles and responsibilities (e.g., the researcher was to consent mothers in advance), (b) type of photographs to be taken (e.g., digital photographs were to be taken) and (c) logistics (i.e., dates, time) of taking the photographs. Subsequently, over a 5-day period, over two weeks, the researcher worked with, and directed, the photographer in taking photographs of neonates on various behavioural interventions (i.e., KC, FT, swaddling, breastfeeding/breast milk, and NNS). To create "the unusual angle" (Harper, 2002, p. 20), the photographs were taken from short- and long-range and from different perspectives. In total 124 photographs were taken.

**Development of photo interview kit.** Of the 124 photographs taken, four photographs of each intervention (20 in total) were selected based on how clearly they depicted the intervention and the angle from which the photograph was taken. It was assumed that use of photographs depicting local mothers and neonates would bridge the gap in world views of participants and the researcher by anchoring the interviews on images that participants could relate with (Harper, 2002). Similarly, selection of photographs taken from different angles was intended to trigger

participants to explore and reflect on the images from diverse perspectives. Since commercially prepared oral sucrose is not available in Kenya (Murkis & Subramanian, 2011), a picture of a clearly labelled bottle of oral sucrose and a dropper (*images available online*) was downloaded and included among the set of photographs.

The photographs were laminated to make them waterproof and to allow for cleaning between interviews. The laminated photographs were assembled in a large hole-punch photo-binder that participants could easily remove and view during the interviews. The binder was partitioned to enable easy location of photographs of the interventions. Arranging the photographs in a sequential manner in the “photo interview kit” (Capello, 2005, p. 174) gave structure to the interview. The photos were organized as follows:

Set 1: A neonate in kangaroo care position (*Appendix M -1*)

Set 2: A neonate in a swaddled position (*Appendix M- 2*).

Set 3: A neonate held in a facilitated tucking position (*Appendix M -3*).

Set 4: A neonate on a pacifier (non-nutritive sucking) (*Appendix M-4*)

Set 5: A neonate on breastfeeding (*Appendix M -5*)

Set 6: Oral sucrose and a dropper (*Appendix M – 6*)

**Recruitment of HCPs.** Unit managers informed HCPs about Phase 3 of the study, using phase-specific information leaflet (*Appendix N*), during at least two change-of-shift reports. Subsequently, the researcher was invited to the next morning’s change-of-shift meeting to provide more detailed information about the Phase of the study, including procedures and rationale. Thereafter, the researcher approached eligible HCPs individually, provided them with further information about the study, and addressed their questions and concerns about the

interview process. None of the eligible HCPs who were approached individually declined to be interviewed.

Prior to the interview each participant was requested to (a) consent for the interview (*Appendix O*) and audio-recording of the interviews (*Appendices P*) and (b) complete a brief demographic questionnaire developed for Phase 3 (*Appendix Q*). Recruitment and interviewing of HCPs continued until data saturation was attained (Curtis, Gesler, Smith, & Washburn, 2000; Francis et al., 2010; Sandelowski, 2000); after which two more interviews were conducted for a total of 13 interviews.

All interviews were conducted on a day and time when the participants were on duty. The researcher reserved a quiet and private room within the hospital where the interviews were conducted. All except two interviews were conducted during daytime and each interview lasted 30-60 minutes. After the interview participants were provided with a small non-monetary honorarium (a meal coupon worth about \$5) as a token of appreciation.

**Recruitment of administrators.** The administrators were approached individually by the researcher who explained the study using a standardized study information leaflet (*Appendix N*). Five out of the six targeted administrators were interviewed; the head physician in one of the neonatal units had resigned by the time this phase of the study was conducted. Written consents for the interview and audio-recording were obtained prior to start of the interviews (*Appendices O & P*). All interviews were conducted by the researcher in the administrators' offices, or in another private room, at a time that was convenient. Each interview lasted 30-60 minutes.

**Recruitment of mothers.** Initial contact with mothers was made through a social worker not directly involved in neonatal care in the units at least 72 hours after delivery. It was hypothesized that by the third postnatal day the mother would have sufficiently recovered from

delivery-related fatigue to voluntarily consent to the study (Kennel & McGrath, 2005). Using a study information leaflet (*Appendix N*), the social worker explained the aim, rationale and procedures to the mothers. For mothers who showed interest, the researcher explained the study and obtained written consent for the interview (*Appendix R*) and audio-recording (*Appendix S*) and asked them to complete a brief demographic survey (*Appendix T*). Only two mothers declined to participate; one felt the study was not going to be of any benefit to her neonate and the other felt she needed to prepare for the discharge of her neonate. Interviews were conducted until data saturation was attained (Francis et al., 2010; Sandelowski, 2000).

Mothers with diverse demographic characteristics were recruited for interviews. The interviews were conducted shortly before the neonate's discharge. The timing of interview allowed mothers to reflect on their experiences of nursing a hospitalized neonate who was undergoing painful procedures. The interviews were conducted during daytime in a private room within the unit and lasted for a similar time like HCPs' and administrators'.

## **Interview Guides**

Three sets of interview guides, one for each category of participants, were used to conduct the interviews. The first section of each interview guide consisted of a set of core questions to explore participants' perceptions on pain treatment practices and expectations regarding pain treatment in the unit. Subsequent sections were structured to capture unique perspectives of each category of participants regarding acceptability and feasibility of behavioural and sweet-tasting solution interventions.

**Health care professionals.** The interview guide was developed by the researcher and reviewed by qualitative methods and content (neonatal pain) experts (*Appendix U*). The questions were structured to enable collection of rich information about acceptability and



feasibility of behavioural and sweet-tasting solution interventions, as well as factors thought to influence the acceptability and feasibility. The primary interview questions were interspersed with probes designed to clarify points and to further illuminate interviewees' perspectives. Since photo elicitation was an integral part of the interviews, questions were structured to draw the attention of the participant to the images (e.g. *"to what extent do you relate with what is happening in the picture in your daily practice?"*). These questions sequentially increased in complexity as more pictures were introduced, drawing the participant to higher level of reflection (e.g. *"what do you think could be done for staff to embrace and routinely use this intervention [referring to a photo or set of photos] on babies?"*).

Although the interview questions were objectively developed to address the research aims, the researcher holds ethical and professional views that may have affected the content and the manner in which the questions were posed. The researcher holds the view that (a) pain treatment is an individual human right that should be observed at all times, (b) procedural pain in neonates should be avoided or adequately treated, (c) neonatal pain should be a fundamental component of neonatal care and (d) HCPs should prioritized procedural pain treatment. Additionally, despite the focused nature and specificity of the interview questions, the fact that the interviewer (the researcher) was a HCP at a higher level of training may have put him in a position of authority over participants. This relative positionality might have compelled HCPs to provide "socially acceptable" responses that fit what they perceived to be professionally acceptable standards of practice (Diefenbach, 2009, p.881). By taking a reflexive stance, the researcher acknowledges the possibility that these issues may have (a) affected the formulations of the questions and (b) influenced how the interview questions were asked (Guillemin & Gillam, 2004). However, the researcher consistently took stock of these possibilities, critically

scrutinizing each completed interview and considered such assumptions when interpreting the data (Diefenbach, 2009; Guillemin & Gillam, 2004).

**Administrators.** Administrators were interviewed using a similar interview guide as HCPs with a view of gaining a managerial perspective and broader institutional view. The interview questions were structured to allow for a reflection on their roles and expectations as administrators (*Appendix V*). Although interviews with administrators were anticipated to be professional in nature, the possibility of them (administrators) sharing the official position of the hospital, by virtue of their managerial positions, rather than their own perspectives as local administrators cannot be overlooked (Diefenbach, 2009). The reflexive processes discussed for scrutinizing and interpreting HCPs' data were also applied for interviews with administrators.

**Mothers.** Mothers were interviewed using a similar interview guide as the HCPs' and administrators'. However, the questions were framed to allow elicitation of information through reflection on their experience and/or expectations with regard to pain and pain treatment for their neonates. The framing of the questions focused on their roles and perspectives as caregivers. An example of a question in their interview guide read "*Were you involved (or expecting to be) in calming your baby during procedures?*" The questions allowed mothers to reflect on their experiences and roles thus provoking more reflective, tangible and tacit perspectives about how neonates could be helped to cope with pain (*Appendix W*).

### **Pilot Study**

A pilot study was conducted prior to Phase 3 to evaluate clarity of the interview questions and the researcher's interviewing technique. The pilot study also allowed the researcher to evaluate whether the interview questions and the photos were likely to provoke participants' responses and to generate rich data (Epstein et al., 2006); to explore the length of the interview

and to determine whether the technique was feasible and acceptable to participants. The pilot study involved 2 HCPs (a nurse and a physician) and a mother who met the study inclusion criteria. Since no modifications to the interview guides were necessary, the pilot interviews constituted part of the main study results.

## **Data Management**

Audio-recorded interviews were transcribed verbatim by a trained transcriptionist who spoke the two national languages in Kenya, following each interview. The original language of interview was maintained during the transcription; English for HCPs and administrators and a mixture of English and *Kiswahili* for mothers. Both verbal and non-verbal components of the interviews such as prolonged pauses, silences and hesitations were captured during transcription. The researcher reviewed the transcribed interviews with the audio records and incorporated observations made during the interviews to the verbatim transcripts (e.g., a participant was tense or avoided certain aspects despite gentle probing).

Sections of transcripts that were in *Swahili* were translated into English prior to analysis. To (a) maximize on linguistic and content accuracy of the transcripts (Karwalajtys et al., 2010), (b) optimize on reliability of the data (Twinn, 1997) and (c) preserve meaning of terminologies across transcripts (Lopez et al., 2008) the researcher conducted all the translations. A forward-backward translation process (Al-Amer, Ramjan, Glew, Darwish, & Salamonson, 2015) was conducted. Sentences and phrases in *Swahili* were translated to English and back to *Swahili* in order to ensure a semantic congruence with the original transcripts was maintained (Karwalajtys et al., 2010). The retranslated *Swahili* version of transcripts were compared with the original ones for accuracy of terminology and phrases. Any correction made on the retranslated transcript were also captured in the English version that was used for analysis.

An electronic copy of the interview transcripts was stored in a password-protected and encrypted USB drive. The audio-tapes of the interviews were duplicated to avoid loss of data in case of accidental deletion of data files. A paper copy of the transcripts and the USB drive were stored in a double-locked cabinet in a secure office in a local public university (Moi University) where the researcher holds a faculty position. Electronic copies of the encrypted interview transcripts were moved by secure data transfer from study sites (in Kenya) to University of Toronto using REB approved methods previously described. All paper copies made from the transferred transcripts will be kept in a locked and secure office at the University of Toronto's Centre for the Study of Pain (UTCSP), where the researcher's supervisor is Director. Only the investigator and his thesis committee members had access to the raw data. The keys to the cabinet where the transcripts were stored were accessible to the researcher only.

## **Data Analysis**

Ritchie, Spencer and O'Connor's (2003) and Graneheim and Lundman's (2004) descriptive, inductive content analysis approach was employed. Overall, the process entailed: (a) immersion in the data for overall understanding, (b) developing a coding structure, (c) applying the coding structure to the whole set of data and (d) generating categories and sub-categories (Bradley, Curry, & Devers, 2007; Graneheim & Lundman, 2004; Pope, Ziebland, & Mays, 2000).

**Immersion in the data.** The researcher read the interview transcripts multiple times to get an overall impression; and to identify and index emergent ideas centering on particular phrases, incidents or participant experiences (Pope et al., 2000; Ritchie et al., 2003). Reading and rereading the interview transcripts provided the researcher with a sense of the meaning inherent in the data (Bradley et al., 2007).

**Developing a coding structure.** Codes are tags or labels (Bradley et al., 2007) that are assigned to segments of documents (e.g., paragraphs, sentences, or words) to help catalogue key concepts while preserving the extent in which these concepts occur. An inductive approach was used to develop a coding structure by which data were examined and referenced (Pope et al., 2000). Starting with one interview for each category of participants, the transcripts were reviewed line by line, assigning codes whenever new ideas became apparent in the data. Sub-codes were assigned to texts that carried a meaning more specific but related to an existing code (e.g., staffing as a sub-code under resources). To ascertain whether a text had been appropriately coded, the text was compared with the segment that had previously been assigned to the same code to see whether the two segments reflected the same idea. Additional codes and sub-codes were created whenever, reading through the transcripts, texts carrying unique meanings from any of the existing codes were found.

To refine the coding structure, additional transcripts for each category of participants were reviewed and coded into the existing codes and sub-codes, creating new codes when necessary, until no new codes emerged from reviewing successive sets of data (Bradley et al., 2007; Thorne, 2000). In total, nine transcripts (3 from each category of participants) were used in the development of the coding structure. The coding structure was discussed on four different occasions with the doctoral thesis supervisor and a member of the supervisory committee during which related codes and sub-codes were grouped together while repeated and redundant codes and sub-codes were collapsed.

To establish credibility of the coding structure, a transcript from each category of participant (i.e., HCPs, administrators and parents) was given to another doctoral candidate experienced in qualitative methods to independently develop a coding structure. The researcher

and the doctoral candidate met twice, after coding the first transcript and when the last transcript had been coded, to compare the coding structures and to discuss discrepancies and differences in coding of data segments. Overall, the coding structures were similar except for minor inconsistencies in labelling and organization of the codes and sub-codes that were addressed through consensus to arrive at a final coding structure (*Appendix X*).

**Applying the coding structure to the data.** The researcher and the doctoral candidate independently applied the coding structure to three transcripts (one for each category of participants) that had not been used in the development of the coding structure. Codes for each transcript were compared consecutively and discrepancies between coders were addressed through discussion and consensus. The percentage of all segments of transcripts coded into the same codes was computed with more than 85% coding agreement. With inter-coder reliability established (Burla et al., 2008) the researcher independently coded the remaining transcripts.

**Development of categories.** Categories are general propositions that emerge from diverse and detail-rich experiences (or perspectives) of participants and provide recurrent and unifying ideas regarding the subject of inquiry (Bradley et al., 2007; Ryan & Bernard, 2003). To develop categories and sub-categories, codes and sub-codes from the same and between participant groups (i.e., HCPs, administrators and parents) were compared. The iterative comparative approach (Bradley et al., 2007; Ritchie et al., 2003) enabled the researcher to arrive at overarching categories and sub-categories for each group of participants.

The data analytic process was aided by the use of NVivo 10 computer software for windows (QSR International, 2012). Descriptive statistics were computed to describe demographic characteristics of participants. Continuous data (e.g., age, work experience) were

summarized using mean and standard deviations while frequency counts were computed for categorical data (e.g., gender, level of education).

## **Ethical Considerations**

Although incorporation of photographs in the interviews significantly improved the depth of the interviews (Clark-Ibáñez, 2004), their inclusion posed the possibility of breaching privacy and anonymity of those captured in the photographs (Smith, Gidlow, & Steel, 2012; Wiles et al., 2008). Moreover, inclusion of the photographs as part of the thesis posed a bigger challenge to the participants' privacy and anonymity. As recommended by ethicists in visual methods (Wiles et al. 2008), the researcher reached a “conventional agreement” (Smith et al., 2012, p. 380) with mothers not to use the photographs in a manner that was likely to portraying them or the neonates in a negative light. Written consent to be photographed for the interview kit was sought from mothers of neonates who were captured in the photographs (*Appendix Y*). Photos were taken from a private section of the unit (i.e., for breastfeeding, KC) or in cots placed in a private corner of the neonatal unit (i.e., for swaddling, FT). The procedure for taking and processing the photographs were guided by institutional policies at the study site.

Before conducting interviews, all groups of participants were asked to consent for the interview as well as the audio-recording (*Appendices O & P; R & S*). Copies of signed consent forms were given to each participant. The voluntary nature of participation in the study was emphasized. During interviews participants were regularly reminded that they could interrupt or stop their participation at any time without giving reasons. It was also emphasized that declining to be interviewed or stopping participation in the course of the interviews would neither affect their relationship with the hospital administration, the researcher or the quality of care offered to the neonates. The researcher assigned each participant a code name whose first part was the

study site code previously described. Audio records were labelled with participants' codes and duplicates made to avoid loss of data in case of accidental deletion. Signed consent forms and interview transcripts were securely stored, observing the double-lock policy, for at least 7 years and destroyed according to institutional policies on destruction of confidential information at The Hospital for Sick Children.

### **Time Lines**

Phase 3 commenced immediately following completion of Phase 2. To allow for sufficient time for development of the interview-kit in readiness for Phase 3 (Capello, 2005), the photographs were taken during Phase 1 of the study. At least two interviews were conducted every week for a total of eight individual interviews per month. Two months was adequate to recruit and interview a sufficient number of participants from each category of participants to achieve data saturation. The projected timelines for Phases 1, 2 and 3 of the study are illustrated in *Table 3*.

### **Significance of Phase 3**

Exploring the acceptability and feasibility of behavioural and sweet-tasting solution interventions from the perspectives of HCPs, administrators and mother is fundamental in isolating strategies to use for procedural pain treatment in neonatal units in Kenya. Identifying similarities and differences in participants' perceptions regarding acceptability and feasibility of interventions is important in isolating interventions most likely to be successfully implemented and routinely used for pain treatment. Moreover, determining the factors that influence acceptability and feasibility of interventions is critical in the development of knowledge translation (KT) strategies to facilitate routine use of the interventions for procedural pain treatment in neonatal units in Kenya and other LMICs globally.



## **Summary of Methods**

A 3-phase sequential mixed methods study was conducted with the aim of (a) determining the nature and frequency of procedures and use of pain treatment interventions and (b) exploring the acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain treatment in neonatal units in Kenya. Descriptive quantitative, prospective and observational designs were used to comprehensively evaluate the nature and frequency of painful procedures and use of interventions for procedural pain treatment. In addition, a qualitative descriptive study using photo elicitation interview technique was conducted to determine the acceptability and feasibility of behavioural and sweet-tasting solution interventions from the perspectives of HCPs, administrators and mothers. Results will inform development of strategies to bridge the evidence-practice gap on neonatal pain treatment and, consequently, improve neonatal outcomes by preventing the possible deleterious complications associated with untreated pain in neonatal units in Kenya.

Table 3

*Study Timelines*

Year and Month			
	2013	2014	2015
<b>Activity</b>			
Proposal defense	December		
Scientific Review		January	
REB		February – April	
Orientation of Unit		May	
Phase 1		June – August	
Phase 2		September – October	
Phase 3		November – February (2015)	
Data analysis			January – July
Report writing			April – December
Thesis defence			February 2016
Knowledge translation			December – August, 2016

## CHAPTER FIVE

### Results

#### Phase 1

##### Demographic Characteristics of Neonates

Between June and September 2014, 200 neonates (100 each from the Level I and Level II neonatal unit) were followed for the first seven days of hospitalisation, or until discharge; whichever came first. The 200 neonates were admitted for a total of 1104 days for an average of 3.6 hospitalisation days ( $SD = 1.95$ , range: 1-7 days). There was no significant difference in the number of neonates by gender (male;  $n = 114/200$ , 57%),  $\chi^2(1) = 3.63$ ,  $p = .06$ . More inborn ( $n = 162/200$ ; 81%) than outborn neonates were recruited,  $\chi^2(1) = 75.27$ ,  $p < .001$ . The median ( $Mdn$ ) GA was 36 (IQR: 32-39) weeks with a mean birth weight of 2360.24 grams ( $SD = 916$ ; range: 700-4300 grams). Neonates in the Level II unit had significantly higher Apgar scores at 1-minute ( $Mdn = 7$  vs. 6),  $U = 2678$ ,  $p < .001$  and 5-minutes ( $Mdn = 8$  vs. 7,  $U = 2982$ ,  $p = .005$ ). There was no significant difference in birth weight, GA at birth, CRIB II scores and duration of hospitalisation between neonates in Level I and Level II unit.

More neonates were being treated for birth asphyxia in the Level I ( $n = 41$ , 71.9%) than in the Level II unit ( $n = 16$ , 28.1%),  $\chi^2(1) = 10.34$ ,  $p = .001$  while respiratory distress syndrome was more common among neonates in the Level II unit (63.6% vs. 36.4%),  $\chi^2(1) = 4.03$ ,  $p = .04$ . At least 90% of the mothers had some formal education. The demographic characteristics of the sample are summarized in Table 4.

Table 4

*Demographic Characteristics of Neonates*

Characteristic	Level I	Level II	p-value
Birth weight, <i>M</i> (SD)	2386.4 (952.2)	2343.7 (884.4)	.74
GA, <i>Mdn</i> (IQR)	36 (32 to 39)	36.5 (32 to 40)	.84
Apgar score 1 minute, <i>Mdn</i> (IQR)	6 (4 to 8)	7 (6.5 to 8)	< .001
Apgar score 5 minutes, <i>Mdn</i> (IQR)	7 (6 to 9)	8 (7 to 9)	.005
CRIB II score, <i>M</i> (SD)	8.8 (2.4)	8.9 (2.6)	.96
Length of stay, <i>Mdn</i> (IQR)	7 (4 to 7)	6 (3 to 7)	.22
Gender (Male) <sup>a</sup>	64 (56.1)	50 (43.9)	.04
Place of birth (Inborn)	83 (51.2)	79 (48.8)	.39
Infant hospitalised on day 7 (Yes)	58 (56.9)	44 (43.1)	.13
Neonate's medical diagnosis <sup>b</sup>			
Prematurity	44 (52.4)	40 (47.6)	.82
Respiratory distress syndrome	16 (36.4)	28 (63.6)	.04
Birth asphyxia	41 (71.9)	16 (28.1)	.001
Low birth weight/IUGR	21 (53.8)	18 (46.2)	.21
Neonatal sepsis	8 (33.3)	16 (66.7)	.07
Neonatal Jaundice	6 (66.7)	3 (33.3)	.35
Respiratory distress	0 (0.0)	9 (100)	.002
Meconium aspiration syndrome	1 (14.3)	6 (85.7)	.05
Transient tachypnea of newborn	0 (0.0)	6 (100)	.01

Congenital defects <sup>c</sup>	3 (25)	9 (75 )	.03
Other conditions <sup>d</sup>	1 (9.1)	10 (90.9)	.04
Parent's highest level of education			
Primary	71 (60.7)	46 (39.3)	< .001
Secondary	14 (28.6)	35 (71.4)	< .001
Tertiary	6 (26.1)	17 (73.9)	.001
None	9 (81.8)	2 (18.2)	.04

---

M = mean; SD = standard deviation; Mdn = median; IQR = interquartile range; IUGR = intrauterine growth retardation.

<sup>a</sup> Value in parenthesis from this point onwards are percentages for each category. <sup>b</sup> Neonates had multiple diagnosis. <sup>c</sup> Includes cardiac defects, gastroschisis, hydrocephalus, cranial malformations, spina bifida, cystic haemangioma, pyloric stenosis, and rectal atresia. <sup>d</sup> Includes hypoglycaemia, hypothermia, anaemia, chorioamnionitis, and macrosomia.

### Nature and Frequency of Painful Procedures

The 200 neonates underwent a total of 1693 painful procedures (1479 first attempt procedures and 214 repeat attempt procedures) over the study period. The mean (*M*) number of painful procedures per neonate per day of hospitalisation was 1.34 (*SD* = 1.51, 95% CI [1.25, 1.43], range: 0-12, *Mdn* = 1, IQR: 0-2) procedures, for first attempt procedures; and 1.53 (*SD* = 1.1, 95% CI [1.42, 1.64], range: 0-12, *Mdn* = 1, IQR: 0-2) for all procedure attempts. The average number of procedures per neonate per day of hospitalisation was 2.41 (*SD* = 1.79, 95% CI [2.28, 2.54], range: 1-12, *Mdn* = 2, IQR: 1-3) after excluding days for which neonates had no procedures. Neonates underwent more tissue-damaging procedures (*n* = 1084; *M* = 1.0, *SD* = 1.32) than non tissue-damaging procedures (*n* = 395; *M* = 0.34, *SD* = 0.6) for first attempt

procedures ( $t(1) = 10.44, p < .001$ ) as well as for all procedures ( $n = 1291; M = 1.2, SD = 1.7$  vs  $n = 402; M = 0.34, SD = 0.6$ ),  $t(1) = 2.24, p = .03$ .

More than half of the procedures were performed by RNs (60.7%), a third by physicians (36.8%) and the rest by COs (2.5%). More intravenous cannulations were performed in the Level II unit ( $n = 345, 71.4\%$ ) than in the Level I unit ( $n = 138, 28.6\%$ ),  $\chi^2(1) = 12.8, p = .02$ .

Intramuscular injections were more prevalent in the Level I unit ( $n = 263, 74.7\%$ ) than in the Level II unit ( $n = 89, 25.3\%$ ),  $\chi^2(1) = 11.06, p = .02$ . Wound dressing and heel sticks (100%) were exclusively documented in the Level II unit while nasal cannulations were predominantly performed in the Level I unit (97.7% vs. 2.3%),  $\chi^2(1) = 24.6, p < .001$ . Most of the procedures categorized as severely invasive ( $n = 265, 74.9\%$ ) were performed in the Level I neonatal unit,  $\chi^2(1) = 14.62, p = .02$  (Table 5).

**Number of attempts to complete procedures.** The 214 repeat attempt procedures consisted of 195 intravenous cannulations, 10 venepunctures, 5 nasopharyngeal suctioning, 2 nasogastric tube placements, 1 IM injection and 1 heel stick. The total numbers of attempts performed to complete each procedure are summarized in Table 6. On average, procedures were attempted 1.14 times ( $SD = 0.4, 95\% \text{ CI } [1.12, 1.17], \text{ range: } 1\text{-}8$ ) to complete.

Table 5

*Nature and Frequency of Painful Procedures (N = 1693)*

Nature of procedure	Level I	Level II	p-value
Intravenous cannulation	138 (28.6)	345 (71.4)	.02
Intramuscular injection	263 (74.7)	89 (25.3)	.02
Venepuncture	19 (6.3)	283 (93.7)	< .001
Heel stick	0 (0)	152 (100)	< .001
Nasogastric tube insertion	50 (46.7)	57 (53.3)	.41
Removal of tapes	40 (42.1)	55 (57.9)	.38
Suctioning	69 (73.4)	25 (26.6)	.01
Nasal cannulation	85 (97.7)	3 (2.3)	< .001
Wound dressing	0 (0)	16 (100)	< .001
Others <sup>a</sup>	2 (50)	2 (50)	> .99
Invasiveness of procedures			
Mild	244 (60.7)	158 (39.3)	.03
Moderate	157 (16.8)	780 (83.2)	< .001
Severe	265 (74.9)	89 (25.1)	.02

<sup>a</sup> Includes two lumbar punctures and two subcutaneous injections

Table 6

*Number of Attempts to Complete Painful Procedures*

Procedure	Total	No. of attempts to complete procedure (%) <sup>a</sup>				Max. Attempts <sup>b</sup>
		1	2	3	≥4	
Intravenous cannulation	485	52.1	34.5	9.7	3.8	8
Intramuscular injection	352	99.7	0.3	0.0	0.0	2
Venepuncture	301	96.9	2.8	0.3	0.0	3
Heel stick	151	99.3	0.7	0.0	0.0	2
Nasogastric tube insertion	107	98.1	1.9	0.0	0.0	2
Removal of tapes	95	100	0.0	0.0	0.0	1
Suctioning	94	94.4	5.6	0.0	0.0	2
Nasal cannulation	88	100	0.0	0.0	0.0	1
Wound dressing	16	100	0.0	0.0	0.0	1
Others <sup>c</sup>	4	100	0.0	0.0	0.0	1

<sup>a</sup> Proportion of procedures contributed by respective number of attempts to complete. <sup>b</sup> Maximum number of attempts performed. <sup>c</sup> Lumbar puncture and subcutaneous injections

**Factors Influencing the Nature and Frequency of Painful Procedures**

**Neonatal factors.** The number of painful procedures over the hospitalisation period was highest among neonates born 24-36 weeks GA but tapered from 37 weeks GA ( $M = 7.2$ ,  $SD = 4.3$ ) through 44 weeks GA ( $M = 4$ ,  $SD = 1.4$ ) (Figure 2). Although preterm ( $M = 1.65$ ,  $SD = 1.02$ ) and term neonates ( $M = 1.66$ ,  $SD = 0.98$ ) underwent similar numbers of painful procedures per day,  $t(198) = -0.08$ ,  $p = .94$ , maturity at birth predicted the number of painful procedures



neonates underwent. More specifically, neonates born at term were less likely to undergo painful compared with preterm neonates (Table 7).

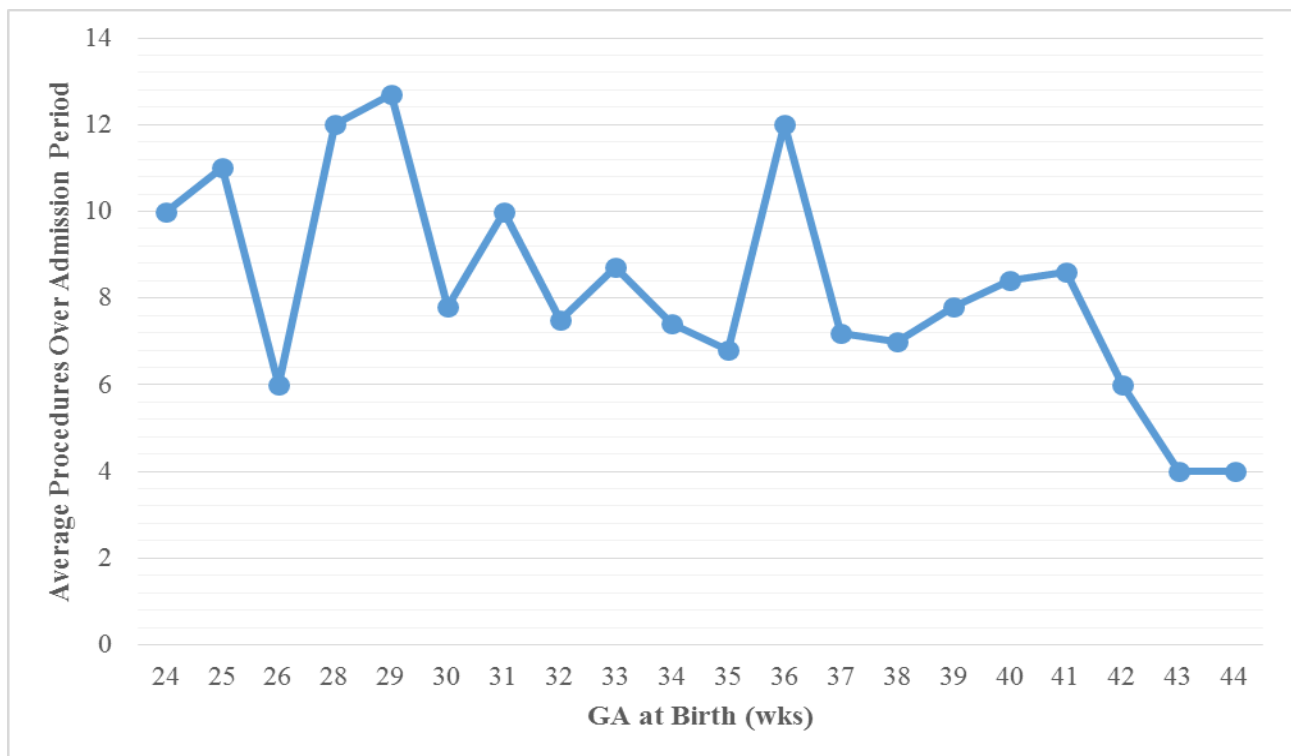


Figure 2. Number of painful procedures by gestational age.

Mild-to-moderate ill neonates underwent more painful procedures per day ( $M = 1.63$ ,  $SD = 0.97$ ) compared to moderate-to-severe ( $M = 1.8$ ,  $SD = 1.2$ ) and severely ill neonates ( $M = 1.71$ ,  $SD = 0.79$ ); however, the difference was not statistically significant,  $F(2, 197) = 0.35$ ,  $p = .7$ . Severity of illness did not influence the number of painful procedures (Table 7).

There was a statistically significant difference in the mean number of painful procedures for each day of hospitalisation,  $F(6, 194) = 108.4$ ,  $p < .001$ . Neonates underwent more procedures during the first two days of life ( $Mdn = 2.0$ ,  $IQR: 1-4$ ) compared to the rest of the hospitalisation period ( $Mdn = 1.0$ ,  $IQR: 0-1$ ),  $Z = 15.64$ ,  $p < .001$ . More specifically, there was a significant decrease in number of painful procedures performed from day 1 ( $M = 3.9$ ,  $SD = 1.9$ ) to day 2 ( $M = 1.4$ ,  $SD = 1.6$ ),  $p < .001$ ; and from day 2 ( $M = 1.4$ ,  $SD = 1.6$ ) to day 3 of

hospitalisation ( $M = 1.1$ ,  $SD = 1.4$ ,  $p = .01$ ). The decrease in number of procedures continued throughout the hospitalisation period although the difference was not significant from day 3 through day 7. Figure 3 illustrates the changes in the mean number of painful procedures across the days of the hospitalisation. On the other hand, neonates were 1.8 times more likely to undergo procedures during the 3<sup>rd</sup> – 7<sup>th</sup> day of life compared with the first two days of life (Table 7).

**Situational factors.** Time of the day significantly influenced the number of procedures; more procedures were performed during daytime ( $M = 1.1$ ,  $SD = 1.4$ ) than during night time ( $M = .45$ ,  $SD = 1.2$ ),  $t(1) = 11.86$ ,  $p < .001$ . Place of birth did not predict the number of procedures (Table 7) and neither was there any difference in number of procedures between inborn ( $M = 1.63$ ,  $SD = 0.97$ ) and outborn neonates ( $M = 1.76$ ,  $SD = 1.1$ ),  $t(198) = -0.73$ ,  $p = .5$ . A total of 465 (27.5%) painful procedures were documented to have been performed in presence of parents.

**Organizational factors.** On average, neonates admitted in the Level II unit underwent more procedures per day of hospitalization ( $M = 2.04$ ,  $SD = 1.11$ ) compared to those in the Level I unit ( $M = 1.27$ ,  $SD = 0.69$ ),  $t(198) = 5.92$ ,  $p < .001$ . Additionally, level of care positively predicted the number of procedures; neonates in the Level II unit were 1.6 times more likely to undergo procedures than those in the Level I unit (Table 7).

### **Nature and Frequency of Use Behavioural and Sweet-tasting Solution Interventions**

In none of the 1693 painful procedures was a behavioural or sweet-tasting solution interventions used for pain treatment. However, one of the procedures, a dressing change post-surgery, was accompanied with analgesia, a tramadol (a synthetic opioid) which was administered intramuscularly.

Table 7

*Predictors of Number of Painful Procedures*

Predictor	Beta Estimate (SE <sup>a</sup> )	Relative Risk (95% CI)	<i>p</i> - value
Gestational age			
≥ 37 weeks	-0.16 (0.06)	0.85 (0.76 to 0.95)	.003
24- 36 weeks	0.00	1.00 (Ref) <sup>b</sup>	-
Day of life			
3-7 days	0.59 (0.12)	1.81 (1.44 to 2.28)	< .001
1-2 days	0.00	1.00 (Ref) <sup>b</sup>	-
CRIB II Score <sup>c</sup>			
> 15	0.004 (0.142)	1.0 (0.76 to 1.32)	.98
11 to 15	0.07 (0.08)	1.07 (0.92 to 1.24)	.38
6 to 10	0.00	1.00 (Ref) <sup>b</sup>	-
Place of birth			
Inborn	0.081 (0.062)	1.08 (0.96 to 1.22)	.19
Outborn	0.00	1.00 (Ref) <sup>b</sup>	-
Level of care			
Level II	0.45 (0.05)	1.57 (1.43 to 1.74)	< .001
Level I	0.00	1.00 (Ref) <sup>b</sup>	-

<sup>a</sup> Standard error. <sup>b</sup> Refers to the reference category. <sup>c</sup> No neonate with CRIB II Score 0-5

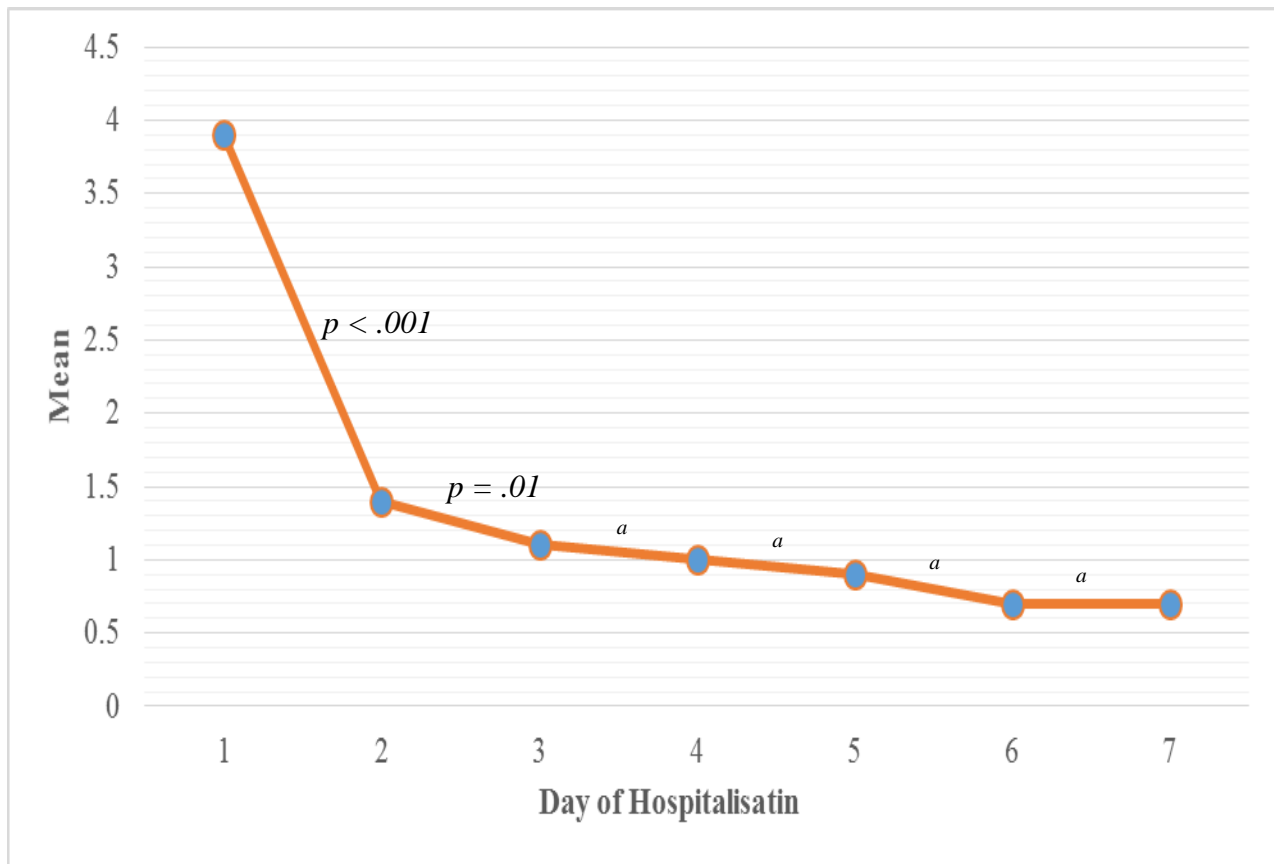


Figure 3. Number of procedures per neonate by day of hospitalisation.

<sup>a</sup>  $p > .05$

## Phase 2

### Demographic Characteristics of Sample

Over a period of one month, two consecutive weeks in each study site, 200 HCP-neonate observations were made during painful procedures. The mean GA at birth of the study sample was 34.87 weeks ( $SD = 4.74$ , range: 25-43 weeks,  $Mdn = 36$ , IQR: 31-39); there was no difference in gestational maturity between neonates in the Level II unit ( $Mdn = 36$ , IQR: 32-40) and the Level I unit ( $Mdn = 36$ , IQR: 28-38),  $\chi^2(1) = 1.64$ ,  $p = .07$ . The mean birth weight was 2268.61 grams ( $SD = 921.07$ , range: 790-4650 grams) with no significant difference in birthweight between the two study sites (2289.9 vs. 2243.2),  $t(198) = .41$ ,  $p = .72$ . The average CRIB II score (Parry et al., 2003) was 8.8 ( $SD = 2.6$ ) with neonates in the Level I neonatal unit having higher scores compared with the neonates in the Level II neonatal unit,  $t(198) = -3.68$ ,  $p < .001$ . Neonates in the Level II neonatal unit were hospitalized for a longer period compared to their counterparts in the Level I neonatal unit,  $t(198) = 7.31$ ,  $p < .001$ .

A majority of the observations were on inborn neonates ( $n = 144$ , 72%),  $\chi^2(1) = 243.72$ ,  $p < .001$ . Most of the neonates had a diagnosis of prematurity or birth-related medical conditions ( $n = 162$ , 81%) with a few having congenital defects involving varied body systems ( $n = 13$ , 6.5%). The demographic characteristics of the sample are summarized in Table 8.

Table 8

*Demographic Characteristics of Sample*

Characteristic	Level I	Level II	<i>p</i> -value
Birth weight (grams), <i>M</i> (SD)	2243.2 (1027.3)	2289.9 (792.8)	.72
GA (weeks), <i>Mdn</i> (IQR)	36 (28 to 38)	36 (32 to 40)	.07
Apgar score, <i>Mdn</i> (IQR)			
1 minute	6 (5 to 7)	7 (5 to 8)	.004
5 minutes	7 (6 to 8)	8 (6 to 9)	.03
CRIB II score, <i>M</i> (SD)	9.5 (3.0)	8.2 (1.8)	< .001
Days of life, <i>Mdn</i> (IQR)	3 (1 to 5)	7.5 (3 to 15)	< .001
Gender (Male) <sup>a</sup>	58 (53.7)	52 (47.3)	.4
Place of birth			
Inborn	80 (55.6)	64 (44.4)	< .001
Born in another hospital	20 (57.1)	15 (42.9)	.23
Born at home	0 (0.0)	12 (100)	< .001
Born before arrival	0 (0.0)	9 (100)	.01
Mothers' highest level of education			
Primary	56 (53.8)	48 (46.2)	.42
Secondary	41 (52.6)	37 (47.4)	.43
Tertiary	1 (7.7)	12 (92.3)	.02
None	2 (40.0)	3 (60.0)	.05

#### Neonate's medical diagnosis<sup>b</sup>

Prematurity	36 (48.6)	38 (51.4)	.24
Respiratory distress syndrome	13 (26.5)	36 (73.5)	.002
Birth asphyxia	26 (66.7)	13 (33.3)	.003
Low birth weight/IUGR	34 (65.4)	18 (34.6)	.02
Neonatal sepsis	10 (27.0)	27 (73.0)	.03
Neonatal jaundice	3 (50.0)	3 (50.0)	>.99
Meconium aspiration syndrome	0 (0.0)	6 (100.0)	.07
Transient tachypnea of newborn	5 (55.6)	4 (44.4)	.63
Macrosomia	0 (0.0)	12 (100.0)	.01
Congenital defects <sup>c</sup>	0 (0.0)	13 (100)	.01
Other conditions <sup>d</sup>	1 (20.0)	4 (80.0)	.02

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M = mean; SD = standard deviation; Mdn = median; IQR = interquartile range; IUGR = intrauterine growth retardation.

<sup>a</sup> Values in parenthesis from this point represent % within category. <sup>b</sup> Total > 200, most neonates had multiple medical diagnosis. <sup>c</sup> Includes omphalocele, anencephaly, hydrocephalus, spina bifida. <sup>d</sup> Includes hypoglycaemia and respiratory distress.

#### Nature and Frequency of Painful Procedures

Nearly three quarters of the painful procedures (70.5 %) were performed by RNs, 46 (23%) by physicians while the rest (n = 13, 6.5%) were performed by COs. Most of the procedures observed were tissue-damaging (n = 143, 71.5%),  $\chi^2(1) = 35.28, p < .001$ . The three most commonly performed procedures, including intravenous cannulation, IM injection and venepuncture, contributed more than half of the total procedures (54%). Nearly all IM injections were observed in the Level I unit (n = 35/37; 94.6%,  $p < .001$ ) while heel sticks were exclusively

observed in the Level II neonatal unit. The highest proportion of severely invasive procedures were observed in the Level I ( $n = 35/38$ ; 92.1%,  $p < .001$ ). Procedures were attempted on average 1.64 times ( $SD = 1.1$ ,  $Mdn = 1.0$ , range: 1-8); procedures were attempted more in the Level II unit ( $M = 1.87$ ,  $SD = 1.37$ ) than in the Level I unit ( $M = 1.45$ ,  $SD = .72$ ),  $t(198) = 2.27$ ,  $p = .01$ . The nature and frequency of observed painful procedures are summarized in Table 9.

### **Factors Influencing the Nature and Frequency of Painful Procedures**

**Neonatal factors.** A comparable number of procedures were observed among preterm ( $n = 111$ , 55.5%) and term neonates ( $n = 89$ , 44.5%),  $\chi^2(1) = 2.42$ ,  $p = .12$ . A significantly higher proportion of procedures were observed on mild-to-moderately ill neonates ( $n = 162/200$ ; 81%) than moderate-to-severely ill ( $n = 32/200$ ; 16%) and severely ill neonates ( $n = 6/200$ ; 3%),  $\chi^2(2) = 209.56$ ,  $p < .001$ . More procedures were observed during the first 7 days of life ( $n = 141$ , 70.5%) compared to the 8-28 days of life ( $n = 59$ , 29.5%),  $\chi^2(1) = 33.62$ ,  $p < .001$ .

**Situational factors.** The majority of observed procedures were moderately invasive ( $n = 93/200$ ; 46.5%),  $\chi^2(2) = 27.01$ ,  $p < .001$ . Nearly three quarters ( $n = 144/200$ ; 72%) of procedures were performed on inborn neonates ( $\chi^2(1) = 38.7$ ,  $p < .001$ ) and approximately two thirds ( $n = 129/200$ ; 64.5%) were performed during daytime – 7 a.m. to 6 p.m.,  $\chi^2(1) = 16.82$ ,  $p < .001$ . More than half of the procedures were performed in the absence of parents ( $n = 121/200$ ; 60.5%),  $\chi^2(1) = 8.82$ ,  $p < .003$ . In more than half of the observations (53%) the HCP performing the procedure had an assistant (a fellow HCP or a trainee).

**Organizational factors.** The frequency of intravenous cannulation was observed equally between the Level I (41.7%) and Level II unit (58.3%,  $p = .46$ ). On the other hand, nearly all IM injections ( $n = 35/38$ , 94.6%) were observed in the Level I unit ( $p < .001$ ) while heel sticks were exclusively observed in the Level II neonatal unit ( $p < .001$ ).



Table 9

*Nature and Frequency of Procedures<sup>a</sup>*

Procedure	Level I	Level II	p-value
Intravenous cannulation	20 (41.7)	28 (58.3)	.46
Intramuscular injection	35 (94.6)	2 (5.4)	< .001
Nasogastric tube insertion	20 (74.1)	7 (25.9)	.02
Venepuncture	6 (26.1)	17 (73.9)	.02
Heel stick	0 (0.0)	21 (100.0)	< .001
Sub-cutaneous injection	2 (16.7)	10 (83.3)	.02
Removal of tapes	2 (18.2)	9 (81.8)	.04
Nasal cannulation	9 (100)	0 (0.0)	.01
Suctioning	4 (80.0)	1 (20.0)	.31
Wound dressing	2 (40.0)	3 (60.0)	.37
Others <sup>a</sup>	0 (0.0)	2 (100.0)	.53
Procedure invasiveness			
Mild	38 (55.1)	31 (44.9)	.42
Moderate	27 (29.0)	66 (71.0)	< .001
Severe	35 (92.1)	3 (7.9)	< .001

<sup>a</sup> value in parenthesis denotes % within category of procedure. <sup>b</sup> Includes lumbar puncture and catheterization

### **Nature and Frequency of Use of Behavioural and Sweet-tasting Solution Interventions**

Only eight (4%) of the observed procedures were performed with any form of pain treatment intervention; four with facilitated tucking, two with tramadol (a synthetic opioid) and one each with breastfeeding and swaddling. The eight procedures included two each of venepuncture, intravenous cannulation and heel lance; and one each of wound dressing and IM injection. The venepunctures were performed with tramadol and FT, the intravenous cannulations with swaddling and FT, the heel lances with FT and breastfeeding, the wound dressing with FT, and the IM injection with tramadol. One of the eight procedures was performed in the Level I neonatal unit; seven were performed by RNs and one by a physician. Although 74 (37%) of the procedures were performed in the presence of parents, in only 2 was the parent involved in pain relief; breastfeeding (heel stick) and FT (wound dressing).

### **Factors influencing Nature and Frequency of Use of Behavioural and Sweet-tasting Solution Interventions**

Due to the small number of painful procedures performed with any form of pain management intervention, it was not feasible to explore the influence of neonatal, situational and organizational factors on use of interventions in a regression model. The influence of the factors on use of interventions was, therefore, explored descriptively.

**Neonatal factors.** Pain treatment interventions were used proportionately more on preterm ( $n = 5/8$ ; 62.5%) than on term neonates ( $n = 3/8$ ; 37.5%). More than four fifths of the procedures accompanied with a form of intervention were performed on mild-to-moderately ill neonates ( $n = 7/8$ ; 87.5%) while the rest were performed on moderate-to-severely ill neonates ( $n = 1/8$ ; 12.5%). Most of the interventions were used during the first week of life ( $n = 6/8$ ; 75%).

The number of procedures accompanied by interventions was too small to perform any meaningful analysis beyond description.

**Situational factors.** There was an equal number of procedures accompanied with a pain management intervention between inborn and outborn neonates. Most interventions were used on procedures performed during daytime – 7 a.m. to 6 p.m. ( $n = 7$ , 87.5%) and half were performed in the presence of the mother. Three quarters of the painful procedures ( $n = 6/8$ ) accompanied with some form of pain management strategy were moderately invasive and were performed on neonates whose mothers were in the low socio-economic group (primary level of education). None of the differences were statistically significant.

**Organizational factors.** Most procedures accompanied with pain management interventions ( $n = 7/8$ ; 87.5%) were performed in the Level II neonatal unit,  $\chi^2(1) = 4.688$ ,  $p = .03$ .

### **Comparison between Documented and Observed Nature and Frequency of Painful Procedures**

The nature and frequency of the 1693 procedures (from review of medical records in Phase 1) were compared with the 200 procedures observed in Phase 2. The nature of procedures for the two samples was similar except for catheterization which was noted through observation but not documented in medical records. Intravenous cannulation (28.5% documented vs. 24% observed,  $p = .03$ ) and venepuncture (17.8% documented vs. 11.5% observed,  $p = .02$ ) were documented proportionately more frequently than was observed. Conversely, sub-cutaneous injection (6% observed vs. 0.1% documented,  $p = .03$ ) and NGT placement (13.5% vs. 6.3%,  $p = .001$ ) were performed proportionally more on observation than was documented in medical

records. Table 10 illustrates a comparison in the distribution of painful procedures between the study samples.

The number of repeat attempts to complete a procedure was documented less in medical records ( $M = 1.1$ ,  $SD = 0.5$ , range: 1-8) than was noted in real-time observation ( $M = 1.7$ ,  $SD = 1.1$ , range: 1-8),  $p < .001$ ).

Table 10

*Comparison between Documented and Observed Nature and Proportion of Procedures*

Type of Procedure	Documented (N = 1693)	Observed (N = 200)	<i>p</i> -value
Intravenous cannulation	483 (28.5)	48 (24)	.03
Intramuscular injection	352 (20.8)	37 (18.5)	> .99
Venepuncture	302 (17.8)	23 (11.5)	.02
Heel stick	152 (9.0)	21 (10.5)	.13
Nasogastric tube insertion	107 (6.3)	27 (13.5)	.001
Removal of tapes	95 (5.6)	11 (5.5)	.99
Suctioning	94 (5.6)	5 (2.5)	.01
Nasal cannulation	88 (5.2)	9 (4.5)	.99
Wound dressing	16 (1.0)	5 (2.5)	.01
Sub-cutaneous injection	2 (0.1)	12 (6.0)	.03
Lumbar puncture	2 (0.1)	1 (0.5)	> .99
Catheterization	0 (0)	1 (0.5)	.99

<sup>a</sup> Value in parenthesis denotes percentage contributed by each procedure for each data category.

## **Comparison Between Documented and Observed Nature and Frequency of Use of Behavioural and Sweet-tasting Solution Interventions**

One procedure had a pharmacologic pain treatment intervention documented in Phase 1 compared to eight procedures where any form of pain relief was noted on observation in Phase 2. On observation, six of the procedures performed were accompanied by a behavioural intervention (i.e., FT, swaddling and breastfeeding) and two were performed with analgesia. Further statistical comparison of use of interventions during procedures between samples was not feasible due to the few interventions reported in either sample. A third of the procedures in Phase 1 ( $n = 465/1693$ ; 31.4%) were documented to have been performed in the presence of parents which is comparable to the 37% ( $n = 74/200$ ) of the procedures where parents were present on observation.

### **Phase 3**

#### **Demographic Characteristics of the Sample**

**Health care professionals.** Thirteen HCPs that included 9 RNs – five from the Level I and 4 from Level II neonatal unit, three physicians and a nutritionist were interviewed. Ten of the HCPs had previously been observed performing painful procedures during Phase 2. Eight of the HCPs had more than five years of professional experience, four had worked for 3-5 years, and one HCP had less than three years of professional experience. The HCPs had an average neonatal care experience of 2.5 years ( $SD = 1.99$ , range: 1-7); HCPs in the Level II neonatal unit had a longer but statistically insignificant neonatal care experience ( $M = 2.94$  years,  $SD = 2.35$ ) than those in the Level I unit ( $M = 1.6$  years,  $SD = 0.6$ ),  $t(12) = 1.24$ ,  $p = .24$ .

**Administrators.** The five administrators, four nursing and one medical, interviewed had worked in their respective positions for an average of 5.2 years ( $SD = 3.9$ , range: 2-12 years). Due to the small sample of administrators, it is not possible to provide a detailed description of their demographic characteristics without revealing their identity.

**Mothers.** Fifteen mothers, eight from the Level II neonatal unit and seven from the Level I neonatal unit, participated. The average age was 25.8 years ( $SD = 6.19$ ); the age was comparable between mothers in the Level II ( $M = 26.1$  years,  $SD = 5.94$ ) and the Level I unit ( $M = 25.4$  years,  $SD = 6.93$ ;  $p = .84$ ). Five were first time mothers and only two had previous neonatal experience. The length of hospitalisation at the time of the interview was similar for mothers from the two sites; Level I unit ( $M = 15.86$ ,  $SD = 11.5$ , range: 3-28 days), Level II unit ( $M = 13.38$ ,  $SD = 7.96$ , range: 5-28 days),  $t(13) = 0.49$ ,  $p = .63$ . Mothers had a total of 20 other children between them ( $Mdn = 1$ , IQR: 0-3, range: 0-4). Half of the participants (53.3%,  $n = 8$ ) had attained high-school level of education, three each (20%) had primary and tertiary level of education and one had not attended school.

### **Interviews with Health Care Professionals**

Four main categories including (a) pain practices, (b) feasible interventions, (c) contextual challenges to pain practices and (d) changing pain practices; and 12 sub-categories emerged from the data on views about pain practices and acceptability and feasibility of behavioural and sweet-tasting solution interventions (Table 11). The categories and sub-categories emerged from analysis of interview data from all professional categories of HCPs from the two study sites. In this regard, the verbatim quotes accompanying each sub-category were derived from any participant.

**Pain practices.** Health care professionals reflected on their practices regarding procedural pain in the unit. Their views captured two main elements; documentation practices and treatment practices of procedural pain.

***Documentation practices.*** Documentation of painful procedures was described as both incomplete and inconsistent. HCPs felt that, although they were professionally expected to, not all procedures were documented. Participants' views pointed to two clusters of procedures; those that were always documented and those that were rarely documented. Procedures performed for execution of a medical order (e.g. IM injection for administration of medication), life-saving procedures such as suctioning and resuscitation and procedures prone to life-threatening complications, including exchange transfusion and lumbar puncture were always documented. Participants also described procedures that they thought were unlikely to be documented. This category included procedures that participants christened normal, routine or everyday-procedures:

...if a line has been fixed, an NGT has been inserted somebody might not find that as something to document, it is a normal procedure, babies are pricked everyday removing samples, so you don't think that is something to document (HCP 1, p. 4, line 17-20).

Participants also felt that, even when procedures were documented, certain aspects of the procedure were not recorded. Descriptive attributes of procedures such as specific time of the day when the procedure was performed and the number of attempts to complete the procedure were rarely documented. Participants gave an example of intravenous cannulation which they observed, even when attempted multiple times, only the successful attempt was documented. HCPs also felt that it was unnecessary to document any nonpharmacological pain treatment interventions used, including verbal soothing, maternal holding and breastfeeding. Pressure of

work due to staff shortage was associated with the selective documentation which may, ultimately, compromise the quality of care:

Sometimes the workload also will make them maybe write something they really feel they need to pass it on to the next shift but, at times they tend also to leave out other important things in the process of trying to select whatever they think it is important to be forwarded to the next shift (HCP 10, p. 4, line 18-21).

Table 11

*HCPs' Perspectives about Pain Practices and Acceptability and Feasibility of Interventions*

Main Categories	Sub-categories
Pain practices	Documentation of procedures
	Treatment practices
Contextual challenges to pain practices	Perceptions and attitudes
	Fear of side-effects
	Workload
Feasible interventions	Kangaroo care
	Breastfeeding
	Facilitated tucking
Strategies for changing pain practices	Creating awareness
	Encouraging mothers' involvement
	Improving staffing
	Constant reminders



***Treatment practices.*** HCPs also discussed their views about procedural pain treatment in the units. Neonates undergoing painful procedures were rarely treated for the pain. Reflecting on their daily practice, they reported to have, occasionally, used some pain treatment interventions, mainly breastfeeding or allowing the mother to hold the neonate, after the procedure. Use of interventions during procedures was infrequent and inconsistent.

... at times the mother may not be available but whoever is doing the procedure or with the assistant will try to calm the baby as you do the procedure, you talk to the baby, telling them consoling words as you do the procedure. We also encourage the mother if she is available to talk to the baby and try to calm them during the procedure (HCP 9, p. 1, lines 16-17, 21-23).

In the few instances when interventions were used during procedures, HCPs opted for interventions without sound empirical evidence of efficacy. Pharmacological interventions, mainly synthetic opioids, were rarely used; only for post-operative pain treatment predominantly during dressing change.

***Contextual challenges to pain practices.*** Several contextual challenges, including (a) perceptions and attitudes, (b) fear of side-effects and (c) workload hindered pain practices.

***Perceptions and attitudes.*** HCPs attributed the lack of treatment of procedural pain to perceptions and attitudes. The perception that neonates do not feel pain or that neonates tolerate pain better resulted in clinicians not prioritizing pain treatment during procedures. Participants attributed the undertreatment of pain to their inability to discriminate pain from other causes of stress. Informants felt that, since neonates cry all the time, it was difficult to discern when the cry was due to pain and requiring pain relief:

... the fact that they cannot verbalize because a paediatric baby who is a bit bigger will tell you I am feeling pain or they cry but now these are neonates, they cry all the time so we assume they are not in pain. I think it's our perception that we need to change (HCP 1, p. 4, line 1-4).

Poor attitudes towards neonatal pain among HCPs were also discussed. Participants felt that clinicians were less concerned about pain treatment during procedures. It was disheartening

to some participants that not even obvious signs of pain and distress would prompt clinicians to minimize it or give some form of pain relief:

... they assume the baby will just scream, let me finish the procedure and then the baby will be quiet. We are not very, what do I say now...(thoughtfully...what is the best word to use now!), we are not conscious that these babies are feeling pain, so all you want to do is do a procedure and then walk away, and leave the baby screaming. It is not right (HCP 1, p. 2, line 16-22).

***Fear of side-effects.*** Unfounded fears about analgesics causing complications in neonates were also discussed. Fear of liver damage from use of acetaminophen was a major concern among clinicians. The complications were, however, specific to certain groups of neonates. Clinicians were more concerned about the complications when a preterm was involved or if the analgesic was given early in life. Fear of sedation and respiratory complications also prevented use of opioids for routine painful procedures. These fears, a physician suggested, would be minimized if clinicians developed competence in dosing of the analgesics:

... fear that the medication might be either too strong or likely to create complications probably makes most of us not to be able to put babies on those medications. And also something like tramadol, I am aware, I think most of the clinicians are able to give the doses but not everyone. Other people think that maybe it can cause complications by over-sedating the baby, causing other respiratory depression and all that. So people are not willing to go into that, to do procedures which they think relatively small (HCP 12, p. 3, lines 12-18).

Some participants were also concerned that routine use of analgesics would interfere with early diagnosis of illnesses. They singled out acetaminophen that posed the risk of masking fever, a common symptom of infections that neonates were being treated for.

***Workload.*** Participants stated that workload posed a major challenge to their individual and collective desire to use pain treatment interventions during procedures. The workload was viewed differently by RNs and physicians. RNs described how they were expected to care for more than 10 neonates per shift, some very critically ill, often requiring many care-related and

painful procedures. Informants felt that with the high number of neonates, it was impossible to plan and prioritize pain treatment:

... then workload, may be you want to finish and move, you want to finish this, go to another baby, so if the workload is too much, you do not even have time to think ooh I think this is a small human being who I think I need to be very careful and at least give some comfort to the baby (HCP 1, p. 2, line 21-24).

Physicians' views depicted workload as a function of the high number of neonates they were caring for and long working hours. They described how they were expected to attend to many neonates that required life-saving medical care. In such circumstances, the priority was to complete the life-saving procedures as quickly as possible notwithstanding the amount of pain such procedures caused. Physicians' views also illustrated how long working hours and consequent fatigue may diminish their ability to use pain management interventions during procedures:

If for example you have been working throughout the day, on call also at night, I think depending on the level of how awake you are, someone might not be talking to a baby at 3am, might also just be asleep themselves and also ...[incomplete sentence]. And that again will affect, and the possibility of being using those pain-relieving strategies (HCP 12, p. 4, line 1-5).

The workload meant that even the available resources were not optimally used for pain treatment. Participants noted that, due to the workload, they could not get someone to call the mother to soothe the neonate during procedures or by the time they got to perform procedures mothers has already left the bedside.

**Feasible interventions.** Participants described interventions that could be used routinely by HCPs for pain relief during procedures, including KC, breastfeeding and FT. The choice of interventions was informed by a reflection on their practice experiences; and hindsight on factors such as resource implications, availability and ease of use of the intervention during procedures.

**Kangaroo care.** KC was routinely practiced in the unit, mainly on stable preterm neonates in the morning, for warmth and bonding. Although KC for pain relief was not a familiar practice, on reflection, they felt that the intervention could be adapted for pain relief. Participants felt that using KC position during procedures would give “the primary owner of the baby” the responsibility of soothing the neonate. Participants enumerated procedures (e.g., NGT placement, intravenous cannulation and venipuncture) for which KC could be used. It was apparent that their perceptions were not informed by empirical evidence on effectiveness of the intervention for pain relief from those procedures (Johnston et al., 2014). Instead, their views were based on how easy they thought it would be, from a clinical practice experience (Rycroft-Malone et al., 2004), to perform the procedures with the neonate in the KC position.

... this position when the mothers are holding their babies in this position you cannot perform a procedure, unless you remove the baby from that position. Maybe after the procedure is when the..., after performing the procedure is when the baby is taken back to the position of kangaroo but in that position no! (HCP 6, p. 5, line 5-8).

The option of placing the neonate in KC position after the procedure was preferred by many participants; participants felt that mothers would be uncomfortable holding neonates in KC during procedures. Participants were also convinced that it would be impossible to access the site for most procedures with the neonate in KC.

**Breastfeeding.** Participants described how they encouraged breastfeeding for routine nursing but sparingly used it for pain relief. HCPs, however, thought that the intervention provided the best option for soothing neonates after procedures. Allowing neonates to breastfeed during procedures was an unfamiliar practice. HCPs appeared so accustomed to breastfeeding after procedures that, even when conditions during procedures were perfect for breastfeeding, they opted to using the intervention to sooth the neonate after the procedure:

...we ask the mother to allow us do our procedures first then, when we are done because the baby is in pain, to try to soothe the baby with the breast,... we ask the mother to hold

the baby not to feed just hold the baby at the breast as we do the procedure and when we are done so then soothe the baby with the breast (HCP 5, p. 10, lines 12-14, 15-17).

Apart from the practice culture, inherent misconceptions among participants about using breastfeeding for pain relief during procedures existed. Participants felt that mothers would be uncomfortable breastfeeding during procedures and that breastfeeding during procedures could result in life-threatening complications such as choking. Due to the misconceptions, HCPs were unlikely to encourage mothers to breastfeed during procedures:

... when performing the procedure it is not suitable because the baby can cry and then get choked by the milk. Because if the pain is...the baby will leave the breast and start crying and may be the milk is coming out...can be choked. So me I don't prefer this one, may after the procedure (HCP 4, p. 13, lines 12-15).

Some participants felt that although clinicians would wish to use breastfeeding for pain relief, the absence of mothers, occasioned by timed visiting hours, made it impossible to routinely use it during painful procedures. HCPs concurred that allowing mothers unlimited, round the clock, access to the unit would increase the frequency of use of the intervention during procedures.

***Facilitated tucking.*** FT was not routinely practiced in either of the units. Nonetheless, participants' views represented great enthusiasm about adapting and using the intervention on neonates during procedures. Interpretation of the intervention as a method of restraining the neonate, rather than as an effective pain treatment intervention, appeared to inform the participants' perceptions. Despite the positive views among HCPs, there were contextual challenges to its routine use, including high patient population and staff shortage. Participants felt that they would use the intervention regularly if the conditions in the unit improved:

... personnel is a problem in the unit, you know! Our numbers are many and at times you may be caught you are just the nurse and the clinician maybe the nurse is acting on another patient ... so yeah it does help, yeah it's only that the limitation is the availability of personnel. If we had enough personnel this is the best (HCP 2, p. 8, lines 5-7, 16-17).

In lieu of the staff shortage, participants agreed that mothers should be involved in doing FT during procedures. Procedures for which mothers could be involved in were, however, limited. Reflecting on their clinical experiences, participants believed that mothers would not be comfortable positioning neonates during invasive procedures that may require multiple attempts to complete. A physician while reflecting on her experiences with mothers during procedures stated:

There are some who fear so they go away and come back later ... they don't like seeing the babies in pain, being pricked several times. Some of them can't handle it, to see the babies in pain so, they ask us to leave, leave first, wait for the procedure to be done then come back (HCP 5, p. 8, lines 1, 4-6).

Despite the acknowledgement that mothers may be uncomfortable positioning neonates during procedures, participants believed that mothers would develop the confidence to do FT if they are adequately prepared for their roles and on what to expect during procedures.

**Strategies for changing pain practices.** Creating awareness among staff, improved staffing levels, encouraging mothers' involvement, and use of reminders were described. HCPs' views about the strategies were informed by reflections on clinical experiences (Rycroft-Malone et al., 2004) and their understanding of the contextual challenges in the units.

***Creating awareness.*** Participants were emphatic about the need to create awareness among staff that neonates feel pain as a first step towards better pain practices. The need to make clinicians aware that even nonverbal and unresponsive neonates feel pain was emphasized. Informants felt that it was easy for clinicians to plan for pain treatment during procedures if they appreciated that neonates feel pain:

When we have changed the perception and we have come to the awareness that babies are like any other person who can feel pain, then the rest will follow. They will think, these are the interventions, these are the things at our disposal that we can employ for pain relief (HCP 13, p. 15, line 11-14).

Participants' views also portrayed the need to create awareness among HCPs about the pain treatment interventions. They also felt that HCPs needed to be made aware of the significance of treating pain in neonates and how to use the interventions during procedures. Participants also discussed the need to create awareness among HCPs about involving parents and, when possible, delaying procedures until mothers are available. Participants also felt that there was need to create awareness among mothers to be proactive in advocating for pain relief for their neonates. A nurse advised the researcher:

...with the mothers every morning talk to them, tell them that you have a right to be involved, which is a right most of mothers don't know. You have a right to be involved in the care of your baby, if you see a painful procedure happening you can even tell the doctor "can I hold the baby for you, can I put the baby on the breast, can I do kangaroo" as you are doing this procedure. Let them become aware that they should be involved in management of their ... babies (HCP 1, p. 15, lines 11-16).

***Improving staffing levels.*** Improved staffing was associated with improved pain practices including minimizing pain and better pain treatment practices. Due to inadequate staffing, they were compelled to complete procedures no matter the number of attempts. The pressure to complete procedures and high workload limited the chances of planning and implementing pain treatment interventions. Clinicians also felt that some of the pain treatments could only be considered for implementation when the staffing levels in the unit were improved:

... if we have enough personnel because you find that some of these procedures actually need involvement of more than one person. If there was enough personnel in the unit then we should be able to implement the same (HCP 2, p. 14, lines 16-18).

Participants felt that with improved staffing levels, procedures could be shared among clinicians; HCPs would pay more attention to individual neonate's needs rather than focusing on completing procedures. Overall, improving staffing would result in better quality of care including pain treatment practices.

***Encouraging mothers' involvement.*** Participants appreciated the significant role played by mothers in the treatment of pain. They felt that mothers should be encouraged to participate in the care of neonates during procedures and be informed of their right for involvement; and to be encouraged to take a proactive role in the care of neonates during procedures. Informants felt that involving mothers could prompt HCPs to use analgesia. The association between mothers' involvement in the care of the neonate and improved chances of using pain treatment interventions such as breastfeeding and KC during procedures was discussed. Informants also felt that they could work collaboratively with mothers during procedures to use other strategies if the mother is uncomfortable doing KC or if the neonate is unable to breastfeed:

... talking to the mother as in verbal issues, if you just talk to the mother and the mother keeps on communicating to the baby, availability of the mother if not necessarily breastfeeding the baby as such, even just being there like in the form of giving psychological support to the baby that is another way that we should be able to implement (HCP 2, p. 15, lines 1-4).

***Reminders.*** Participants desired a process where HCPs could be continuously reminded of the need to treat pain and the available pain treatment interventions. Verbal reminders, every morning, of the importance of treating pain and the need to actively involve mothers in the care of neonates during procedures was noted as a critical first step. The need to create paper-based and pictorial reminders was also discussed. A vivid account of what an effective reminder in the unit should entail was provided:

... take pictures and make them as small as possible, you don't magnify, like reduce them into small sizes where they can fit in a A4; this is pacifier, this is touch, put in every cube, so when someone is doing a line [fixing a cannula] and they can see that they say; ooh! Let me try this today! So if you take like every cube there like four laminated small pictures of babies going through...you doing a procedure, a procedure happening and that pain management is happening, somebody will definitely...remember to use the intervention (HCP 1, p. 14, lines 17-24).

Participants felt that the reminders could be placed in strategic points in the units such as on the walls of each room and beside the resuscitation table (or resuscitaire) where procedures



were performed. Reminders would continuously reinforce previously learned practices and serve as prompts for HCPs to plan for and use pain treatment interventions during procedures.

### **Interviews with Administrators**

Five main categories and 11 sub-categories capturing administrators' views about procedural pain treatment practices in two neonatal units in Kenya were generated (Table 12).

**Expectations.** Participants discussed the hospital administrations' views regarding pain treatment in neonates. There was a clear expectation that pain in neonates needed to be treated and that parents were to be involved in the care of the neonate during procedures. Accordingly, HCPs working in the neonatal units were expected to work towards meeting these expectations.

***Pain should be treated.*** Participants discussed the administrations' expectations regarding pain treatment. Participants felt that HCPs should minimize pain and use pain treatment interventions on neonates during procedures. The need to use both pharmacological and nonpharmacological pain treatment strategies during painful procedures was emphasized.

Administrators were, however, aware that some of the expectations were not being met.

Administrators committed to support HCPs until better pain practices are achieved:

We should work towards looking at ensuring that all babies that require some form of pain relief, whether drug or non-drug related should have that given [some form of pain relief given] and, so in my view it's something we should work towards because it is something that is important (Adm. 1, p. 3, lines 19-22).

***Parental involvement.*** Administrators acknowledged parents as partners in the care of hospitalized neonates. They felt that mothers should be actively involved, whenever they are available, in the care of the neonate during procedures. The benefits of involvement to both the mother and neonate were discussed; mothers would soothe the neonate during or immediately after the procedure. Participants acknowledged that mothers may be uncomfortable participating

in the care of neonates during procedures and the need for adequate preparation prior to involvement was emphasized:

I think it's for the parent or the mother to be available during procedure and people will argue about it will stress them or not but if it is explained to them what is happening, their presence and also the comfort they might be able to offer for the child goes a long way trying to help in pain relief both to the mother and even that small baby (Adm. 1, p. 4, lines 4-7).

Participants also felt that, even with the prior preparation, involvement during procedures may be traumatizing to some mothers. The need for HCPs to carefully evaluate individual mother's level of preparedness and preference was emphasized.

**Pain management interventions.** Pain in neonates was not treated as expected. Administrators isolated two pain treatment interventions, breastfeeding and KC, that they thought could be used by HCPs during painful procedures. Cost and availability of the interventions were the determining factors in the informants' choices. Participants felt that less costly and readily available interventions were more acceptable and feasible in the unit.

**Breastfeeding.** Participants felt that breastfeeding could be easily embraced by HCPs for pain treatment. Breastfeeding was practiced routinely in the units for feeding and HCPs were expected to encourage exclusive breastfeeding among mothers. Adapting a practice that was part of the existing unit's culture (McCormack et al., 2002) was thought to be easier. Similarly, it was felt that neonates are used to breastfeeding as a source of comfort when in pain or in stress. Absence of the mother during procedures was considered the main challenge to routine use of breastfeeding for pain relief. Solutions on how HCPs could overcome this challenge were suggested:

... actually it's the best if the mother is around. You just give the baby to the mother, obviously this is even a natural way where the baby will feel now am secure and, will really relieve the pain....or even sent for the mother, let the mother come so that she can put the baby on the breast and help in relieving the pain (Adm. 2, p. 16, lines 14-16, p. 17, lines 5-8).

Participants also favoured breastfeeding because it would minimize stress in mothers. They felt that being around the neonate during procedures and knowing that the neonate did not crying from pain would minimize stress in mothers.

***Kangaroo care.*** Administrators described how KC was routinely practiced in the unit, intermittently, but not for pain treatment. Although KC was mainly being used for warmth and bonding, participants felt that it could also be used during painful procedures. Minor infrastructural challenges, including limited space and lack of comfortable seats were thought to be the only impediments to its routine use for pain relief. Considering that HCPs were not accustomed to using KC for pain relief, administrators emphasized the need for constant support and reminders until it became part of the HCPs' daily practice:

... it is a very good procedure if we can be able to maintain it, ... So, I think it is acceptable, it's only that we need to emphasize so much that it becomes more routine as a practice (Adm. 2, p. 12, lines 7-10).

Some administrators who also worked on the floor were concerned about accessing the procedure site (e.g., during venepuncture, IM injection) with neonates in KC. Participants recommended that, for those procedures, the mother hold the neonate during the procedure but is helped to place the neonate in KC immediately the procedure is completed.

**Documentation practices.** Administrators described the documentation practices of HCPs as incomplete and selective. Painful procedures were either incompletely documented or HCPs documented some and left others undocumented.

***Incomplete documentation.*** Participants described aspects of procedures that they felt were not comprehensively documented. The category of HCP who performed the procedure, time of the day when the procedure was performed and number of attempts to complete the procedure are aspects that were rarely documented. The incomplete documentation was

associated with the staff shortage in the units. Participants felt that, due to the high clinician-patient ratio, HCPs were under pressure to complete care task at the end of a shift leaving minimal time for detailed documentation. Administrators continued to place a premium on the need for complete documentation during routine supportive supervision in the units:

... there are times you find that there are procedures that are done and they are not documented. And this we have really been trying to encourage all the clinical staff to ensure that whatever they do is well documented (Adm. 3, p. 1, lines 19-21).

**Selective documentation.** Participants felt that some procedures were always documented while others were missed. The level of invasiveness of the procedures determined what HCPs usually documented. Procedures such as intravenous cannulation, venepuncture for blood work and nasogastric tube placement were unlikely to be documented. More traumatic procedures such as chest tube insertion and exchange transfusion were always documented. Similarly, participants' views demonstrated selective documentation of pain treatment interventions. Whereas pharmacological analgesia was always documented, use of behavioural pain treatment interventions such as breastfeeding, holding, and positioning were rarely documented. An administrator who also worked on the floor, reflecting on her daily practice, said:

... if you requested a mother just to soothe the baby or hold the baby for you so that the baby could be a bit calm and you are doing the procedure which might inflict some pain, I haven't seen us write a mother held the baby or something like that to calm the baby or to relieve that pain (Adm. 2, p. 1, lines 18-21).

Although administrators expected HCPs to document all procedures, they felt that nurses bore the highest responsibility of ensuring complete documentation, by virtue of being with the neonates most of the time. Participants also acknowledged that the selective documentation posed the risk of compromising on the overall quality of neonatal care particularly when information critical for planning of subsequent care is not documented.

Table 12

*Administrators' Perspectives about Acceptability and Feasibility of Interventions*

Main Categories	Sub-categories
Expectations	Pain should be treated
	Parental involvement
Pain management interventions	Breastfeeding
	Kangaroo care
Documentation practices	Incomplete documentation
	Selective documentation
Contextual challenges	Misconceptions
	Workload
	Competing care priorities
Changing practice	Educating staff
	Improving on staffing

**Contextual challenges.** Administrators felt that contextual challenges affected use of pain treatment interventions in the units. The challenges posed by HCPs' misconceptions and attitudes, workload, and competing care priorities were identified. Participants felt that addressing these challenges would contribute to significant improvement in pain treatment practices.

**Misconceptions.** Participants discussed how misconceptions among HCPs affected procedural pain treatment practices in the units. According to administrators, most HCPs believed that neonates did not feel pain, their pain experiences were short-lived, or they can tolerate the pain without any form of pain relief. Administrators regretted that it was only through crying that neonates were recognized to be in pain. The need to change the misconception that only a crying neonate could be in pain was emphasized:

... if a baby is crying so much then, that is the only time it will prompt the caregivers to ensure that they do something about the crying. But sometimes the baby may just; ... the facial expression, these people have not been taking it very seriously; it is just the crying that is taken seriously (Adm. 3, p. 3, lines 1-4).

**Workload.** Participants acknowledged the challenge workload posed on HCPs' pain treatment practices. Informants felt that HCPs were often overwhelmed by the high patient population in the unit. They appreciated the desperate circumstances under which HCPs operated; the desire to sooth the neonate during procedures but with no one to assist in calming the neonate. Mothers who could assist in soothing the neonate were, often, not at the bedside during procedures. Due to the workload, administrators felt, HCPs could only sooth the neonate verbally although they would have wished to use other interventions like positioning. Administrators believed that with improved staffing, HCPs would work in pairs during procedures – one performing the procedure and the other giving some form of pain relief:

... sometimes you are alone, there is the issues of numbers and staff-patient ratio. If we had enough and, you have enough staffs in a unit, they will be able even to support one another because I would call you, tell you my friend or so and so come! I have this procedure; assist me so that we can do it. And in the process you could be calming down the baby to relieve the pain or I tell you to do something that would help the baby not feel a lot of pain when am doing the procedure (Adm. 2, p. 9, lines 15-20).

***Competing care priorities.*** Administrators described the unique challenge they felt HCPs faced as they tried to prioritize pain treatment among other care activities. Participants felt that it was easier to plan for scheduled treatment for post-operative pain compared with procedural pain. They described how, due to staff shortage and the unpredictable timing of procedures, HCPs were forced to focus on the core life-sustaining care activities:

In most cases if it's a baby in the new born unit, people focus on ensuring that the baby breaths, the baby is gaining weight, the baby is feeding, more than whether the baby is feeling pain. So you will find that due to the shortage of staff they will tend to do what they must do! (Adm. 3, p. 3, lines 7-9).

***Changing practice.*** Administrators felt that efforts to change pain practices should target both HCPs and the hospital administration. Informants discussed the need to (a) educate staff about pain in neonates and (b) improve staffing in the units.

***Educating staff.*** Administrators felt that lack of knowledge on pain in neonates and pain treatment interventions contributed to the undertreatment of pain. Clinical staff working in the units, including physicians, COs and RNs needed to be educated on pain, pain treatment interventions, and how to use the interventions during procedures. They stressed the need for education to be continued over time until use of the interventions became part of the HCP and unit's culture:

... a routine mention of these, because I think habits come from repetition, so giving the information from the onset, the people have a one to one with and then having that information repeated in one way or another throughout the year or throughout so that so things become routine (Adm. 1, p. 12, lines 1-4).

The need to educate staff on the importance of treating pain in neonates was also discussed. Participants felt that, to be successful, HCPs in other departments of the hospital and trainees who do clinical placement in the unit should also be educated about neonatal pain and procedural pain treatment interventions.

***Improving on staffing.*** Administrators emphasized the need for the hospital to consider improving on staffing if pain treatment practices were to improve. They admitted that improved knowledge without adequate resources would not translate to better pain practices. They argued that use of some of the pain management strategies, such as facilitated tucking, required resources in the form of staff. Participants described how with improved staffing HCPs would allow for improved care planning to achieve improved pain treatment during procedures:

... if they can have a good staff-patient ratio so that we don't have one person being overwhelmed because have so many patients. I think it would give some kind of support because the staff will be able now to work as a team and help each other when they are performing this procedures, painful procedures (Adm. 2, p. 10, lines 2-5).

## **Interviews with Mothers**

Analysis of mothers' transcribed data resulted in 3 main categories and 7 sub-categories (Table 13).

**Pain during hospitalization.** Mothers described the painful experiences that neonates underwent during hospitalization. Their views were related to the burden of pain and the untreatment of pain.

***Burden of pain.*** Mothers discussed the burden of pain that characterized the neonate's hospitalization experience. The procedures were many and varied; the pain was "a lot" and for some neonates, indescribable. The mothers vividly described painful procedures that characterized the neonates' hospitalization experience, including intravenous cannulation, NGT placement, and venepuncture for bloodwork. Mothers had not expected their neonates to undergo



so many painful procedures at the time of admission and especially considering that, to most, this was their first neonatal experience. Over time, however, mothers viewed the procedures as part of treatment that every neonate must undergo:

I was not expecting it. ... [thoughtfully] but I came to learn that she had to undergo all that process as part of treatment. There is no way she could have got treatment without those injections (Mother 15, p. 3, lines 6-8).

The effects of the numerous painful procedures to the neonate and the mother were described. Painful procedures left physical scars on the neonate's body that mothers felt would serve as a constant reminder of the eventful neonatal experience. Knowing that the neonate was repeatedly undergoing painful procedures was emotionally and psychologically traumatic to the mothers. These thoughts made some mothers cry. A feeling of helplessness, for not protecting the neonate from the painful procedures was evident in the mothers' voices. The effects of the procedures on mothers were made worse by clinicians who appeared not to appreciate what the mothers were going through:

You cannot have peace when your baby is in pain, when she is in pain you feel it too, you feel like they are performing the procedure on you. Unfortunately clinicians never understand that especially when you get emotional on seeing what your baby has to undergo (Mother 1, p. 3, lines 4-7).

***Untreatment of pain.*** Despite undergoing procedures repeatedly, mothers felt that neonates were not being given any form of pain relief. They recounted numerous incidents when neonates were placed back in the cot after the procedure, crying and without any form of pain relief. On few occasions, however, the mother was encouraged to pick up and soothe the neonate after the procedure. Mothers felt that clinicians were never concerned about pain treatment no matter the number of painful events neonates underwent:

... the doctor seeing the baby today will come and find the baby has no cannula, especially the cannula, so he will remove the tissue cannula without giving the baby any form of pain relief, the baby goes through so much pain! After that he proceeds to fix

another cannula without giving the baby any analgesic. So the baby really undergoes a lot of pain (Mother 9, p. 2, lines 16-20).

Some mothers described incidences when they felt their presence at the bedside prompted clinicians to treat the pain. Clinicians would gently handle and verbally soothe neonates during procedures when mothers were present. However, mothers felt that these attempts at pain treatment were not commensurate with the amount of pain neonates experienced.

**Feasible interventions.** Although pain was rarely treated, mothers described strategies that they thought could be used on neonates during painful procedures. They preferred the use of KC, breastfeeding, and facilitated tucking.

**Kangaroo care.** Mothers were aware of kangaroo care and occasionally practiced it in the unit for warmth. They described how the neonate easily calmed down when crying and slept shortly after feeding when put in the KC position. Reflecting on that experience, they felt that clinicians should routinely allow them to use KC during procedures. Mothers were prepared to work with HCPs to ensure that most procedures are performed when the neonate was in the KC position. The willingness of mothers to support use of KC was captured by a mother who said:

I can allow him to do it because in that position the baby won't cry for long, she will cry for a short while. But if he does the procedure away from my chest the baby will cry a lot, and it will take time to calm the baby after the procedure when I place her back on my chest (Mother 8, p. 5, lines 9-11).

**Breastfeeding.** Breastfeeding was also viewed as a strategy that could be used for pain relief. Mothers described how they were often requested by HCPs to soothe the neonate after the procedure through breastfeeding. Breastfeeding was also described as a strategy that mothers always used, instinctively, to calm a neonate when in distress. Using breastfeeding to soothe the neonate after procedures was very desirable but views on its use during procedures were divided. Whereas some mothers felt that they could breastfeed during procedures, others were afraid that the neonate may choke if a procedure was performed with the neonate on the breast:

The baby wont cry for long although, she may feel the pain is the needle goes in and maybe at that point you may get her out of the breast for the prick because if she cries she may get choked but give her the breast immediately the procedure is done (Mother 8, p. 9, lines 1-4)

***Facilitated tucking.*** Mothers also recommended the use of FT during painful procedures.

However, their views on the usefulness of the intervention appeared to be informed by a misinterpretation of the intervention as form of physical restraint. They felt that positioning the baby would enable the clinician to complete the procedure over a shorter time. Although mothers felt uncomfortable positioning the neonate during procedures, they were willing to endure the discomfort and support the neonate if only to lessen the burden of pain:

... it is painful because you see the baby is crying, and then the doctor is holding that needle now, so you just feel the pain the child is experiencing, you feel like crying. But just because it's my baby ... I can do anything! I will have to feel the pain she is experiencing (Mother 4, p. 3, lines 16-19).

Table 13

*Mothers' Perspectives about Pain and Acceptability and Feasibility of Interventions*

Main Categories	Sub-categories
Pain during hospitalisation	Burden of pain
	Untreatment of pain
Feasible interventions	Kangaroo care
	Breastfeeding
	Facilitated tucking
Improving on pain treatment	Involving mothers
	Educating mothers

**Improving on pain treatment.** Two strategies targeting mothers including involving mothers and educating mothers were identified.

***Involving mothers.*** Mothers felt that HCPs should actively involve them in the care of their neonates. Mothers were candid about ways they could help, including calming, holding, and breastfeeding the neonate after the procedure. Mothers observed that, although it was uncomfortable watching the neonate undergo procedures, it was more psychologically traumatizing by not being involved. Overall, maternal involvement was associated with better chances of the neonate to get some form of pain relief during or after the procedure:

You see. It's better to be involved because after the procedure I would hold my baby and try to calm her down because after the procedure she is left all alone in pain (Mother 3, p. 2, lines 19-20).

***Educating mothers.*** Mothers' views portrayed a great desire for knowledge on how to assist their neonates during painful procedures. They felt that HCPs should educate them about the strategies and how to use them during procedures. HCPs were expected to encourage mothers to use the interventions and to emphasize how use of the interventions may benefit the neonate:

Maybe talk to mothers and educate them on the benefits of those strategies. But there are some mothers who are not comfortable exposing themselves like when doing kangaroo. So it depends on individual mothers. But if you can talk to them and tell them "if you place the baby in this position the baby will calm down and will sleep". Because it is not easy to get it without being explained to its benefits (Mother 8, p. 11, lines 7-11).

## **Summary of Results**

Neonates in the study units underwent a total of 1693 painful procedures for an average of 1.5 procedures during each day of hospitalisation. Highly invasive and tissue-damaging procedures were the most prevalent with intravenous cannulation, venepuncture, IM injections and heel sticks constituting more than three quarters of the total procedures. IM injections were predominantly performed on neonates admitted in the Level I unit. The burden of pain was significantly aggravated by the supplemental attempts made on procedures. More procedures

were performed on preterm neonates, on the first 2 days of hospitalisation, during daytime, and on neonates admitted in the Level II neonatal unit.

Procedural pain treatment was disconcertingly sub-optimal and behavioural interventions were insignificantly used despite the administrations' expectation that procedural pain should be treated. Mothers were rarely involved during painful procedures despite their presence at the bedside and willingness to be involved. Lack of treatment of procedural pain was emotionally and psychologically traumatic to mothers. Contextual challenges including (a) workload, (b) perceptions and attitudes, (c) fear of side effects of analgesics and (d) competing care priorities were associated with the poor procedural pain treatment practices.

Mothers were acknowledged as critical resource for procedural pain treatment and their role in the care of neonates during procedures was emphasized. Mother-derived behavioural interventions (i.e., Breastfeeding and KC) and FT were found to be acceptable and feasible for implementation and routine use in the units for pain treatment. Implementation and routine use of the interventions would require creation of awareness among HCPs and mothers, change in perceptions and attitudes, improvement in staff levels and constant reminders on the need to use interventions during painful procedures.

## **CHAPTER SIX**

### **Discussion**

#### **Frequency of Painful Procedures**

Painful procedures are a frequent phenomenon in neonatal units (Carbajal et al., 2008) with immature and critically ill neonates undergoing the highest number of procedures (Chen et al., 2012; Johnston et al., 2011; Kyololo et al., 2014). Global estimates indicate that neonates undergo 4-16 painful procedures per day of hospitalization (Britto et al., 2014; Chen et al., 2012; Guedj et al., 2014; Roofthoof et al., 2014; Stevens et al., 2011). An earlier survey in Kenya found that neonates were undergoing, on average, 4.3 (SD = 2.0) painful procedures per day (Kyololo et al., 2014). In the current study, we found that neonates were undergoing significantly less procedures compared with what was reported in the country 2 years ago; 1.3 (SD = 1.5) for first attempt and 1.5 (SD = 1.8) for all attempts with some neonates undergoing up to 12 painful procedures per day. The current study covered the first seven days of life while the earlier study was a 24-hour retrospective chart review, mostly the first day of hospital admission (Kyololo et al., 2014). Most procedures are performed during the first days of hospitalisation (Chen et al., 2012; Stevens et al., 2003) which could explain the higher number of procedures in the previous study (Kyololo et al., 2014). The number of procedures per day after excluding days when neonates had no procedures was still significantly lower than the previous study results (Kyololo et al., 2014).

Researchers that prospectively followed neonates over a similar period (7 days) to this study have reported more painful procedures per neonate. A large multisite Canadian study (Johnston et al., 2011) and another in two Canadian NICUs (Stevens et al., 2003) found that neonates underwent 4 and 10 painful procedures per day respectively. The latter study was over a

decade ago and pain practices could have significantly changed since then, accounting for this difference.

Researchers who followed neonates for more than seven days in both LMICs (Britto et al., 2014; Chen et al., 2012; Jeong et al., 2014) and high-income countries (Carbajal et al., 2008; Roofthoof et al., 2014) also reported more procedures than we found. Jeong et al. (2014) and Britto et al. (2014) reported an average of 7.5 and 8.1 painful procedures per day in South Korea and India respectively while Chen et al. (2012) reported 6 painful procedures per day in Chinese NICUs. Two European studies reported nearly ten times the number of painful procedures we found in Kenya; 11.4 procedures per day in Dutch NICUs (Roofthoof et al., 2014) and 12 procedures per day in France (Carbajal et al., 2008).

The higher number of procedures in the North American (Johnston et al., 2011; Stevens et al., 2003), European (Carbajal et al., 2008; Roofthoof et al., 2014) and Asian (Britto et al., 2014; Chen et al., 2012; Jeong et al., 2014) NICUs could be associated with data collection techniques and level of neonatal care. In these studies, procedures were prospectively documented at the bedside which may have been more comprehensive compared with the chart review method we used. Additionally, we conducted our study in a Level I and a Level II neonatal unit while the other studies (Britto et al., 2014; Carbajal et al., et al., 2008; Chen et al., 2012; Jeong et al., 2014; Johnston et al., 2012; Roofthoof et al., 2014; Stevens et al., 2003) were conducted in Level III units (NICUs) which, conventionally, admit more critically ill neonates (APA, 2012) that are prone to the highest number of painful procedures (Stevens et al, 2003). The less number of procedures in our study could also be resource-related. Neonatal units in Kenya lack materials, supplies and expertise to perform some of the procedures (e.g., insertion of

central catheters and umbilical lines, chest tube draining, intubation, tracheal suctioning) that contributed substantially to the burden of pain in the other settings.

Although procedures were performed on all neonates, the younger ( $\leq 2$  days), preterm and those admitted in the Level II unit underwent more procedures and were more likely to undergo procedures than their counterparts. We also found that neonates underwent more procedures during daytime. Preterm and newly admitted neonates are likely to be critically ill which could have predisposed them to more diagnostic and treatment-related procedures. Numerous researchers have reported consistent findings; the most immature neonates undergo the highest number of painful procedures (Jeong et al., 2014; Roofthoof et al., 2014). Chen and colleagues (2012) also reported more painful procedures among preterm (6 per day) than term (5 per day) neonates. A relationship between higher levels of care and more painful procedures has also been reported (Stevens et al., 2011). Kyololo et al. (2014) also found that neonates in Level II neonatal units underwent 1.5 times the number of procedures experienced by neonates in Level I units. Four other researchers (Chen et al., 2012; Jeong et al., 2014; Stevens et al., 2003; Simons et al., 2003) found that most procedures were performed during the first 2 days of life. Only one researcher who categorized suctioning, the most frequently performed procedure, as stressful rather than painful reported no relationship between day of life and frequency of procedures (Carbajal et al., 2008).

Consistent with our study, Britto et al. (2014), in an Indian NICU, found that most procedures were performed during daytime but Johnston et al. (2011) found no difference in the number of procedures between daytime and night time. Most laboratory investigations (e.g., bloodwork for urea and creatinine levels, heel sticks) were ordered and done during physicians' rounds; predominantly during day time. Additionally, medications that were ordered to be given



once daily (e.g., IM injection for aminoglycosides) were mainly administered during the 9 a.m. medication schedule due to better staffing levels during morning shifts. These care practices could possibly explain the higher frequency of procedures during daytime. Nonetheless, larger, multi-site studies would shed more light on the influence of time of the day on frequency of procedures.

### **Nature of Procedures**

More tissue-damaging procedures than non tissue-damaging procedures were performed; there were three tissue-damaging procedures for every non tissue-damaging procedure. These findings are consistent with the results of a previous Kenyan study (Kyololo et al., 2014) but a complete contrast from a Canadian study that found that non tissue-damaging procedures (3 per neonate per day) predominated over tissue-damaging procedures (0.8 per neonate per day) (Johnston et al., 2011). The higher proportion of non tissue-damaging procedures in the Canadian study could be practice-related. Tracheal and gastric aspirations, the most frequently performed procedures in Canada (30.2% of total procedures), were not performed in Kenya because none of the neonates were intubated. Additionally, there are no protocols on suctioning in Kenyan neonatal units; suctioning is mainly done during resuscitation which is different from the practice in Canadian NICUs where intubated neonates are frequently suctioned to maintain airway patency (Kalyn, Blatz, Feuerstake, Paes, & Bautista, 2003).

The most prevalent procedures (i.e., intravenous cannulation, IM injection, venepuncture and heel stick) constituted two thirds and three-quarters of the total procedures on observation and review of medical records respectively in our study. This finding is consistent with results of an earlier Kenyan (Kyololo et al., 2014) and a Canadian study (Stevens et al., 2003); but strikingly inconsistent with findings from numerous studies in LMICs (Britto et al., 2014; Chen

et al., 2012; Jeong et al., 2014) and high-income countries (Carbajal et al., 2008; Cignacco et al., 2009; Johnston et al., 2011; Roofthoof et al., 2014; Stevens et al., 2011). The four procedures constituted 60% of the total procedures in the earlier Kenyan study (Kyololo et al., 2014), 19% in South Korea (Jeong et al., 2014) and 14% in the Netherlands (Roofthoof et al., 2014). Mothers felt that the highest burden of pain on their babies emanated from intravenous cannulation and venepuncture. These findings, from multiple sources, lend credence to the argument that neonates in Kenya undergo more highly invasive procedures than in other settings (Kyololo et al., 2014).

Intravenous cannulation (28.5% and 24%), venepuncture (17.8% and 11.5%) and heel stick (9% and 10.5%) substantially defined the pain experiences through review of records and observations. In China, the frequency of the individual procedures was significantly different from Kenya's save for one procedure; intravenous cannulation that was performed at a comparable frequency (21%) while venepuncture (4.4%) and heel sticks (3.8%) were scarcely performed (Chen et al., 2012). Intravenous cannulation (3.2%) and venepuncture (7%) were also performed significantly less often in India but heel stick was performed at a significantly higher frequency than in our study (9% vs. 30%) (Britto et al., 2014). Heel stick was performed at a higher frequency in France – 19.5% (Carbajal et al., 2008), the Netherlands - 10.7% (Roofthoof et al., 2014) and Canada – 12.6% (Johnston et al., 2011) but less frequently in Switzerland – 5.2% (Cignacco et al., 2009) compared to Kenya. Intravenous cannulation and venepuncture were the least performed procedures in high-income countries (Carbajal et al., 2008; Cignacco et al., 2009; Johnston et al., 2011). In Netherlands, for instance, intravenous cannulation (2.2%) and venepuncture (0.2%) were rarely performed (Roofthoof et al., 2014).

Clinical context may contribute to the high frequency of intravenous cannulation and venepuncture in Kenya compared to other countries. The Level I and Level II neonatal units in Kenya, unlike NICUs in the other countries, lacked the resources (supplies and skilled HCPs) for placement of long-lasting central lines (Kyololo et al., 2014). Peripherally inserted intravenous cannulas, which are prone to dislodgement, were used for all treatment interventions requiring venous access. Replacement of the dislodged intravenous cannula could possibly account for the higher frequency of the procedure in Kenya compared to other countries. Conversely, insertion of central lines (central catheter, umbilical catheter) was performed in the studies that reported less intravenous cannulations. Indwelling blood sampling catheters are used in many NICUs globally (von Lindern & Lopriore, 2014) which may explain why venepuncture was not performed or performed significantly less frequently in the other countries compared to Kenya.

IM injections contributed to about a fifth of the total procedures in both samples which is comparable to the 22% reported in the previous Kenyan survey (Kyololo et al., 2014). Conversely, IM injection is rarely performed in other countries including Canada – 2.2% (Johnston et al., 2011), India – 2.3% (Britto et al., 2009), South Korea – 0.4% (Jeong et al., 2014), China – 0% (Chen et al., 2012), France – 0% (Carbajal et al., 2008), Switzerland – 0.1% (Cignacco et al., 2009), and the Netherlands – 0% (Roofthoof et al., 2014). In Canada, the intramuscular injection was discontinued across paediatric settings due to (a) the pain associated with it and (b) availability of alternative routes (e.g., IV or oral) of administering most pharmacological agents (Ellis et al., 2002). There are a few exceptions including the Vitamin K injection at birth and immunizations. It is unclear why other settings would report no IM injections considering that Vitamin K is administered at birth intramuscularly in most countries globally (Van Winckel, De Bruyne, Van De Velde, & Van Biersliet, 2009).

Although the high number of IM injections in neonatal units in Kenya had previously been associated with delays in insertion of intravenous cannulas due to shortage of physicians (Kyololo et al., 2014), a careful scrutiny of data appeared to disapprove the argument. Three quarters of the IM injections were performed on neonates in the Level I neonatal unit. Some antibiotics (e.g., aminoglycosides) that were ordered for intravenous administration were given intramuscularly even when the neonate had an intravenous cannula in situ. Interviews with HCPs in the unit revealed inherent fears and misconceptions about development of complications from intravenous administration of the medication. Some of these IM injections could have been avoided if evidence-based practice guidelines existed and were used and if medical orders were followed. This finding highlights the existence of unit-specific practice cultures (McCormack et al., 2002) that are unsupported by scientific evidence; and that should be addressed if the burden of pain in neonates in Kenya is to be minimized.

Less invasive procedures including nasogastric tube placement, removal of tapes, nasopharyngeal suctioning and nasal cannulation were consistently the least performed procedures; constituting a total 22.7% and 26% of the documented and observed procedures respectively. Kyololo et al. (2014) previously found that the less invasive procedures contributed the least burden of pain in the country. Conversely, these less invasive procedures were the most frequently performed in NICUs in other LMICs (Britto et al., 2014; Chen et al., 2012; Jeong et al., 2014) and high-income settings (Carbajal et al., 2008; Cignacco et al., 2009; Johnston et al., 2011; Roofthoof et al., 2014). For instance, suctioning alone (i.e., oral, tracheal, and nasal) constituted 32% of the procedures in China (Chen et al., 2012), 83.1% in South Korea (Jeong et al., 2014), 40% in Canada (Johnston et al., 2011), 52.2% in France (Carbajal et al., 2008), and 64% in the Netherlands (Roofthoof et al., 2014). Removal of adhesives contributed 29% of the

procedures in India (Britto et al., 2014) and 13-14% of the procedures in Chinese, Canadian and French NICUs (Carbajal et al., 2008; Chen et al., 2012; Johnston et al., 2011) compared with 5.5% in Kenya.

Differences in level of care may account for the high frequency of suctioning and removal of adhesives in the India, China, South Korea, Netherlands, France and Canada compared with Kenya. The Asian (Britto et al., 2014; Chen et al., 2012; Jeong et al., 2014), North American (Johnston et al., 2011) and European studies (Carbajal et al., 2008; Cignacco et al., 2009; Roofthoof et al., 2014) were conducted in NICUs that provide respiratory support via endotracheal tube (APA, 2012). Notably, endotracheal intubation and extubation accounted for a substantial proportion of procedures in these settings. Mechanically ventilated neonates are likely to undergo tracheal and nasopharyngeal suctioning more frequently; mainly due to ventilator and cardiac monitor alarms (Gardner & Shirland, 2009). In our study, removal of adhesive tapes was predominantly associated with changing of intravenous cannulas while in other settings the procedure may have also included removal of cardiac monitor leads which may explain its higher frequency in India (Britto et al., 2014), China (Chen et al., 2012), France (Carbajal et al., 2008) and Canada (Johnston et al., 2011).

HCPs and administrators viewed non-invasive procedures as “normal” and routine procedures that were not necessarily documented. This selective documentation of procedures was also noted in Canadian NICUs where “routine” procedures such as nasogastric tube placement and removal of tapes were rarely documented (Stevens et al., 2003). Because our observations were limited to specific times of the day, we may not have observed the full spectrum of procedures to compensate for the reporting bias. The documentation practices may partly account for the slightly less frequency of non-invasive procedures in our study.

## **Procedural Pain Treatment Practices**

The frequency of pain treatment was very low in our study; a single procedure through review of records and eight on observation were accompanied by an intervention. The nine incidences of use of interventions is not plausibly better than none that was previously reported in the country (Kyololo et al., 2014). The Kenyan situation is consistent with other LMICs (Chen et al., 2012) but inconsistent with pain treatment practices in high-income countries in Australia (Foster et al., 2013; Harrison, Loughnan, Manias, & Johnston, 2009), Europe (Carbajal et al., 2008; Cignacco et al., 2009; Rennix et al., 2004; Roofthoof et al., 2014), and North America (Johnston et al., 2011; Stevens et al., 2011) where 20-50% of procedures are accompanied by an intervention; mainly behavioural and sweet-tasting solution interventions.

Interviews with HCPs and administrators revealed selective documentation of pain treatment interventions; nonpharmacological interventions (e.g., breastfeeding, maternal holding, sucking a finger, positioning) were occasionally used but not documented. Similarly, few mothers described using breastfeeding and holding their neonates during or immediately after procedures. Although we did not observe substantial use of the interventions by either mothers or HCPs, their views suggest that the poor pain treatment practices are reversible.

The higher frequency of pain treatment in high-income countries has been as result of concerted efforts involving researchers, training institutions and hospitals. Educational initiatives at pre-licensure (Hunter et al., 2008; Watt-Watson & Siddall, 2013) and post-licensure training levels (Dunbar et al., 2006; Ellis et al., 2007; Johnston et al., 2007; Stevens et al., 2014) have resulted in significant improvements in knowledge and attitudes towards pain and pain treatment. Organizational commitment to better pain practices (Zhu et al., 2012) and sustained initiatives targeted at addressing unit-specific barriers and improving contexts for pain treatment have also

been witnessed in many high-income countries (Cregin et al., 2008; Jordan-Marsh et al., 2004; Stevens et al., 2014; Zhu et al., 2012).

There has been increased knowledge synthesis of pain treatment interventions in the form of systematic reviews (Bueno et al., 2013; Johnston et al., 2014; Pillai Riddell et al., 2011; Shah et al., 2012; Stevens et al., 2013) and clinical practice guidelines (AAP, 2016; Lee et al., 2014) in high-income countries. Although the practice guidelines are intended to bridge the evidence-practice gap, most are of poor quality; few are rigorously developed and most lack tools to guide clinicians on how to implement them in practice (Lee et al., 2014). There exists no clinical practice guidelines on pain treatment in neonatal units in Kenya (Kyololo et al., 2014) and access to empirical evidence on pain treatment interventions is very limited in most sub-Saharan countries including Kenya (Molyneux, 2012). The availability synthesized sources of evidence (Rycroft-Malone et al., 2004) such as systematic reviews and guidelines in high-income countries could explain the better pain treatment practices in those settings compared to Kenya.

HCPs and administrators highlighted lack of knowledge and negative attitudes towards neonatal pain as challenges to optimal pain treatment in the units. They also revealed the existence of misconceptions that neonates do not feel pain or they tolerate pain better. The misconceptions are not unique to Kenya (Akuma & Jordan, 2012; Cong, Delaney & Vazquez, 2013). Gibbins et al. (2015) and Stevens and colleagues (2011) reported similar misconceptions among Canadian HCPs; they felt that it was difficult to discriminate pain in neonates thus hindering the use of pain treatment interventions. The misconceptions and negative attitudes should be addressed if improved pain treatment practices are to be realized in Kenya.

HCPs and administrators believed that lack of resources made for an unfavourable context for utilisation of interventions (Rycroft-Malone et al., 2004; Squires et al., 2012). Staff,

time and infrastructure (e.g., space, reclining seats and stools) have been shown to affect routine use of pain interventions such as KC (Cong, Ludington-Hoe, Vazquez, Zhang, & Zaffetti, 2013; Johnston et al., 2014; McNair et al., 2013) and FT (Cignacco et al., 2007). Administrators and HCPs felt it was impossible to routinely use FT for pain treatment due to staff shortages and agreed with other researchers (Axelin et al., 2006; Cignacco et al., 2007) that mothers could be used as alternatives. The actual impact of these contextual challenges on the use of pain management strategies was not quantified.

Researchers have demonstrated the influence of different facets of context on use of evidence in neonatal pain treatment (Cummings et al., 2010). Squires et al. (2013) found positive leadership, empowering culture, openness to evaluation, formal and informal interactions among HCPs and sufficient resources to influence use of evidence-based pain treatment strategies in Canadian hospitals. Unlike Kenyan HCPs and administrators, Squires and colleagues (2013) found no relationship between organizational slack (i.e., human resource and time) and use of pain treatment interventions. Efforts to improve procedural pain treatment practices in Kenya would benefit from a comprehensive understanding of which contextual factors would drive successful use of evidence in resource-limited settings.

### **Factors Influencing the Use of Interventions**

**Neonatal factors.** The small number of painful procedures that were accompanied with interventions precluded development of a predictive model to explore the influence of GA, day of life and severity of illness on use of interventions during procedures. Large prospective multisite studies in Kenya would be required to comprehensively answer the research question.

**Gestational age.** Interventions were used equally between term and preterm neonates. Although it is statistically illogical to draw further inference from our study, Carbajal et al.



(2008) and Cignacco et al. (2009) found that preterm neonates were more likely to receive interventions. Johnston and colleagues (2011) also found that neonates born less than 28 weeks GA were 1.5 times more likely to receive behavioural interventions for tissue-damaging and non tissue-damaging procedures. The (a) repertoire of evidence on the efficacy and safety of behavioural interventions (Johnston et al., 2014; Pillai Riddell et al., 2011; Shah et al., 2012), (b) plethora of practice guidelines (Lee et al., 2014) and (c) fact that the interventions can be used without a medical order may explain the high rate of their use in preterm neonates.

Although no procedure was accompanied by a sweet-tasting solution intervention, researchers have reported inconsistent results regarding the influence of GA on use of the sweet-tasting solutions. Carbajal et al. (2008) found that preterm neonates were more likely to receive sweet-tasting solutions while Johnston et al. (2011) found no relationship between GA and use of sweet solutions. The only caution to routine use of sweet-tasting interventions is extreme prematurity (Johnston et al., 2002; Johnston et al., 2007). Johnston et al. (2002) found that repeated doses of oral sucrose (> 10 doses over a 24 hour period) caused poor motor development, diminished vigour and alertness and impaired orientation in neonates born before 31 weeks GA. Johnston's findings may be challenged from a methodological perspective; (a) the study was limited to the first week of life when most procedures are performed, (b) only a fraction of the sample had all outcome measures taken and (c) the adverse effects were reported 1-2 weeks after the last dose of sucrose (Johnston et al., 2002). The negative effects may have been a manifestation of the neonates' inability to develop self-modulating behaviours after cessation of continuous external modulation with oral sucrose rather than actual adverse effects. Nonetheless, oral sucrose continues to be used with caution in extremely preterm neonates until these safety concerns are conclusively addressed (Stevens et al., 2013).

**Severity of illness.** On the six occasions when behavioural interventions were observed, they were used on moderately ill neonates. Other researchers have found behavioural interventions to be used on less ill neonates (Carbajal et al., 2008). Johnston et al. (2011) also found that less critically ill neonates were more likely to receive behavioural interventions for invasive and non-invasive procedures. Generally, it is neither feasible nor recommended to use interventions such as KC, breastfeeding, FT and swaddling on physiologically unstable and critically ill neonates even for routine nursing care (APA, 2012; Byers, 2003; Jefferies et al., 2012). The predominant use of behavioural interventions on less critically ill neonates could also point to practice cultures in NICUs (McCormack et al., 2002; Rycroft-Malone et al., 2004) where pharmacological interventions are almost exclusively used in critically ill neonates (Johnston et al., 2011).

Johnston and colleagues (2011) and Carbajal et al. (2008) found that less acutely ill neonates were more likely to receive sweet-tasting interventions during procedures. Empirical evidence on the use of sweet-tasting solutions with critically ill neonates and the safety of multiple doses during procedures is inconclusive (Holsti & Grunau, 2010; Johnston et al., 2002; Stevens et al. 2013). Considering that the most critically ill neonates undergo the highest number of procedures (Stevens et al., 2003; Carbajal et al., 2008), it is recommended that clinicians exercise caution when using sweet-tasting solutions repeatedly for procedures with critically ill neonates.

**Day of life.** Of the procedures accompanied by interventions, five were performed during the first week of life. Carbajal et al. (2008) found that specific interventions, including behavioural and sweet-tasting interventions, were two times more likely to be used between day 2 and day 14 of life while Johnston et al. (2011) found no relationship between day of life and

use of behavioural interventions. Sweet-tasting solution interventions were, however, less likely to be used during the first week of life (Johnston et al., 2011). The high acuity of neonates during the first days of life coupled with the inconclusive evidence on safety of sweet-tasting solution interventions for critically ill neonates (Johnston et al., 2002; Stevens et al., 2013) may account for the low incidence of use of interventions with sicker neonates. Researchers should further explore the influence of day of life on use of interventions and the factors that affect the variability.

### **Situational factors.**

***Place of birth.*** Interventions were used proportionately more on inborn than on outborn neonates. Johnston et al. (2011) found that inborn neonates were 2.4 and 1.8 times more likely to receive behavioural and sweet-tasting solution interventions, respectively, for tissue-damaging procedures than out-born neonates. Being inborn was also associated with the likelihood of receiving behavioural but not sweet-tasting solution interventions, for non tissue-damaging procedures in Canada (Johnston et al. 2011). Although there is no contra-indication to the use of pain treatment interventions by place of birth, clinicians may perceive outborn neonates as critically ill and, therefore, use of behavioural interventions not feasible. Additionally, the empirical evidence that sweet-tasting solutions may be unsafe for critically ill neonates (Harrison et al., 2012; Holsti & Grunau, 2010; Stevens et al. 2013) may account for less use of the intervention on outborn neonates if they are perceived to be critically ill.

***Presence of Parents.*** Although two fifths of the procedures were performed in the presence of parents, their presence did not translate to better use of pain interventions. Other studies have not supported this finding. Carbajal et al. (2008) and Johnston et al. (2011) showed that behavioural and sweet-tasting solution interventions for both tissue-damaging and non

tissue-damaging procedures were more likely to be used in the presence of parents. Presence of a parent at the bedside increased the likelihood of receiving a behavioural intervention (e.g., NNS, swaddling) by 1.6 times and a sweet-tasting solution intervention by 2.3 times (Johnston et al., 2011).

Interviews with HCPs, administrators and mothers revealed contrasting perceptions regarding parental presence and involvement during procedures. Administrators expected mothers to be involved in the care of their hospitalized neonates; mothers desired to be involved to calm the neonate during painful procedures but HCPs disagreed. This mismatch between the administrations' expectations and clinicians' perceptions (Rycroft-Malone et al., 2004) likely resulted in the underutilization of mothers for pain treatment. Nonetheless, the high incidence of maternal presence during procedures points to a favourable clinical context that can be modified for better pain treatment practices (McCormack et al., 2002; Squires et al., 2012). Their unequivocal desire to be actively involved during procedures and their familiarity and experience with some of the pain treatment strategies (e.g., KC, breastfeeding, holding) provides the best impetus to include them in pain relief efforts.

***Number and invasiveness of procedures.*** Although we found no relationship between frequency and invasiveness of procedures and use of interventions, other researchers such as Stevens et al. (2011) found that the frequency of use of interventions increased with increasing number of procedures. Carbajal et al. (2008) also found that interventions were more likely to be used for the most invasive procedures; specific analgesia (including behavioural and sweet-tasting interventions) was 13 times and 50 times more likely to be used for needle stick and chest tube insertion, respectively, than for nasogastric tube insertion. It is unclear why clinicians would mainly use interventions on neonates who undergo more and highly invasive procedures since

every episode of pain ought to be treated (Lee et al., 2014). Perhaps clinicians become more concerned about pain treatment based on the perceived cumulative burden of pain and anticipated pain intensity (Batton et al., 2006). Or it could be that clinicians are aware of the relationship between higher numbers of untreated painful events and increased risk for long-term complications (Brummelte et al., 2012; Vinall et al., 2014).

***Time of the day.*** The majority of interventions were implemented during day time. Researchers have found specific analgesia to be more likely to be used during daytime (Carbajal et al., 2008) while others have found the use of interventions to be high in the morning, tapering throughout the day to the lowest at late night (Guedj et al., 2014). Variability in use of interventions between day and night could be accounted for by workload (Guedj et al., 2014) and differences in leadership and teamwork between shifts (McCormack et al., 2002; Rycroft-Malone, 2004). The leader in any shift should galvanize a sense of teamwork towards the unit's goals (e.g., use of interventions for every procedure). For optimal pain treatment round the clock, HCPs should be supported with the requisite resources (e.g., better staffing) (Rycroft-Malone et al., 2004; Squires et al., 2012) and a leadership structure that cultivates teamwork and shared vision during each shift (McCormack et al., 2002; Rycroft-Malone, 2004).

***Socio-economic status.*** A higher proportion of procedures accompanied by interventions was performed on neonates born of mothers in the low-income group. Notably, more than half of the neonates observed (52%) were born of mothers in the low SES which may explain the finding. We had hypothesized that neonates of mothers in the middle-to-high SES group would be treated for pain more often. Our assumption was that mothers in the high socio-economic group would more likely advocate for the use of interventions during procedures. Due to the small number of procedures accompanied by interventions, it was not feasible to explore our

hypothesis. We also did not find any study reporting on the relationship between SES and use of behavioural and sweet-tasting solution interventions. Interestingly, all mothers were concerned about undertreatment of procedural pain and desired to be involved during procedures notwithstanding the SES. This finding suggests that SES of the mother may not necessarily influence use of interventions during procedures as we had hypothesized.

**Level of care.** Most interventions (8 out of 9) were used on neonates admitted in the Level II unit. The higher use does not, however, suggest a predictive relationship between level of care and use of interventions. A number of researchers have found significant site differences in the frequency of specific and non-specific analgesia during procedures (Carbajal et al., 2008; Johnston et al., 2011; Kahn et al., 1998). Such differences were not predictive in nature. Generally, each neonatal unit is a unique context with regard to policies and guidelines, training competences, care priorities and resource availability (McCormack et al., 2002; Rycroft-Malone et al., 2001; Rycroft-Malone, 2004; Squires et al., 2012). It would be challenging to explain differences in pain treatment practices between units and levels of care without, first of all, accounting for these confounding variables.

### **Acceptability and Feasibility of Behavioural and Sweet-tasting Solution Interventions**

Participants reflected on the spectrum of behavioural and sweet-tasting solution interventions and concurred that breastfeeding, KC and FT would be acceptable and feasible to implement in neonatal units in Kenya. Participants' views reflected a conscientious balance between inherent contextual challenges to routine use and potential benefits of using the interventions for pain treatment.

**Breastfeeding.** Participants felt that breastfeeding could be adapted and used routinely for pain treatment. Clinicians' training on promoting breastfeeding and mothers' experiences

with the intervention as a comfort measure informed their perceptions. These determining factors are consistent with some of the sources of evidence proposed in the PARiHS framework (Kitson et al., 2008; Rycroft-Malone et al., 2004). Efficacy of breastfeeding for pain treatment appeared not to influence participants' views possibly due to lack of access to the research evidence. Nonetheless, the role of research evidence (Rycroft-Malone et al., 2004) can neither be replaced by clinician practice experiences nor by the mothers' preferences.

There were safety and availability concerns related to use of the intervention. HCPs and mothers thought that using breastfeeding during procedures posed the risk of choking; favouring use of the intervention after procedures. Risk of choking is not supported by empirical evidence; Zhu et al. (2015) and Taddio et al. (2009) reported no incidence of choking when breastfeeding was used during heel lancing and immunization respectively.

Although the challenge posed by unavailability of the mother has been reported in other studies (Campbell-Yeo et al., 2011; Harrison et al., 2015), we observed many instances in Kenya when mothers were at the bedside during procedures. It, therefore, appears that presence of mothers may not be a major challenge in neonatal units in Kenya for as long as clinicians embrace the principles of family-centred care. Overcoming the misconceptions about choking, changing clinicians' practice culture (McCormack et al., 2002) and keeping abreast with the latest research evidence on efficacy of the intervention (Kitson et al., 2008; Rycroft-Malone et al., 2002) is likely to result in successful implementation of the intervention in the neonatal units.

**Kangaroo care.** All participants thought of KC as an acceptable and feasible intervention given it was a familiar practice; used routinely for warmth and bonding. This finding supports what has been observed by many other researchers (Campbell-Yeo et al., 2011; Cignacco et al., 2010; Harrison et al., 2015). Johnston et al. (2011) found KC to be acceptable and feasible for

pain treatment in Canadian NICUs. That KC was routinely practiced in the unit, albeit not for pain treatment, is indicative of a receptive clinical context for implementation (McCormack et al., 2002; Rycroft-Malone, 2004). With an administration that supports use of KC and HCPs who advocate for the practice, it is logical to expect the intervention to be adapted for pain treatment in the neonatal units.

Insufficient resources (e.g., space and comfortable seats for mothers), ergonomics of performing certain procedures when neonates are in KC and unavailability of the mothers were identified as the main implementation challenges. Although sufficient resources characterize receptive clinical contexts for implementation of evidence (Rycroft-Malone et al., 2004; Squires et al., 2012), availing the suggested supplies and equipment may not be feasible in a resource-limited setting. Working judiciously with the available resources such as designating a procedure point, using a reclining chair or an adjustable bed in the procedure room, with a low-rise stool for the clinician, would mitigate the infrastructural challenges (Cong et al., 2013; McNair et al., 2013).

The ergonomic challenges of performing procedures such as heel sticks and venepuncture with neonates in KC has been a pertinent concern in numerous other settings (Chia, Sellick, & Gan, 2006; Cong et al., 2013). However, with skills training and role-modelling, clinicians have developed the competence to perform most procedures in KC (Chia et al., 2006). Additionally, modifying procedure techniques such as gently pulling out the lower limb under the mother's gown for heel stick or pulling the upper limb over the gown for intravenous cannulation could make the procedure site more accessible with the neonate in KC (McNair et al., 2013).

Availability of mothers during procedures has been frequently cited as a barrier to routine use of KC for pain relief (Campbell-Yeo et al., 2011; Harrison et al., 2013). A substantial



number of mothers were present and many desired to be involved during painful procedures. This finding suggests that unavailability of the mother would not be a concern if clinicians were considerate of mothers' preferences. Practice and policy changes in the neonatal units would be required for a successful implementation and routine use of KC for pain treatment. Embracing the principles of family-centred care and scheduling non-urgent procedures until the mother is available are critical first steps (Lee, Carter, Stevenson, & Harrison, 2014; McNair et al., 2013).

**Facilitated tucking.** Participants thought that FT would be feasible and acceptable mainly because of a misinterpretation of the intervention as a form of immobilization rather than a pain treatment strategy. Other researchers have found FT to be feasible and acceptable in neonatal units (Axelin et al., 2006; Herrington & Chiodo, 2014). Axelin et al. (2010) reported that Finnish mothers perceived FT positively and wished to continue using it for pain relief.

The misinterpretation of FT as a method of restraint is not unique to our study; studies in countries that have used the intervention extensively for pain treatment have reported similar misconceptions (Johnston et al., 2011). Accordingly, it is comprehensible when HCPs with no prior experience of using FT misconstrue it as form of immobilization. Nonetheless, the misperception must be addressed if implementation of the intervention is to translate to better pain treatment practices in the neonatal units.

Administrators and HCPs viewed staff shortage as the major challenge to routine use of FT. Cignacco and colleagues (2010) found that nurses were constrained in using FT during procedures due to low staffing levels. Although administrators and HCPs agreed that mothers could perform FT, there was a perception that mothers would be uncomfortable holding the neonate during procedures. Conversely, mothers' views reflected a great desire for involvement in doing FT. Therefore, the challenge with resource constraints could be overcome if mothers'

views are sought and their preferences considered when planning for pain treatment in the neonatal units.

### **Factors Influencing Acceptability and Feasibility of Interventions**

Evidential and contextual factors including resource implications, safety and familiarity with the interventions informed participants' perceptions about acceptability and feasibility.

**Resource implications.** Participants placed a high premium on resource implications of implementing interventions in the neonatal units. Interventions that were readily available, inexpensive, accessible and sustainable in the long-term were preferred. Mother-driven interventions were thought to be less-resource intense in terms of availability and ease of access. These resource considerations, in accord with the PARIHS framework, shape the context for the successful implementation of interventions (Rycroft-Malone et al., 2013).

Participants were also concerned about the financial implications, to the hospital and the family, of implementing interventions. Interventions described as “cost-free” were the most acceptable; indicating that participants were cognizant of the resource constraints in the units. HCPs and administrators felt that it was unreasonable to expect the hospital to budget for costly interventions at the expense of basic life-saving drugs, equipment and supplies. With these competing resource priorities, it makes intuitive sense that participants would choose interventions with the least financial implications.

Although oral sucrose was not thought to be feasible on account of unavailability and cost, there exists equally safe and efficacious alternatives such as dextrose and glucose solutions (Bueno et al., 2013; Uzelli & Günes, 2015). Dextrose solution, in particular, is readily available in the units and is regularly given orally during blood exchange transfusion, ostensibly, to prevent hypoglycaemia. With the available research evidence on effectiveness of the solution for

pain treatment (Bueno et al., 2013; Uzelli & Günes, 2015) and the favourable practice culture in the neonatal units (McCormack et al., 2002), it is possible that it could be used for pain treatment without a significant resource implication to the unit and the hospital.

A conscientious consideration of the resource implications of implementing evidence into practice including fiscal, time and skills has been highlighted in implementation frameworks (Rycroft-Malone et al., 2004; Squires et al., 2012). The need to judiciously strike a balance between resource implications and the potential benefits, to the neonate and institution, of using interventions is paramount (Rycroft-Malone, 2004). Although behavioural and sweet-tasting solution interventions have often been described as free or inexpensive (Campbell-Yeo et al., 2011; Harrison et al., 2013), numerous non-material costs (e.g., time) are required to successfully use them for pain relief (Cignacco et al., 2010). Chia and colleagues (2006) and Cong et al. (2013) found that the time to prepare and use interventions (e.g., KC) is often not considered when selecting cost-effective interventions. Additionally, it takes a substantial amount of time for breastfeeding, KC and FT to work effectively during procedures (Campbell-Yeo et al., 2011; Johnston et al., 2014; Shah et al., 2012). Therefore, it would be unrealistic to assume that implementation of these interventions would be without any cost implications to the unit, hospital and the family. Careful consideration should be given to these implementation outcomes, such as direct and indirect costs, if the interventions are to be successfully implemented and routinely used in Kenya.

**Safety concerns.** Safety of interventions was critical; interventions perceived to pose the least risk for immediate and long-term complications were preferred. For instance, HCPs and administrators felt that NNS could be used conveniently during procedures but posed more risks in relation to spread of infections compared to breastfeeding, KC and FT. Breastfeeding was

thought to pose the risk of choking but participants felt the risk could be significantly reduced by modifying practice (e.g. using breastfeeding after the procedure)

There is no pain treatment intervention without safety concerns; respiratory depression and constipation for opioids (Bellù et al., 2010), bradycardia and desaturation with sweet-tasting solutions (Bueno et al., 2013; Gibbins & Stevens, 2003) and desaturations and apnoea with KC (Jefferies et al., 2012). As argued by other researchers, these safety concerns should be weighed against the efficacy of the intervention within the context of practice (Cignacco et al., 2010). Unlike the risk of infection from using NNS which is real (Castilho & Rocha, 2009), researchers have found no evidence of choking from breastfeeding during procedures (McNair et al., 2013; Taddio et al., 2009; Zhu et al., 2015). With these misconceptions about safety of interventions, it is unlikely that their implementation would translate to any meaningful improvement in pain treatment practices in the units. Ensuring that clinicians' decisions are informed by a strong body of empirical evidence would be a significant first step in this endeavour (Kitson et al., 2008).

**Familiarity with intervention.** Participants were more comfortable using interventions that were part of their routine practice. In particular, KC and breastfeeding were preferred on account of being part of the units' practice culture (McCormack et al., 2002). Breastfeeding was described as the only intervention that was familiar to the neonate. Familiarity with FT was, however, premised on a misinterpretation of the intervention as physical restraint rather than a pain treatment strategy.

Some interventions were routinely practiced by clinicians and mothers, but not for pain treatment, denoting a potentially favourable culture for implementation (McCormack et al., 2002; Rycroft-Malone et al., 2004). The somewhat favourable context does not obliterate the task of changing clinicians' attitudes and skills to adapt to use of the interventions for pain

treatment (Rycroft-Malone et al., 2004; Squires et al., 2012). There are numerous ergonomic differences when using KC and breastfeeding for routine nursing care and when using the interventions for pain treatment (McNair et al., 2013; Cong et al., 2013). For instance, the mother's posture and the neonate's position would require modification when using KC for pain relief (Cong et al., 2013). The modification will ensure the clinician is at the same level with, or slightly higher, than the level of the neonate, thus maximizing efficiency and minimizing the fatigue and discomfort from bending over to access the procedure site (e.g., during heel stick).

The view that FT was a form of immobilization raises serious practice and implementation concerns. FT for pain treatment requires different techniques and skills compared with physical restraint (Axelin et al., 2006) and if not properly done (e.g., applying too much pressure) could result in injury to the neonate (McNair et al., 2013). Implementing the intervention before addressing this misconception is likely to result in incorrect or non-use of the intervention. Strategies to change clinicians' perceptions and to develop skills on how to use the intervention are warranted prior to its implementation in the neonatal units.

**Changing pain treatment practices.** There was convergence of views among participants that changing the poor pain treatment practices required clinicians, mothers and the hospital administration to work collaboratively. The practice change strategies were informed by acknowledgment of the contextual barriers and individual preferences and experiences in the neonatal units.

**Creating awareness.** Respondents felt that the use of interventions required creation of awareness about pain in neonates, pain interventions and how to use routine nursing care activities such as breastfeeding and KC for pain relief. Participants enumerated strategies for creating awareness including educational outreach, educational meetings (e.g., continuous

medical education [CME] sessions, grand rounds, seminars) and educational materials. These KT strategies have been used to change pain treatment practices in numerous high-income countries (Ellis et al., 2007; Johnston et al., 2007). Spence and Henderson-Smart (2011) found that sharing information about interventions with HCPs and families resulted in an increase in the number of hospitalized neonates who received breastfeeding and oral sucrose for pain relief. Zhu et al. (2012) also found that creation of awareness through formal and informal meetings improved use of pain interventions in Canadian NICUs. Although the proposed KT strategies have inconsistent and minimal effect (Grimshaw et al., 2012; Medves et al., 2011; Scott et al., 2012), their low cost makes them more feasible for creating awareness in resource-limited settings such as Kenya (Grimshaw et al., 2012).

***Encouraging maternal involvement.*** Active involvement of mothers was viewed as critical for a successful change of pain practices and use of interventions. Mothers were acknowledged as a source of the most natural, safe and less-costly pain interventions. Participants felt that encouraging mothers' involvement would present an alternative to HCPs for doing FT during procedures. Researchers have found mothers to be as effective as HCPs in performing FT (Axelin et al., 2006; Cignacco et al., 2010). Involving mothers could also mitigate the human resource burden during procedures (Cignacco et al., 2010) and minimize the emotional and psychological trauma associated with non-involvement (Franck et al., 2004; Gale et al., 2004). Mothers, however, should only be involved after an explicit evaluation of the level of preparedness, individual preferences and level of competency.

***Improving staffing.*** Underutilization of pain treatment interventions was associated with high workload in the units. There was concurrence among HCPs and administrators that improved staffing levels would be required for a successful implementation and routine use of

pain treatment interventions. Certainly, highly receptive clinical contexts are characterized by sufficient resources including manpower (Rycroft-Malone et al., 2004; Squires et al., 2012); additional staff are required for routine use of some interventions (Cignacco et al., 2012). Cignacco and colleagues (2010) stressed the need to plan for additional staff when using FT for pain treatment. Similarly, Stevens et al. (2011), in qualitative interviews with HCPs, found that insufficient staffing influenced use of pain treatment interventions; HCPs felt that they needed more staff to be able to use interventions during routine painful procedures such as venepuncture. Increasing staffing levels alone is, however, not the ultimate solution to underutilization of interventions (Latimer et al., 2009; Squires et al., 2013); other forms of resources such as knowledge and skills on how to use the interventions are also required (Rycroft-Malone et al., 2004; Squires et al., 2012). Future research efforts should focus on explicitly determining the optimal staffing levels and other forms of resources that would be required to successfully implement and support routine use of interventions in the neonatal units.

***Reminders.*** HCPs and administrators felt that clinicians required regular reminding about the pain treatment strategies and the need to treat procedural pain. Different forms of reminders were described depending on the target audience; paper-based pictorial reminders for HCPs and oral reminders for mothers. Reminders have been used as part of multifaceted interventions to improve pain treatment practices in many neonatal units (Dunbar et al., 2006; Stevens et al., 2014; Zhu et al., 2012). Stevens et al. (2014) found different forms of verbal and written reminders (e.g., posters, stickers, screen savers) to be effective in changing pain treatment practice in Canadian hospitals. They also found pictorial reminders to be more effective and most preferred among HCPs (Stevens et al., 2014). The overall effect of reminders in changing practice is estimated to range from small to moderate (Boaz et al., 2011; Grimshaw et al., 2012;

Johnson & May, 2015). Utility of reminders in neonatal units in Kenya may, however, be limited by contextual factors such as availability of resources (e.g., finances, personnel) and the risk of spread of infections. For instance, unavailability of computers limits the feasibility of electronic reminders (e.g, screen savers) while use of paper-based reminders, particularly wall posters, would pose the risk of spread of infections due to overcrowding in the units.

In summary, the burden of pain in neonatal units in Kenya is high despite neonates undergoing less procedures compared with other countries globally. This burden is mainly aggravated by the peculiarly high incidences of invasive procedures and the unusually high number of supplemental attempts. Moreover, the pain associated with these procedures is severely undertreated despite the existence of some effective, safe, acceptable and feasible pain relief strategies. These findings have enormous practice and policy implications; numerous changes (e.g., HCPs' attitudes and practice cultures, postponing non urgent procedures) in the unit are warranted if better procedural pain treatment practices are to be realized in neonatal units in Kenya.



## **CHAPTER SEVEN**

### **Implications**

This chapter addresses the significance, strengths and limitations of the study. Implications for theory, research, practice and policy as well as the knowledge translation plan are discussed.

### **Significance**

Although procedural pain in neonates is a health concern globally, a minimal number of studies have reported on the burden of pain and pain treatment practices in neonatal units in sub-Saharan Africa. Few studies have used mixed methods design to comprehensively examine the nature of procedures, use of interventions and the influence of context on nature of procedures and pain treatment practices. Kenyan neonates underwent few but highly invasive procedures compared with neonates in other countries; the highest burden of pain was borne by the most immature and youngest neonates. Use of pain treatment interventions was very low. Efforts to reduce the burden of pain and to improve neonatal outcomes would benefit from strong empirical evidence on the consequences of pain and pain treatment practices worldwide; particularly from regions that report the highest incidence of neonatal morbidity and mortality globally (Lawn et al., 2013).

Interviews with HCPs, administrators and mothers revealed preference for interventions that can be used for pain treatment in Kenya. Strategies for changing context to improve pain practices were also identified. Identification of acceptable, effective and low cost interventions by critical stakeholders in neonatal care is an important first step in changing pain practices in Kenya and other resource-limited countries. The study findings are also important in shedding light on how to overcome the contextual barriers to routine use of pain treatment interventions in

neonatal units in Kenya. For instance, creating awareness among mothers and increased involvement during procedures would result in improved pain treatment practices by minimizing resource constraints that have been associated with the undertreatment of pain in the neonatal units.

Conceptualization of the study and interpretation of findings were guided by the PARiHS framework (Kitson et al., 2008; Rycroft-Malone et al., 2004). Multiple methods were used to generate research evidence on the nature and frequency of procedures and use of pain treatment interventions. Clinicians' and mothers' experiences, views and preferences augmented quantitative data on the nature and frequency of procedures and pain treatment practices. They provided empirical evidence on acceptability and feasibility of behavioural and sweet-tasting solution interventions in the neonatal units and factors influencing their acceptability and feasibility. These findings will be important when initiating policy changes at institutional and national levels to address the burden of pain. For instance, these findings will be relevant when advocating for clustering of procedures, rescheduling nonurgent procedures and involvement of parents in the care of neonates during painful procedures.

Study sites were purposely selected to enable examination of the burden of pain and pain treatment practices in two clinical contexts that are typical of neonatal care in Kenya. Contextual factors influenced both the nature of use and perceptions of acceptability and feasibility of interventions. In particular, the units' culture informed HCPs' and administrators' views about interventions. The administration had clear expectations for HCPs about pain treatment which is suggestive of a receptive leadership (McCormack et al., 2002). However, administrators and HCPs considered availability of resources including financial, human resources and time to be critical determinants of the acceptability and feasibility of interventions. Facilitation strategies

for implementing and supporting routine use of the acceptable pain treatment interventions in the neonatal units were identified. These findings are important because they highlight the possibility of administrators supporting initiatives targeted at improving pain practices. The findings will also inform decisions on critical resources when developing strategies to improve pain treatment practices in Kenya.

### **Strengths of the Study**

The sequential mixed methods design (Creswell & Clark, 2011) allowed for building on each phase of the study and for triangulation of data to answer the study questions and validate results. Results of Phases 1 and 2 largely informed interview questions for Phase 3. Initial interview questions were modified and new ones added to explain gaps and unique findings of the first 2 phases. For instance, since the number of procedure attempts were noted more on observation than was documented in medical records, and use of pain treatments were neither documented nor observed during procedures, interview guides were modified to capture participants' views about challenges to documentation of attempts and why pain treatment interventions were rarely used. This iterative sequential interpretive process ensured that the research questions were comprehensively answered.

Few studies have employed multiple data collection methods to examine the nature of procedures and use of pain treatment interventions in a single study. Using review of medical records and real time observations allowed for the strength of the observation design to counterbalance the weaknesses of chart reviews; thus increasing the likelihood of more conclusive results. The consistency in findings between the two data collection methods lends credence to the study findings. It is highly likely that our findings are representative of the nature

of painful procedures and pain treatment practices in Kenya, especially when it is observed that the findings are consistent with what was recently reported (Kyololo et al., 2014).

Use of qualitative interviews with photo-elicitation technique allowed participants to discuss their perspectives about practices aided by visual cues. In particular, the use of local photographs enabled participants to reflect on practices that they could relate to in the local context thus enriching the data. Seeking views from 3 categories of participants and rigorously analysing their perspectives enabled the development of a convergent and comprehensive explanation of the acceptability and feasibility, and factors that influence the acceptability and feasibility of behavioural and sweet-tasting solution interventions in the two neonatal units. Rigour was observed in conducting interviews and analysing the data. For instance, the researcher took a reflexive stance during data collection and analysis (Long & Johnson, 2000) while the data coding scheme was validated by a team of researchers with extensive experience in qualitative methods. High intercoder reliability was established between the researcher and an independent coder thus enhancing the transferability of study results (Kuper, Lingard, & Levinson, 2008).

### **Study Limitations**

There are methodological challenges that may limit the results of this study. Review of medical records may not have fully captured the nature and frequency of painful procedures as revealed through interviews with HCPs and administrators. Selective and/or incomplete documentation practices may have resulted in underestimation of the nature and frequency of painful procedures and use of pain treatment interventions in the neonatal units. Similarly, review of medical records by different persons in the two study sites may have affected the reliability of the findings. To standardize data collection and to mitigate these data collection

limitations, a validated checklist was used to extract data from the two study units. Additionally, to increase reliability of findings (Worster & Haise, 2004) the RA was trained until a high intraobserver reliability between data extractors was achieved. Random checks of completed data extraction checklists were conducted regularly to ensure reliability was maintained throughout the data collection period.

Phase 2 was conducted after an extensive dissemination of information about the data collection procedures; and the data were collected by a nonparticipant observer. Therefore, the possibility of the Hawthorne effect (McCambridge, Witton, & Elbourne, 2014) affecting the findings on nature of procedures and use of pain treatment interventions cannot be ruled out. The fact that the observer was a senior graduate student whose status was known to HCPs may have resulted in a power imbalance. HCPs may have changed their procedure techniques (e.g., number of attempts) and pain treatment practices on account of being observed. Additionally, observations were conducted at specific times of the day when most of the procedures were performed. Considering that workload was described as the main contextual challenge to routine use of pain treatment interventions in the units, the frequency of use of interventions could have been higher if observations were made around the clock. Furthermore, not all HCPs were observed and thus HCPs who were not observed may have had different pain treatment practices from those we observed.

All HCPs and administrators interviewed for Phase 3 were known to the researcher and were aware of his position as a senior graduate student. Mothers also viewed the researcher as a clinician who was visiting the unit for purposes of conducting the study. Knowledge of the researcher by participants raises the question of positionality and risk for social desirability bias. Participants may have described what they thought the researcher desired to hear rather than a

true reflection of their views and perspectives about acceptability and feasibility of interventions. However, the researcher emphasized to participants the significance of expressing their views freely and assured them that the information they shared would be treated confidentially. These measures were taken to minimize the risk for social desirability bias.

Additionally, only English and *Swahili* speaking mothers of Christian faith were interviewed. To standardize the interviews, all were conducted by the researcher who only spoke the two languages; and there were no non-Christian mothers in the units during the study period. Mothers who did not share these criteria may have had unique perspectives that were not captured by virtue of not being interviewed. Additionally, although a rigorous process was used to translate *Swahili* transcripts into English, some meanings inherent in participants' phrases and expressions may have been lost during the translation.

### **Implications for Theory**

The PARiHs framework (Kitson et al., 2008) guided the methods and interpretation of study results. The findings highlighted the elements and sub-elements of the framework that determined the nature of procedures and use of behavioural and sweet-tasting solution interventions in neonatal units in Kenya. The study serves as an example of how qualitative and quantitative sources of research evidence are complementary to each other and how they can be integrated to generate high-quality research evidence to answer a clinical question (Rycroft-Malone et al., 2002). Interviews with administrators and HCPs also highlighted the pivotal role of both local and research evidence in changing practice; lack of access to high quality empirical evidence on safety and efficacy of interventions appeared to influence perceptions regarding procedural pain treatment. Participants also valued mothers' preferences and experiences in making decisions about implementable interventions in the neonatal units.

Study sites were selected purposely to demonstrate the influence of context on the nature and frequency of procedures, use of pain treatment interventions and acceptability and feasibility of interventions. Interviews with HCPs, administrators and mothers revealed the breadth of resources required in the neonatal units to create a receptive context for implementation of pain treatment interventions, including personnel, time, infrastructure, knowledge, skills and attitudes. The type and mix of resources required for optimal implementation of the interventions in each neonatal unit warrants investigation. Participants were biased generally towards interventions that were routinely practiced; this is suggestive of the critical role of practice culture in shaping the context for implementation of interventions in the neonatal units. Moreover, facilitation strategies purposed to overcome barriers for implementation of pain treatment interventions in the neonatal units were delineated.

Although PARiHS is touted as the most pragmatic framework for guiding translation of evidence into practice (Helfrich et al., 2010; Rycroft-Malone et al., 2004), it also has some limitations (Kitson et al., 2008; Ullrich et al., 2014). The PARiHS framework places a high premium on quantitative methods as the core sources of research evidence with qualitative data being less favourable (Rycroft-Malone et al., 2002). Our study is a classic example of how both quantitative and qualitative research evidence can be used singularly and synergistically to answer very important clinical questions. Although the quantitative data was rigorously collected and analysed, it required explication by the qualitative data to form solid research evidence on the nature of procedures and use of interventions. Additionally, it would have been difficult to demonstrate the influence of context on the nature of procedures and pain treatment practices without the qualitative data.

The PARiHS framework also lacks clarity on description of the elements and the nature and forms of interrelatedness between the elements and sub-elements required for the successful implementation of evidence (Helfrich et al., 2010; Rycroft-Malone et al., 2014; Ullrich et al., 2014). Participants' practice routines were both sources of clinical evidence as well as "shapers" of culture. Similarly, participants identified a plethora of resources that are required for the successful implementation of interventions in the neonatal units. It is, however, still unclear from the PARiHS framework which of these resources, and in what quantities, are required for a successful implementation of evidence in any clinical practice (Rycroft-Malone et al., 2004; Squires et al., 2012). This lack of clarity is of particular concern when the context is already resource-constrained. More clarity and further delineation of the sub-elements is required for the framework to remain useful in diverse clinical settings.

Although the PARiHS framework (Kitson et al., 2008) was useful, the lack of clarity limited our explication of the acceptability and feasibility on intervention in the study sites. A comprehensive framework with clearly delineated constructs such as the Consolidated Framework for Implementation Research (CFIR) (Damschroder, et al., 2009) may have been more useful in our study. Consideration of specific constructs of the CFIR framework such as intervention characteristics (e.g., cost, adaptability), quality and accessibility of the research evidence to clinicians and characteristics of the inner setting (e.g., size of the institution, culture) and outer setting (e.g., patient needs and resources, external policies) would have been more helpful in explaining our study findings (Damschroder, et al., 2009; Damschroder & Lowery, 2013). For instance, using the CFIR framework would have made it possible to appreciate that (a) indirect costs associated with use of pain treatment interventions are critical components of context, (b) mothers' concerns and resources at their disposal are important considerations in



selecting pain interventions, (c) apart from the quality, accessibility of research evidence to clinicians is fundamental and (d) clinician's knowledge and beliefs about behavioural and sweet-tasting solution interventions would shape perspectives about their utility.

### **Implications for Research**

The retrospective review of medical records in Phase 1 is prone to documentation errors and omissions (Stevens et al., 2010; Worster & Haine, 2004). A prospective study, perhaps over the entire hospitalization period, is more likely to accurately demonstrate the nature and frequency of procedures and use of interventions in the neonatal units. Similarly, the study was conducted in only two units that were located in the western region of the country. The findings would have been more generalizable if (a) the study was conducted in more units offering more diverse levels of care (e.g., Levels I – IV) and (b) the study settings covered a larger geographical area of the country.

More procedures were performed on neonates admitted in the Level II compared with the Level I neonatal unit and the nature of procedures was different between study sites. Whether this finding is unique to Kenya is unclear considering that multisite studies in high-income settings have found no relationship between level of care and nature and frequency of procedures (Carbajal et al., 2008; Johnston et al., 2011). Conducting a multi-site study in Kenya and other LMICs would be necessary to conclusively examine the influence of level of care on nature and frequency of procedures and use of interventions. Multisite studies are also required to examine the nature of procedures across levels of care and the contextual factors associated with the difference between study sites. For instance, it would be important to determine the contextual factors that predispose neonates in Level I units to high frequency of IM injections.

Mothers were rarely involved during painful procedures despite the administrations' expectation and mothers' desire to be actively involved. Parents' desire for involvement in comforting their neonates during painful procedures is well documented (Franck et al., 2012; Franck et al., 2011) as are the benefits of maternal involvement during procedures (Gale et al., 2004; Johnston et al., 2011). Whether the lack of involvement of mothers was related to lack of awareness about mothers desire to participate or an attitude among HCPs warrants further investigation. Furthermore, qualitative studies with mothers would be helpful in understanding factors that would prevent them from advocating for their neonates' pain treatment despite their presence and strong desire for involvement. With help from HCPs, mothers would develop the confidence to support their neonates during procedures and gain knowledge about pain relieving strategies that they can use during procedures.

The use of photo-elicitation interview techniques is quite unique in neonatal pain research. The method was very useful in facilitating communication with participants and in eliciting their views about interventions in relation to the practice context. The usefulness of the technique was evident from the depth of data generated. Additional empirical work is required to build a body of knowledge around the usefulness of the technique in neonatal pain research. Moreover, other studies can potentially benefit from use of the technique to support the participation of health care users and HCPs in clinical research.

### **Implications for Policy and Practice**

Although the frequency of procedures was slightly less than the global trend, the procedures were highly invasive and placed an unacceptable burden of pain on neonates. The first step to reduce the incidence of these avoidable sources of pain is to adapt and/or develop evidence-based policy and practice guidelines on pain and pain treatment in the neonatal units.

The policies should emphasize the need to cluster procedures and the procedures to be attempted by the most experienced clinician in the unit (Batton et al., 2006). The need for nurses to adhere to acceptable standards of practice and to follow medical orders would significantly reduce the burden of pain. The repetition of procedures up to eight times on a single occasion raises the question of quality of neonatal care and clinicians' competence. Improved competence among clinicians and a judicious evaluation of the need for every procedure would significantly reduce the burden of pain in neonates.

Behavioural and sweet-tasting solution interventions were used infrequently but even more scarcely in the Level I unit. KC was routinely practiced in the units but not for pain treatment; breastfeeding was used occasionally to comfort neonates after the procedure; and positioning was often used as a method of physical restraint rather than as a pain treatment strategy. Given that interventions were routinely practiced, albeit not for pain treatment, indicates the huge potential for their implementation in the neonatal units. Conceivably, with improved knowledge and skills and change of attitudes among clinicians, the interventions could be adapted and used for procedural pain treatment. Policy changes in the units would be required to include the use of the interventions for pain treatment as a core competence of staff and to incorporate pain treatment in the orientation program for new staff.

Although procedural pain was not treated adequately, the administration expected procedures to be accompanied by some form of pain treatment as a basic standard of neonatal care. This finding may serve as an impetus for the administration to position procedural pain treatment as a priority quality improvement initiative. Acknowledging pain prevention and treatment as a care priority is likely to result in change in hospital and unit culture to support initiatives aimed at improving pain treatment practices in the units. Moreover, the finding that

behavioural interventions were routinely used in the units but not for pain, may prompt development of policies and guidelines for the adaption of the interventions for pain treatment.

Participants in Phase 3 emphasized the need to create awareness among mothers about pain treatment interventions and for mothers to be actively involved during painful procedures. The routine use of mother-driven interventions such as breastfeeding and KC would require change in unit practices and policies. For instance, to use breastfeeding and KC routinely would require the units to adapt policies that embrace clustering of procedures and postponing non-urgent procedures until the mother is present. Additionally, it would be critical for the units to adapt strengths-based care (Gottlieb, 2014), a care approach that focuses on what is already working well, what the person does best, and the resources available to individuals and families to help them to address more effectively their health needs (Feeley & Gottlieb, 2000; Gottlieb, 2013; Gottlieb, Gottlieb, & Shamian, 2012). For instance, it would be important to encourage and support use of interventions that mothers are accustomed to (e.g., breastfeeding; KC); leveraging implementation of the interventions on mothers' desire for involvement during painful procedures. Moreover, it would be important to recognize mothers as critical stakeholders when planning for care of hospitalized neonates. Mothers will become true partners in their neonates' care during painful procedures when (a) they are allowed unlimited access to the unit and the neonate, (b) their views and preferences are sought and respected during painful procedures, (c) they are encouraged and supported to participate based on level of competence and (d) their fears and concerns are addressed in a non-judgemental manner.

Although this was not an interventional study, it was possible for HCPs to have developed temporal knowledge and changes in attitude about behavioural and sweet-tasting solution interventions by virtue of participation. The change in knowledge and attitude may

translate to some form of use of the interventions during procedures. Mothers, by virtue of their participation, may also have become more aware about (a) their right for involvement in their neonates' care, (b) the need to advocate for their neonates' pain treatment and (c) strategies they can use to comfort their neonates during procedures. This awareness has the potential to improve pain treatment practices and to reduce the psychological and emotional trauma associated with absence or lack of involvement during procedures.

Mothers described how they were psychologically and emotionally traumatized by the pain experienced by neonates and desired to be involved during painful procedures. Since workload often precluded use of interventions, involvement of mothers would strike a balance between meeting mothers' needs and increasing available resources for better pain treatment. Mothers need to be psychologically prepared for the hospitalization experience and HCPs should show empathy to them. It would be beneficial for mothers to learn more about their role in calming their neonates during procedures. Consequently, their involvement would translate to less stressed mothers, reduced workload during painful procedures and better pain treatment practices.

### **Knowledge Translation Plans**

**Integrated KT.** An integrated KT plan entails researchers and knowledge users working collaboratively to change practice throughout the research process (Graham & Tetroe, 2007; Kothari & Wathen, 2013). HCPs were involved in a pilot study that was conducted in the units prior to the main study (Kyololo et al., 2014). The head physician in one of the neonatal units was a co-investigator in this study; she was actively involved in the generation of the research questions, development of the study design, analysis and interpretation of the data and generation of practice and policy recommendations. Other stakeholders in the hospitals and neonatal units

were engaged at different stages of the study. The legal and public relations departments were involved in planning and generation of the photographs that were used during interviews. Unit managers were involved at every stage of the study; introducing the study to HCPs, identifying potential mothers and HCPs to be photographed and preparing the unit for subsequent phases of the study. HCPs and mothers in the units were captured in the photographs that were used for the study. These engagements with the administration, HCPs and mothers in the planning of the study reflect an integrated approach to KT (Graham & Tetroe, 2007).

The sequential design used in the study also allowed for integrated KT. HCPs, administrators and mothers were engaged in the generation of data for the study. More specifically, unit managers and HCPs were committed to ensuring that the medical records were available for review, observations were conducted uninterrupted and they were willing to be observed during procedures. Participation of HCPs, administrators and mothers in the study process and making decisions on acceptable and feasible interventions based on their views is a characteristic of an integrated KT strategy. It is probable that the sequential design resulted in participants becoming more aware of pain in neonates and pain treatment interventions. In particular, the use of photographs of behavioural and sweet-tasting solution interventions during the interviews is likely to have created awareness about the interventions and their use.

**End of Study KT Plan.** An end-of-study KT plan (Barwick, 2013; Graham & Tetroe, 2009; Straus et al., 2011) has been developed to disseminate and apply the results of the study for the improvement of pain treatment practices in neonatal units in Kenya.

***Aim of the KT plan.*** The overall aim of the KT plan is to change procedural pain practices in neonatal units in Kenya. Additionally, the plan is intended to (a) create awareness of and impart knowledge on neonatal pain and pain treatment strategies among HCPs and parents

and (b) initiate change in policy (Barwick, 2013) to include pain as a core component of care in neonatal units in Kenya.

**Partners.** We have secured the partnership of a multi-professional team that share a goal of changing pain practices in the neonatal units. We have partnered with researchers in the field of neonatal pain treatment and KT, the unit and hospital administration and senior clinicians in the units. Experts in KT methods have been instrumental in developing messages specific to each audience (e.g., mothers). Partnering with the unit and hospital management is critical in decision making regarding timing for the dissemination activities, resource mobilization (e.g. venue for oral presentations) and allocating time for the targeted audience in the units to attend the KT activities. Partnership with senior clinicians is helpful in navigating the insider-outsider relationships between the researcher and the targeted audience in the neonatal units and in enhancing buy-in of the KT message by clinicians. These partners were involved at the conceptualization stage of the project and will continue to be engaged as equal partners throughout the project and beyond.

**Audience.** The KT plan is broad and is targeted at (a) HCPs in the neonatal units and in the newborn vaccination clinic, (b) unit and hospital-level administrators, (c) parents and other family members of hospitalized neonates and (d) expectant women attending the antenatal clinic. Targeting mothers during the antenatal period ensures that they are prepared for their role as active participants in the care of their neonates and are aware of the strategies they can use to comfort their neonates during procedures. The Ministry of Health, regulatory bodies of HCPs (e.g., the Nursing Council, the Medical Practitioners and Dentists' Board) and training institutions (e.g., school of nursing, medical schools) are other targeted audiences. The Ministry of Health would be targeted to ensure that (a) policies and guidelines on pain treatment that are

developed are endorsed and (b) pain treatment is prioritized in neonatal units through inclusion of pain as an accreditation criteria for hospitals. Professional regulatory agencies have been targeted with a view of including procedural pain treatment as a core competency requirement for HCPs. Training institutions are a target audience as they need to incorporate content on neonatal pain, best pain practices (e.g., number of attempts on procedures) and procedural pain treatment interventions in their undergraduate and graduate training programs.

***KT strategies.*** At the unit level, the study findings will be presented during CME, nursing rounds and grand round sessions. One-on-one meetings will be conducted with administrators to share the results of the study and to start a dialogue on how use of interventions for pain can be initiated in the units. The administrators will also receive a brief written summary of the study findings highlighting the sub-optimal pain treatment practices and feasible and acceptable interventions in the units. Peer-reviewed publications arising from the study will also be made available to the administrators.

The findings will be shared with mothers of hospitalized neonates during mother-education sessions that are routinely conducted in the units. Oral presentations in the form of health talks will be conducted at the waiting areas of the antenatal clinics over a 1-week period. Subsequently, we will work with unit managers in the antenatal clinics to ensure a component of pain treatment is captured during health talks that are conducted by nurses every morning. Pictorial pamphlets highlighting the main study findings will be mailed to those mothers who participated in the study and provided mailing addresses. Simple pictorial wall posters highlighting the sources of pain in neonates and the pain relieving strategies (e.g., breastfeeding, KC, FT) that can be used by mothers during painful procedures will be developed. The posters will be placed at strategic points in the waiting areas of the neonatal units and antenatal clinics,



in procedure rooms and in clinics where mothers normally take their neonates for treatment, immunization and routine growth monitoring.

For external dissemination, the findings will be presented, in the form of research posters and orally, in national scientific meetings in Kenya (e.g., annual nurses' conference, medical association conference) and Canada (e.g., nurses' week meeting, Canadian Pain Society meeting) and international conferences on pain such as the International Symposium of Pediatric Pain (ISPP), International Association for the Study of Pain (IASP), Council of International Neonatal Nurses' (COINN) and International Forum on Paediatric Pain (IFPP) meetings as time and funding permit. The findings will also be presented in interactive virtual platforms such as webinars. Moreover, the findings will be published in pain, paediatric and child health peer-reviewed journals.

### **Conclusion**

Neonates underwent 1.6 procedures per day during the first 7 days of hospitalization. Unlike in high-income and other LMICs, most of the procedures in Kenya were highly invasive and tissue-damaging in nature, including IM injection, venepuncture, intravenous cannulation and heel stick. Neonatal and organizational contextual factors predicted the frequency of procedures. More specifically, neonates were more likely to undergo procedures if they were born preterm, between the 3<sup>rd</sup> and 7<sup>th</sup> day of life, and if they were hospitalized in the Level II neonatal unit. Although behavioural interventions such as breastfeeding, kangaroo care and facilitated tucking were feasible and acceptable, their use was very low; only eight procedures were accompanied by a pain treatment intervention. Availability of resources, perceptions about safety of interventions and practice culture of mothers and HCPs were critical determinants of acceptability and feasibility of interventions.

Comprehensive examination of painful procedures was important in demonstrating how the burden of pain in neonatal units in Kenya compares with global trends. Efforts to reduce pain in neonates requires the support of quality evidence from both LMICs and high-income countries. The evidence serves as an impetus to focus efforts on improving pain treatment practices in the neonatal units. Examining the nature and frequency of procedures and pain treatment practices and factors that affect them was a critical first step in informing institutional policy changes and in developing and implementing practice guidelines on procedural pain. New scientific evidence is the basis for evaluating future efforts to change procedural pain practices in neonatal units in Kenya. Implementation of the acceptable and feasible interventions would result in better pain treatment practices and improved health outcomes of neonates and children in Kenya and other LMICs globally.

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## APPENDICES

### Appendix A

#### Glossary of Terms

**Acceptability:** Acceptability refers to the perception among different implementation stakeholders that a given intervention, practice, or innovation is agreeable, satisfactory, and palatable (Proctor et al., 2011). Acceptability denoted the extent to which HCPs, administrators and mothers were willing to use behavioural and sweet-tasting solution interventions during procedures. Acceptability was determined through perception of health care providers, administrators, and mothers that behavioural and sweet-tasting solution interventions were embraceable in the neonatal units.

**Administrators:** Administrators are persons, with or without training or experience in a specific clinical specialty, who are responsible for planning, directing, coordinating, and supervising delivery of health care. For purposes of this study, administrators included director of nursing services, unit managers and head physicians of the study units.

**Behavioural interventions:** There exist numerous descriptions of what constitutes behavioural interventions (Srouji, Ratnapalan, & Schneeweis, 2010; Stevens, Johnston, Newman, & Rugg, 2007) as well as diverse opinions regarding which specific strategies should be classified as behavioural or physical interventions (Franck & Lawhon, 1998; Harrington et al., 2012). Due to these inconsistencies, and the manner in which the terms are used interchangeably, the term behavioural intervention was used to denote both groups of interventions. Behavioural interventions are strategies that optimize the neonate's regulatory and coping abilities during painful procedures by modulating pain impulses, activating the attention of the neonate, and

distracting neonates from the noxious event (Pillai Riddell et al., 2015; Stevens et al., 2007). In this study, behavioural interventions included, kangaroo care, containment (facilitated tucking and swaddling), breastfeeding, and non-nutritive sucking; whose efficacy and safety is supported by high quality evidence (Johnston et al., 2014; Pillai Riddell et al., 2015; Stevens et al., 2013).

**Facilitated tucking (FT):** Facilitated tucking is using a caregiver's hands to gently bring the limbs close to the trunk to restrict the neonate's movements by mimicking the *in-utero* posture (Fernandes et al., 2011; Pillai Riddell et al., 2015).

**Feasibility:** In implementation research, feasibility is defined as the extent to which a new intervention or innovation can be successfully used within a given setting (Proctor et al., 2011). In this study, feasibility of behavioural and sweet-tasting solution interventions was determined by eliciting views of HCPs, administrators and mothers regarding the ease with which the interventions could be used routinely for during painful procedures.

**Health care professionals (HCPs):** A HCP is an individual trained according to a prescribed curriculum and accredited to offer health care services. A HCP may be trained and certified to practice medicine, nursing or other allied health practice. HCPs usually involved in the neonatal care in Kenya include registered nurses (RNs), nutritionists, physicians, and Clinical Officers – (COs; physician assistants) (Fitzhugh & Seble 2007). RNs working in neonatal units in Kenya are trained at certificate (3 year program), diploma level (3.5 year program), and Baccalaureate (degree) level. A majority of nutritionists in Kenya are trained at diploma level. And although nutritionists do not perform any painful procedures they play a critical role of initiating and promoting exclusive breastfeeding among mothers. COs are a unique category HCPs common in Sub-Saharan Africa who operate at the level of a junior doctor and who can give medical orders

and perform routine diagnostic, medical, and surgical procedures. Physicians, RNs, nutritionists and COs working in the participating neonatal units were recruited for the study.

**Inborn neonate:** Any baby born in the either hospital where the study was conducted was referred to as inborn.

**Kangaroo care (KC):** Kangaroo care is the skin-to-skin, chest-to-chest contact between a neonate and the mother with only a sheet or a gown covering the pair (Johnston et al., 2014).

**Non-nutritive sucking (NNS):** Non-nutritive sucking is the practice of giving a neonate a pacifier with or without a sweet-tasting solution to suck for purposes of calming of making the neonate feel secure (Badr, 2012; Campbell-Yeo et al., 2011).

**Outborn neonate:** The term outborn neonate was used to denote any neonate born at home, on the way to hospital or in another hospital and transferred postnatally to the unit.

**Painful procedures:** Painful procedures are any procedures that would reasonably be expected to cause more than slight or momentary pain and/or distress. Painful procedures were taken as any medical, nursing, surgical, diagnostic or therapeutic activity performed on a neonate as part of routine care (e.g. lumbar puncture, venepuncture, heel lance, nasogastric tube placement, suctioning, nasal cannulation, and removal of adhesive tape) (Batton et al., 2006). Continuous therapeutic activities such as ventilation or intravenous infusion were excluded because, although they are invasive in nature, once initiated such activities are more likely to cause stress, than pain, in neonates (Batton et al., 2006).

**Parents:** A parent was taken as the primary care giver (mother or father) who spend at least eight hours of each day of hospitalization with the neonate and who provided basic care (e.g. feeding) to the neonate during hospitalization. In the study sites only the mother was available

and thus it is the mothers' views regarding the acceptability and feasibility of behavioural and sweet-tasting solution interventions that were sought.

**Procedural pain:** The International Association for the Study of Pain's (IASP) committee on taxonomy defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage". The committee reiterates the subjective nature of pain emphasizing that even nonverbal patients such as neonates also experience pain. For purposes of this study, procedural pain was operationalized as the response to any noxious stimuli emanating from all tissue-damaging and non tissue-damaging care-related or diagnostic procedures (Stevens et al., 2011) performed on neonates.

**Swaddling:** Swaddling is the practice of wrapping a neonate with a blanket to provide secure boundaries and to minimize movement of limbs during a painful procedure (Fernandes et al., 2011).

**Sweet-tasting interventions:** Sweet-tasting interventions are sugar-containing solutions that relieve pain and calm neonates by activating endogenous opioid pathways (Harrison et al., 2012). They include oral sucrose (mainly 12% and 24%), glucose solutions (20-30% and 50%), and breast milk including expressed breast milk and supplemental breast milk (Stevens et al., 2013; Bueno et al., 2013). In this study, sweet-tasting solutions included all concentrations of oral sucrose and oral glucose, expressed breast milk, and supplemental breast milk that could be given to neonates during painful procedures using a syringe or a dropper. Receiving breast milk through direct suckling of the mother's breast or via a bottle was categorized as breastfeeding (a behavioural intervention).

**Tissue-breaking procedures.** Procedures that involve a break in the skin barrier, including venepuncture, intravenous cannulation, heel lancing, intramuscular injections, immunizations, chest tube insertion, and lumbar puncture were categorized as tissue-damaging.

**Non tissue-damaging procedures.** Procedures are categorized as non tissue-damaging if they do not involve a break in the skin or if they do not involve internal cavity beyond the natural body orifices. Non tissue-damaging procedures included nasal cannulation, nasogastric tube placement, and removal of tapes.

## Appendix B

### Empirical Evidence on Effectiveness of KC for Procedural Pain Treatment

Study	Purpose	Design	Intervention	Sample (N)	Outcome measures	Results & comments
Johnston et al., 2014	To determine the effects of skin-to-skin contact (SSC) on pain from medical and nursing procedures in neonates and to determine the incidence of adverse effects of SSC on neonates.	Cochrane systematic review with meta-analysis	SSC vs. no-treatment control.	19 studies; term and preterm neonates (N =1, 594)	- Composite pain scores - Behavioural and physiological indicators	<p>-Premature infant pain profile score were significantly lower in SSC at 30 seconds (mean difference [MD] = -3.21, 95% CI [-3.94, -2.48]), 60 sec. (MD = -1.85, 95% CI [-3.03, -0.68]), and 90 sec. (MD = -1.34, 95% CI [-2.56, -0.13]) but not at 120 sec.</p> <p>- Oxygen saturation levels were significantly higher at 60 (<math>p &lt; .01</math>) and 90 (<math>p &lt; .05</math>) sec. following heel lance compared to incubator controls.</p> <p>- There was no significant difference in duration of crying between experimental and control groups (MD = -0.93, 95% CI [-2.28, 0.42]).</p> <p><u>Conclusion</u></p> <p>- KC is beneficial in reducing pain from procedures such as heel lance, venepuncture and IM injection.</p> <p><u>Comments</u></p> <p>- Variability in outcome measures limited number of meta-analyses that could be conducted.</p> <p>- Meta-analysis compared KC and no-treatment control thus making the results on efficacy more reliable.</p>

Study	Purpose	Design	Intervention	Sample (N)	Outcome measures	Results & comments
Olsson, Ahlsén, & Eriksson, 2015.	To determine whether KC could provide pain relief during venepuncture in premature neonates.	Cross-over trial	KC vs crib or incubator care	Preterm neonates; 26-35 weeks GA (N = 10)	<ul style="list-style-type: none"> <li>- Oxygenated haemoglobin –HbO<sub>2</sub> (near infrared spectroscopy).</li> <li>- Premature infant pain profile-revised scores (Stevens et al., 2014).</li> </ul>	<ul style="list-style-type: none"> <li>- Higher increase in HbO<sub>2</sub> when venepuncture was performed with neonate in standard care compared with KC (<math>p = .016</math>).</li> <li>- HbO<sub>2</sub> increased more with incubator or crib compared with a sham procedure (<math>p = .044</math>).</li> <li>- No significant difference HbO<sub>2</sub> levels between sham procedure and SSC.</li> <li>- Mean PIPP-R score increased from 4.3 (SD = 2.8) during the sham procedure to 5.0 (SD = 3.2) during the venepuncture in incubator or crib and from 5.0 (SD = 2.2) to 5.7 (SD = 3.5) in SSC; no significant difference between the two conditions.</li> </ul> <p><u>Conclusion:</u> KC during venepuncture had a pain-relieving effect.</p> <p><u>Comment:</u> The sample size was very small and the validated pain scores did reflect significant difference in pain intensity between KC and standard care.</p>

## Appendix C

### Empirical Evidence on Effectiveness of Swaddling & FT for Procedural Pain Treatment

Study	Purpose	Design	Intervention	Sample (N)	Outcome measures	Results & comments
Pillai Riddell et al., 2015.	Determine the effect of swaddling or FT for pain relief	Cochrane systematic review	Swaddling or FT	- 8 studies; preterm infants (N = 331). - 1 study; term neonates (N = 42).	- Pain reactivity - Immediate regulation	- Swaddling effective in reducing pain in preterm infants (SMD = -0.89, 95% CI [-1.37, -0.40]). - FT efficacious in improving immediate regulation in preterm infants (SMD = -0.71; 95% CI [-1.0, -0.43]). - Swaddling/FT are effective in reducing pain related distress in term neonates (SMD = -1.26; 95% CI [-1.92, -.6]). <u>Comment:</u> One study involved term infants.
Kucukoglu, Kurt, & Aytekin (2015)	Evaluate effectiveness of FT in reducing pain during hepatitis B (HBV) vaccinations	Randomized controlled trial	- FT - Standard care	Term neonates; > 37 weeks GA (N = 60)	- NIPS scores (Lawrence et al., 1993) - Respiration rate - Heart rate - Oxygen saturation	- NIPS scores (Lawrence et al., 1993) were significantly lower in neonates who underwent the procedure in the FT position (2.83±1.18) compared with the standard care (6.47±1.07, $p < .001$ ). - 50% of neonates in the FT group had no compared with 93.4% of the neonates in the standard care group who had severe pain. - No significant difference in PR, RR and SPO <sub>2</sub> levels between FT and standard care groups during and after the procedure. <u>Conclusion:</u> FT is more effective than standard care in relieving pain from HBV vaccination in term neonates. <u>Comment:</u> High powered sample; standardization of procedure; and blinding of independent pain raters.



## Appendix D

### Empirical Evidence on Effectiveness of NNS for Procedural Pain Treatment

Study	Purpose	Design	Intervention	Sample (N)	Outcome measures	Results & comments
Pillai Riddell et al., 2015	Assess the efficacy of non-pharmacological interventions (including NNS) for infant and child pain.	Systematic review with meta-analysis.	NNS	- 8 studies; preterm infants (N = 364) - 5 studies; neonates (N = 260)	- Pain reactivity (effect sizes) - Immediate regulation (effect sizes)	<p><u>Preterm infants</u></p> <p>- NNS not effective in reducing pain reactivity (n = 329): SMD -0.31 [95% CI -0.65, 0.04].</p> <p>- NNS is efficacious for improving immediate regulation following procedures (n = 260): SMD -0.43 [95% CI -0.63, -0.23]</p> <p><u>Neonates</u></p> <p>- NNS is effective in reducing immediate pain reactivity during procedures Reactivity (n = 270): SMD -1.20 [95% CI -2.01, -0.38].</p> <p>- NNS is effective for immediate regulation after procedures (n = 325): SMD -0.90 [95% CI -1.54, -0.25].</p> <p><u>Conclusion:</u> NNS is efficacious in reducing procedural pain; maximum effect when started 3 minutes prior to painful procedure.</p> <p><u>Comment:</u> All studies included were rated as of poor or very poor quality.</p>

## Appendix E

### Empirical Evidence on Effectiveness of Breastfeeding & Breast Milk for Procedural Pain Treatment

Study	Purpose	Design	Intervention	Sample (N)	Outcome measures	Results & comments
Shah et al., 2012	Evaluate the effectiveness of breast feeding or breast milk in reducing procedural pain in neonates.	Systematic review (Cochrane)	Breast feeding Expressed breast milk.	- 20 RCTs; healthy term and stable late preterm neonates (N = 2, 024).	Pain scores; reduction in behavioural and physiological responses	- B/feeding associated with lower pain scores, a reduction in changes in HR, % of time crying and duration of cry compared with containment, holding, NNS, and swaddling. - EBM reduced duration of crying but not pain scores, HR changes, and O <sub>2</sub> saturation. <u>Conclusion:</u> Breastfeeding or EBM is effective in reducing procedural pain. <u>Comments:</u> Only healthy term and late preterm neonates were studied. - Limited painful procedures (venepuncture & heel lancing) included in the review.
Bueno et al., 2012	Compare effects of EBM and 25% glucose on pain responses from heel lancing in preterm infants	Non-inferiority RCT	- 2 ml EBM - 2 ml 25% glucose	Late preterm infants; 34-36 weeks GA (N = 113)	- PIPP scores (Stevens et al., 1996). - Incidence of crying - Percentage of time spend crying	- Higher PIPP scores in EBM group compared to glucose group throughout 3 minutes post-lance (e.g. 30 sec: 7.54 [3.61] vs. 4.55 [3.17]; & 180 sec 4.72 [3.48] vs. 2.87[2.54]). - At 30 sec following lancing the mean difference in PIPP scores was 2.995 (95% CI, 1.507 to 4.483). - Higher incidence of crying in EBM (33/42 [78.6%]) than in glucose group (19/45 [42.2%]; $p = .001$ ). - Neonates who received EBM cried longer ( $32.02\% \pm 29.02\%$ ) than did those who received glucose ( $14.53\% \pm 19.98$ ; $p = .014$ ). <u>Comment:</u> EBM is less efficacious than 25% glucose for pain relief during heel lancing.

Study	Purpose	Design	Intervention	Sample (N)	Outcome measures	Results & comments
Ou-Yang et al., 2013	Determine whether expressed breast milk (EBM) reduces pain from heel lancing in preterm infants	Randomized, placebo controlled study	- 5 ml 25% glucose. - 5 ml EBM - Sterile water (placebo)	Preterm infants; < 37 weeks GA (N = 123)	- Crying time - Neonatal pain, agitation and sedation scale (N-PASS) (Hummel et al., 2008).	- Latency to cry after heel lancing was significantly longer in glucose group (122 sec, IQR 2-180) compared with placebo (7.5 sec, IQR 1.5-64), $p = .007$ . - Glucose group had shorter duration of cry (2.0, IQR 0-45) compared with placebo (70.5, IQR 5.5- 104.5), $p = .010$ . - At 1-3 minutes after the procedure, pain scores were significantly lower in the glucose and milk groups compared with the placebo group, $p < .05$ . <u>Conclusion:</u> EBM reduced procedural pain after heel lancing but had no effect on latency of first cry or total crying time. <u>Comment:</u> Sample size not power calculated.
Marin et al., 2013.	Compare the analgesic effect of breastfeeding plus KC with other behavioural and sweet-tasting solution interventions during heel lancing	Randomized controlled trial	- B/feeding + KC - Sucrose + KC - KC - Sucrose	Term healthy neonates (N = 136)	Neonatal infant pain scale (NIPS) scores (Lawrence et al., 1993).	- NIPS scores lower for breastfeeding and KC (median = 1, IQR 0-3) compared with sucrose and KC (median = 2, IQR 2-4), KC alone (median = 4, IQR 2-6), and sucrose alone (median = 4, IQR 2-5), $p \leq .01$ . - Crying time (seconds) less for the breastfeeding and KC group (median = 2, IQR 0-25) compared with the sucrose and KC group (median = 5, IQR 0-26), the KC group (median = 26, IQR 1-62), and sucrose group (median = 13, IQR 2-74), $p = .01$ . - No difference in changes in HR between groups. <u>Conclusion:</u> Combined breastfeeding and KC is more effective than a combination of sucrose and KC, or sucrose and KC alone. <u>Comment:</u> A large sample size was used

Study	Purpose	Design	Intervention	Sample (N)	Outcome measures	Results & comments
Zhu et al., 2015	Compared the effectiveness of breastfeeding, music therapy (MT) and a combination of breastfeeding and MT for pain relief during heel lancing	Randomized controlled trial	<ul style="list-style-type: none"> <li>- B/feeding</li> <li>- B/feeding + music</li> <li>- MT alone</li> </ul>	Term healthy neonates (N = 250)	<ul style="list-style-type: none"> <li>- Neonatal infant pain scale (NIPS) scores (Lawrence et al., 1993).</li> <li>- Latency to first cry</li> <li>- Duration of first cry</li> </ul>	<ul style="list-style-type: none"> <li>- NIPS scores significantly lower during the procedure in breastfeeding group (<math>3.1 \pm 1.88</math>) compared with breastfeeding &amp; MT group (<math>4.38 \pm 2.2</math>), MT alone group (<math>6.06 \pm 0.22</math>) and control group (<math>6.43 \pm 0.23</math>), <math>p &lt; .001</math>.</li> <li>- Lower NIPS scores in breastfeeding (<math>0.35 \pm 0.27</math>) and breastfeeding &amp; MT conditions (<math>0.24 \pm 0.28</math>) compared with MT alone (<math>1.98 \pm 0.29</math>) and control conditions (<math>2.34 \pm 0.29</math>) 1 minute after procedure, <math>p &lt; .001</math>.</li> <li>- Latency to first cry (seconds) was longer for breastfeeding (<math>13.65 \pm 2.34</math>) and breastfeeding and MT (<math>14.89 \pm 2.37</math>) compared with MT alone (<math>5.03 \pm 2.41</math>) and control (<math>4.83 \pm 2.45</math>), <math>p &lt; .001</math>.</li> <li>- Duration of first cry (seconds) was shorter for breastfeeding (<math>27.32 \pm 9.01</math>) and breastfeeding and MT groups (<math>27.17 \pm 9.12</math>) compared with MT alone (<math>90.86 \pm 9.27</math>) and control groups (<math>101.61 \pm 9.43</math>), <math>p &lt; .001</math>.</li> </ul>

## Appendix F

### Empirical Evidence on Effectiveness and Safety of Oral Sucrose and other Sweet-tasting Interventions

Study	Purpose	Design	Intervention	Sample (N)	Outcome measures	Results & comments
Stevens et al., 2013	Determine effectiveness and safety of oral sucrose for procedural pain relief in neonates.	Systematic review with meta-analyses (Cochrane)	Sucrose via oral syringe, dropper or pacifier.	- 57 RCTs; healthy term and stable late preterm neonates (N = 4730).	PIPP scores and duration of crying	<p>- Oral sucrose groups had significantly lower PIPP scores at 30 seconds (weighted mean difference (WMD) = -1.76, 95% CI [-2.54, -0.97]) and 60 seconds (WMD = -2.05, 95% CI [-3.08, -1.02]) post-heel lance.</p> <p>- Sucrose significantly reduced duration of total crying time (WMD = -39 seconds, 95% CI [-44, -34]), but did not reduce duration of first cry during heel lance (WMD = -9 seconds, 95% CI [-20, 2]).</p> <p>- Sucrose did not significantly reduce PIPP scores (WMD = -0.65, 95% CI [-1.88, 0.59]) but did reduce oxygen saturation (%) significantly during ROP examination compared to controls (WMD = -2.6, 95% CI [-4.9, -0.2]).</p> <p>- There were no differences in adverse effects between sucrose and control groups.</p> <p><u>Conclusion:</u> Sucrose is safe and effective for reducing procedural pain from single events (e.g. heel lancing) in term and preterm neonates.</p> <p><u>Comment:</u> Meta-analysis was only possible for heel lancing and eye examination.</p>
Dilli et al., 2014.	Evaluate efficacy of oral sucrose combined with	Prospective randomized and placebo-controlled	- 24% oral sucrose + pacifier - Sterile	Preterm neonates; 29-36 weeks GA (N = 64)	PIPP scores (Stevens et al., 1996)	- PIPP scores were significantly lower for the sucrose-pacifier group ( $13.7 \pm 2.1$ ) than for the sterile water + pacifier group ( $16.4 \pm 1.8$ ; $p = .001$ ).

	NNS for pain treatment during screening for ROP.	study	water + pacifier			<p>- Crying time (sec) was shorter in the sucrose+ pacifier group (<math>58.7 \pm 16.6</math>) compared with the sterile water plus pacifier group (<math>79.8 \pm 30.4</math>; <math>p = .001</math>).</p> <p>- No difference in frequency of development of adverse events (tachycardia, bradycardia, desaturation) between intervention groups (<math>p &gt; .05</math>).</p> <p><u>Conclusion:</u> Sucrose combined with NNS is more effective than sterile water-NNS in neonates undergoing screening for retinopathy of prematurity.</p> <p><u>Comments:</u> video recordings were coded by one researcher thus limiting the reliability of the results.</p>
Bueno et al., 2013.	Establish efficacy and safety of nonsucrose sweet-tasting solutions for procedural pain relief in neonates	Systematic review with meta-analyses	Oral glucose	38 RCTs; preterm and term neonates (N = 3785)	<p>- PIPP scores</p> <p>- Incidence of crying and crying time</p>	<p>When results of 2 trials (124 neonates) were pooled together, 3.6-point reduction in PIPP scores during heel lance was observed in studies comparing 20-30% glucose with no intervention (MD = -3.6, 95% CI [-4.6, -2.6], <math>p &lt; .001</math>).</p> <p>- A meta-analysis involving 3 studies (130 neonates) showed significant reduction in incidence of cry after venepuncture for neonates receiving 25-30% glucose versus water or no intervention (RR = -0.18, 95% CI [-0.31, -0.05], <math>p = .008</math>; NNT = 6, 95% CI [3 - 20], <math>I^2 = 63\%</math>).</p> <p>- Individual trials showed analgesic effects of 30% glucose for IM and subcutaneous injections, PICC placement, eye exam. &amp; circumcision.</p> <p>- Safety: There were no differences in adverse event rates between the glucose and water groups</p>

Uzelli & Güne, 2015.	Determine effectiveness of 5% oral sucrose solution in reducing pain in preterm neonates during IM injections.	Non-blinded randomized controlled trial	5% oral glucose	Preterm neonates (N = 80).	<ul style="list-style-type: none"> <li>- NIPS scores (Lawrence et al., 1993)</li> <li>- Crying time</li> <li>- Oxygen saturation</li> <li>- HR</li> </ul>	<p><u>Conclusion:</u> 20-30% glucose solutions are safe and have analgesic effects for single heel lancing and venepuncture and can be used as an alternative to sucrose for procedural pain reduction in healthy term and preterm neonates.</p> <p><u>Comments:</u> Heterogeneity of interventions and outcome measures limited meta-analyses to heel lance and venepuncture.</p> <p>- NIPS scores significantly higher in the control group (<math>5.6 \pm 0.6</math>) than in the oral glucose group (<math>4.2 \pm 0.7</math>), <math>t(1) = -8.31</math>, <math>p &lt; .001</math>.</p> <p>- The mean crying time significantly shorter in the glucose group (<math>10.9 \pm 3.1</math>) than in the control group (<math>16.9 \pm 3.0</math>), <math>t(1) = -8.75</math>, <math>p &lt; .001</math>.</p> <p>- Oxygen saturations of the glucose group were higher than those of the control group during the procedure (<math>t(1) = -6.24</math>, <math>p &lt; .001</math>) and after the procedure (<math>t(1) = 3.97</math>, <math>p &lt; .001</math>).</p> <p>- Mean HR was also significantly different between groups during the procedure (<math>t = -1.14</math>, <math>p = .03</math>) and after the procedure (<math>t = -1.48</math>, <math>p = .02</math>).</p> <p><u>Conclusion:</u> 5% glucose is effective in reducing distress and physiological indicators of pain in preterm neonates when given 2 minutes before and immediately before the IM injection.</p> <p><u>Comments:</u> Widely varying doses of glucose were used (0.2 – 2mls).</p> <p>- Investigators were not blinded to treatment intervention.</p>
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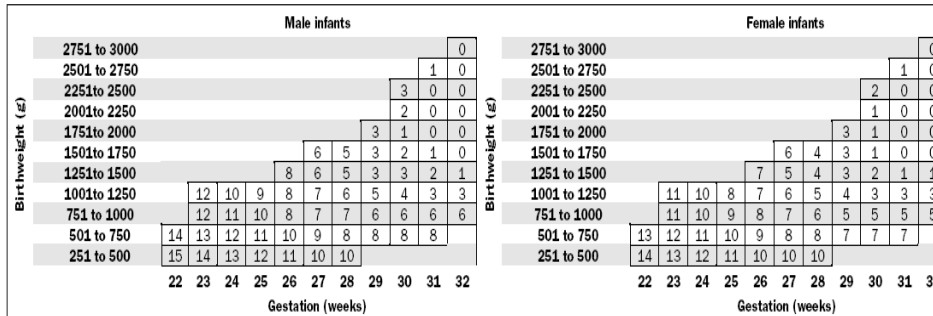
## Appendix G

### Chart Audit Tool

#### Clinical risk index for babies II (CRIB II) – Parry et al., 2003

Birthweight (g) and gestation (weeks):

The maximum (worst) score for birthweight and gestation is 15, which is obtained for a 22 week male infant of less than 501 g birthweight



Temperature at admission (°C):

≤29.6	5
29.7 to 31.2	4
31.3 to 32.8	3
32.9 to 34.4	2
34.5 to 36	1
36.1 to 37.5	0
37.6 to 39.1	1
39.2 to 40.7	2
≥40.8	3

Base excess (mmol/L):

<-26	7
-26 to -23	6
-22 to -18	5
-17 to -13	4
-12 to -8	3
-7 to -3	2
-2 to 2	1
≥3	0

Sex, birthweight (g) and gestation (weeks):

Temperature at admission (°C):

Base excess (mmol/L):

Total CRIB II Score

The logistic regression equation relating CRIB II to mortality (CRIB II algorithm) is:

Log odds of mortality =  $G = -6.476 + 0.450 \times \text{CRIB II}$

Probability of mortality =  $\exp(G) / [1 + \exp(G)]$

The range of possible CRIB II scores is 0 to 27

#### DIAGNOSIS SUCCINT CODING

100	<b>General</b>	400	<b>Cardiovascular</b>
101	Premature	401	Cardiac malformation
102	IUGR	402	Cardiac arrhythmia
103	Macrosomia	403	Cardiomyopathy
104	Congenital infection	404	Patent ductus arteriosus
200	<b>Respiratory</b>	500	<b>Metabolic</b>
201	Hyaline membrane disease	501	Metabolic acidosis
202	TTN, retained fetal lung fluid	502	Hypoglycemia
203	Meconium aspiration	503	Hypothermia/hyperthermia
204	Pneumothorax	504	Icterus
205	Pulmonary infection		
206	PPHN	600	<b>Hematologic</b>
207	Pulmonary haemorrhage	601	Anemia
208	Apnea	602	Hemolytic diseases
209	Respiratory distress undiagnosed		
210	Congenital emphysema	700	<b>Neurologic</b>
211	Cystic adenoma	701	Perinatal asphyxia
212	Choanal atresia	702	Neonatal abstinence syndrome
213	Pierre Robin syndrome	703	Convulsions
300	<b>Digestive</b>	800	<b>Infections</b>
301	Diaphragmatic hernia	801	Septicemia
302	Esophageal atresia	802	Meningitis
303	Other digestive malformation		
304	NEC	1000	Others



Neonate's code \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

Gestational age at birth: \_\_\_\_\_ weeks of amenorrhea      Born at this hospital? No ☐      Yes ☐      Birth weight (grams): \_\_\_\_\_

APGAR at 1 minute \_\_\_\_\_ APGAR at 5 minutes: \_\_\_\_\_ Date of life: \_\_\_\_\_      CRIB II Score: \_\_\_\_\_

Parent's highest level of education:    Primary ☐    Secondary    ☐    Tertiary    ☐    Hospitalized on day 7 No ☐    Yes ☐

				Procedure 1						Procedure 2						Procedure 3						Procedure 4					
	Continuous analgesia			Sequence Code	Type of procedure	Analgesia procedure	Parents	Attempts	Operator	Sequence Code	Type of procedure	Analgesia procedure	Parents	Attempts	Operator	Sequence Code	Type of procedure	Analgesia procedure	Parents	Attempts	Operator	Sequence Code	Type of procedure	Analgesia procedure	Parents	Attempts	Operator
	T1	T2	T3																								
0 h				1001						1002						1003						1004					
1 h				1011						1012						1013						1014					
2 h				1021						1022						1023						1024					
3 h				1031						1032						1033						1034					
4 h				1041						1042						1043						1044					
5 h				1051						1052						1053						1054					
6 h				1061						1062						1063						1064					
7 h				1071						1072						1073						1074					
8 h				1081						1082						1083						1084					
9 h				1091						1092						1093						1094					
10 h				1101						1102						1103						1104					
11 h				1111						1112						1113						1114					
12 h				1121						1122						1123						1124					

13 h				1131						1132						1133						1134					
14 h				1141						1142						1143						1144					
15 h				1151						1152						1153						1154					
16 h				1161						1162						1163						1164					
17 h				1171						1172						1173						1174					
18 h				1181						1182						1183						1184					
19 h				1191						1192						1193						1194					
20 h				1201						1202						1203						1204					
21 h				1211						1212						1213						1214					
22 h				1221						1222						1223						1224					
23 h				1231						1232						1233						1234					

**Type of procedure** = indicate code as below; **Analgesia procedure** = analgesia used specifically for procedure; **Parents**: presence during the procedure? : note YES or NO; **Attempts** = number of attempts to reach procedure success, for example: two passages of the endotracheal tube for suction is noted as 2 attempts; **Operator** = who provided form of pain relief (NUR (nurse), PAR (Parent); MED (physician, RCO, intern, registrar)

TYPES OF PROCEDURES (Note the <u>number</u> in the corresponding box of the procedure table)					
1	Intramuscular injection	7	Insertion of naso-gastric tube	13	Insertion of peripheral arterial line
2	Subcutaneous injection	8	Oral aspiration	14	Endotracheal intubation
3	Peripheral intravenous insertion	9	Gastric aspiration	15	Extubation
4	Nasal aspiration	10	Tape removal and others (electrodes...)	16	Routine care
5	Tracheal aspiration	11	Chest physiotherapy	17	Other invasive procedure (detail)
6	Venous stick for blood draw	12	Arterial stick for blood draw		
ANALGESIA FOR PROCEDURES (Note the <u>code</u> in the corresponding box of the procedure table)					
NONE	None	FT	Facilitated tucking <sup>3</sup>	KC	Kangaroo care <sup>1</sup>
SWAD	Swaddling <sup>4</sup>	NNS	Pacifier	ACE	Acetaminophen
SUC	Oral sucrose	GLU	Glucose Per Os	TRAM	Tramadol
BF	Breastfeeding during procedure <sup>2</sup>	EML	Emla®		

## Appendix H

### CRIB II score (Parry et al., 2003)

Birthweight (g) and gestation (weeks):

The maximum (worst) score for birthweight and gestation is 15, which is obtained for a 22 week male infant of less than 501 g birthweight

Male infants													Female infants																																				
Birthweight (g)	2751 to 3000												0													0																							
	2501 to 2750												1	0													1	0																					
	2251 to 2500												3	0	0													2	0	0																			
	2001 to 2250												2	0	0													1	0	0																			
	1751 to 2000												3	1	0	0													3	1	0	0																	
	1501 to 1750												6	5	3	2	1	0													6	4	3	1	0	0													
	1251 to 1500												8	6	5	3	3	2	1													7	5	4	3	2	1	1											
	1001 to 1250												12	10	9	8	7	6	5	4	3	3													11	10	9	8	7	6	5	4	3	3	3				
	751 to 1000												12	11	10	8	7	7	6	6	6	6													11	10	9	8	7	6	5	5	5	5					
	501 to 750												14	13	12	11	10	9	8	8	8	8													13	12	11	10	9	8	8	7	7	7					
Birthweight (g)	251 to 500												15	14	13	12	11	10	10													14	13	12	11	10	10												
												22	23	24	25	26	27	28	29	30	31	32												22	23	24	25	26	27	28	29	30	31	32					
												Gestation (weeks)																							Gestation (weeks)														

Temperature at admission (°C):

≤29.6	5
29.7 to 31.2	4
31.3 to 32.8	3
32.9 to 34.4	2
34.5 to 36	1
36.1 to 37.5	0
37.6 to 39.1	1
39.2 to 40.7	2
≥40.8	3

Base excess (mmol/L):

< -26	7
-26 to -23	6
-22 to -18	5
-17 to -13	4
-12 to -8	3
-7 to -3	2
-2 to 2	1
≥3	0

Sex, birthweight (g) and gestation (weeks):

Temperature at admission (°C):

Base excess (mmol/L):

Total CRIB II Score

The logistic regression equation relating CRIB II to mortality (CRIB II algorithm) is:

Log odds of mortality =  $G = -6.476 + 0.450 \times \text{CRIB II}$

Probability of mortality =  $\exp(G) / [1 + \exp(G)]$

The range of possible CRIB II scores is 0 to 27

## Appendix I

### Letter of Invitation to Participate in the Study - Hospitals

To  
The Chief Executive Officer/Medical Superintendent  
\_\_\_\_\_ Hospital

Date:

**SUBJECT: INVITATION OF YOUR HOSPITAL TO PARTICIPATE IN A NEONATAL PAIN STUDY**

We have developed a research project to explore the acceptability and feasibility of introducing low-cost and safe strategies for treating pain in newborn babies when they are undergoing painful procedures in the course of their admission in the hospital. The principal investigator is O'Brien Kyololo (RN, MSN), a PhD candidate at the University of Toronto and a graduate student at the Hospital for Sick Children, Toronto, Canada. My co-investigators include:

Bonnie Stevens, (RN, PhD) (Supervisor), The Hospital for Sick Children & University of Toronto, Toronto, Canada

Denise Gastaldo (BScN, PhD), University of Toronto, Toronto, Canada

Julia Songok (MD), School of Medicine, Moi University, Kenya

The study will be carried out in two hospitals and your institution is being invited to be one of the sites as it admits babies after delivery. The study will be in three parts. In the first part, a trained research assistant will review records of babies during the first week of admission to note all painful procedures that the babies undergo during the first 7 days of life and the strategies that are used to help babies cope with the pain. In part two, parents and health care providers will be observed during a variety of painful procedures to document interventions used to help babies cope with pain. In the last phase, 12-20 staff (i.e., nurses, physicians, nutritionists, clinical officers), parents, the nurse manager of the newborn unit, the head physician and director of nursing services at the hospital will be interviewed to establish their views regarding the acceptability and feasibility of using low-cost strategies of helping babies admitted in the unit cope with pain. All participants will also be asked to fill a brief questionnaire which will take 3-5 minutes. It is anticipated that, by carrying out this study we will be able to identify simple and innovative strategies of helping babies cope with pain from care-related procedures. The findings of this study will help us to develop strategies for use by both professionals and parents to help babies cope during painful procedures.

We look forward to your institution being part of this research project.

Yours faithfully,

O'Brien Kyololo (RN, MSN, PhD Candidate – University of Toronto)

## Appendix J

### Study Information Leaflet for Phase 1

**Title of project:** Acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain relief in neonatal units in Kenya

**Investigator(s):**

Principal Investigator:

O'Brien Kyololo (RN, MSN), PhD Candidate, University of Toronto, Canada; & Moi University, Eldoret, Kenya.

Co-Investigators:

Bonnie Stevens, RN, PhD (Supervisor), University of Toronto & The Hospital for Sick Children, Toronto, Canada

Denise Gastaldo, BScN, PhD, University of Toronto, Canada

Julia Songok, MD, Moi University, Eldoret, Kenya

**Purpose of the Research:**

The goal of this study is to establish whether it is possible to use low-cost, safe, and effective methods of pain relief in babies undergoing care-related and diagnostic procedures. One way of investigating this is by documenting the painful procedures and strategies used to help babies cope with the pain associated with procedures. We intend to establish which strategies are acceptable to health care professionals, administrators and parents, and which ones are feasible to use regularly for pain relief in babies. We want to use this information to develop strategies of helping babies cope with pain associated with procedures.

**Description of the Research:**

The study is in three parts. In this first phase we will follow newborn babies admitted in the unit, every day for the first seven days of life, to document all painful procedures they undergo and what strategies are employed to help them cope with pain associated with these procedures. A research assistant will review medical records every day over the first 7 days of admission to document all the painful procedures neonates undergo during the first week of life and the interventions used to relieve the pain.

**Potential Harms:**

We do not think that this study has the potential to harm participants.

**Potential Discomforts or Inconvenience:**

The time you will take to participate in this phase of this study may cause you some inconvenience.

**Potential Benefits:**

**To Individual Subjects:**

There will not be any direct benefit accrued for participating in the study. However, there is a possibility that you will become more aware of the strategies we are investigating by virtue of taking part in the study. A summary of the study results will be sent to the unit when the study is completed.

**To Society:**

Through this study we will be able to better understand alternative, low-cost methods of supporting and helping babies cope during painful procedures.

**Confidentiality**

We will respect and uphold participants' privacy throughout all phases of the study. We will not link the information obtained from any neonate with a specific HCP. In addition, information collected about the baby will be aggregated with data from other babies to form one dataset thus making it impossible to link any piece of data with an individual baby. No information about the baby or health care provider will be shared with anyone or published without permission. Data collected during this study will be stored in a secure, double-lock cabinet; and will only be accessible to the members of the research team. Upon completion of the study, the data will be kept as long as required by the specific hospital's "Records Retention and Destruction" policy; and will be destroyed in accordance with the same policy.

**Reimbursement**

There will be no reimbursement for time you spend participating in the study. We will give the unit a small non-monetary token (e.g., a reference book) at the end of the study in appreciation of the time spend participating in the study.

**Participation**

Your participation in this study is voluntary. If you chose to participate in this study, you may stop your participation at any given point without giving any reasons and without any impact on employment at your institution.

## Appendix K

### Bedside Observation Checklist (Stevens et al., 2010)

Neonate's code number \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Gestational age at birth: \_\_\_\_\_ weeks. Born at this hospital? No ☐ Yes ☐

Birth weight (grams): \_\_\_\_\_ APGAR at 1 minute \_\_\_\_ APGAR at 5 minutes: \_\_\_\_\_

Day of life \_\_\_\_\_

Parent's highest educational level: Primary ☐ Secondary ☐ Tertiary ☐ None ☐

Parent present during procedure: Yes ☐ No ☐

Category of HCP performing procedure: RN ☐ Physician ☐ CO ☐

Time when procedure is performed \_\_\_\_\_

	Type of painful procedure	Invasiveness		Type of intervention
	Venepuncture for bloodwork	Mild <input type="checkbox"/>		Kangaroo care
	Peripheral iv insertion			Swaddling
	Intramuscular injection			Facilitated tucking
	Heel stick	Moderate <input type="checkbox"/>		Pacifier
	Nasopharyngeal suctioning			Breastfeeding/breast milk
	Removal of peripheral catheter	Severe <input type="checkbox"/>		Oral sucrose/glucose
	Subcutaneous injection			Other interventions (Specify) 1) _____ 2) _____ 3) _____ 4) _____
	Orogastric suctioning			
	Insertion of nasogastric tube			
	Catheterization			
	Dressing change			
	Lumbar puncture			
	Insertion of nasal cannula			

#### Observation notes

Describe what you have observed during the procedure:

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## Appendix L

### Study Information Leaflet – Phase 2

**Title of project:** Acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain relief in neonatal units in Kenya

**Investigator(s):**

Principal Investigator:

O'Brien Kyololo (RN, MSN), PhD Candidate, University of Toronto, Canada; & Moi University, Eldoret, Kenya.

Co-Investigators:

Bonnie Stevens, RN, PhD (Supervisor), University of Toronto & The Hospital for Sick Children, Toronto, Canada

Denise Gastaldo, BScN, PhD, University of Toronto, Canada

Julia Songok, MD, Moi University, Eldoret, Kenya

**Purpose of the Research:**

This is the second phase of a three-phase study whose aim is to establish whether it is possible to use low-cost, safe, and effective methods of pain relief in babies undergoing care-related and diagnostic procedures. We intend to establish if these strategies are acceptable to health care professionals, administrators and parents, and whether it is feasible to use them regularly with painful procedures. The aim of this phase of the study is to determine whether there is consistency between what is documented as done in the medical records when babies are undergoing painful procedures and the actual practices regarding management of painful procedures in babies.

**Description of the Research:**

In this phase of the study we will observe health care professionals performing clinically recommended painful procedures on babies. We will note the type of painful procedure and any strategies used to help the baby cope with the pain. We intend to observe a minimum of 55 painful procedures performed on neonates in this unit over two week's period covering both day- and night-shifts. You may be observed up to three times performing a variety of procedures on several babies. We will not collect any identifiable information about you except whether you are a nurse, physician, or CO. The data will only be used for the purpose of meeting the study objective described above.

**Potential Harms:**

We do not think that this study has the potential to harm you in any way.

**Potential Discomforts or Inconvenience:**

By being observed while doing a painful procedure on a baby may make you feel like your professional competence is being evaluated.

**Potential Benefits:**

**To Individual Subjects:**

There will not be any direct benefit accrued for participating in the study. However, there is a possibility that you will become more aware of the strategies we are investigating in this study by virtue of being observed when performing a procedure. A summary of the study results will be sent to your unit once the study is completed.



**To Society:**

Through this study we will be able to better understand which alternative and low-cost methods of relieving pain can be used for babies undergoing painful procedures in resource-limited settings.

**Confidentiality**

We will respect and uphold your privacy throughout all phases of the study. We will not collect any identifiable information about you and we will not link any information collected from you with any particular baby. In addition, all information collected in this phase of the study will be aggregated in one data set thus making it impossible to link any piece of data with you or your unit. No information about you will be shared with anyone or published without your permission. Data collected during this study will be stored in a secure, double-lock cabinet; and will only be accessible to the members of the research team. Upon completion of the study, the data will be kept as long as required by the specific hospital's "Records Retention and Destruction" policy; and will be destroyed in accordance with the same policy.

**Reimbursement**

There will be no reimbursement for time you spend participating in the study.

**Participation**

Your participation in this study is voluntary. If you chose to participate in this study, you may stop your participation at any given point without giving any reasons and without any impact on employment at your institution.

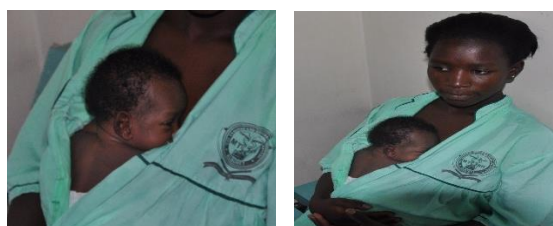
**Consent**

You will be deemed to have consented to participation in this phase of the study **unless** you indicate that you would **NOT** wish to be observed, either prior to or after the start of data collection. If you do not wish to participate in the study please inform the researcher, the research assistant, or the unit manager and you will not be observed.

## Appendix M

### Photographs

Appendix M1



Appendix M2



Appendix M3



Appendix M4



Appendix M5



Appendix M6



## Appendix N

### Study Information Leaflet – Phase 3

**Title of project:** Acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain relief in neonatal units in Kenya.

**Investigator(s):**

Principal Investigator:

O'Brien Kyololo (RN, MSN), PhD Candidate, University of Toronto, Canada; & Moi University, Eldoret, Kenya.

Co-Investigators:

Bonnie Stevens, RN, PhD (Supervisor), University of Toronto & The Hospital for Sick Children, Toronto, Canada

Denise Gastaldo, BScN, PhD, University of Toronto, Canada

Julia Songok, MD, Moi University, Eldoret, Kenya

**Purpose of the Research:**

This is the last phase of a 3-phase study whose aim is to establish whether it is possible to use low-cost, safe, and effective methods of pain relief in babies undergoing care-related and diagnostic procedures. The aim of this phase of the study is to establish the acceptability and feasibility of implementing these interventions from the perspectives of health care professionals, administrators and parents.

**Description of the Research:**

In this phase of the study we will interview a sample of health care providers (nurses, physicians, nutritionists, COs), administrators (unit manager, head physician, director of nursing), and parents of babies admitted in the unit to establish their perceptions regarding the acceptability and feasibility of implementing low-cost methods of helping babies cope with pain. We will use some photographs of babies in the course of the interviews to help illustrate potential methods of pain relief for babies. We will not collect any identifiable information about you. The data will only be used for the purpose of meeting the study objective described above.

**Potential Harms:**

We do not think that this study has the potential to harm you in any way.

**Potential Discomforts or Inconvenience:**

The time spend during the interviews may cause you some inconveniences.

**Potential Benefits:**

**To Individual Subjects:**

There will not be any direct benefit accrued for participating in the study. However, there is a possibility that you will become more aware of the strategies we are investigating in this study by virtue of being interviewed and seeing pictures of these techniques. A summary of the study results will be sent to your unit once the study is completed.

**To Society:**

Through this study we will be able to better understand which alternative and low-cost methods of relieving pain can be used for babies undergoing painful procedures in resource-limited settings.

**Confidentiality:**

We will respect and uphold your privacy throughout all phases of the study. We will not collect any identifiable information about you and we will not link any information collected during the interviews with you or any baby. No information about you will be shared with anyone or published without your permission. Data collected during this study will be stored in a secure, double-lock cabinet; and will only be accessible to the members of the research team. Upon completion of the study, the data will be kept as long as required by the specific hospital's "Records Retention and Destruction" policy; and will be destroyed in accordance with the same policy.

**Reimbursement**

You will not be compensated for taking part in this study. However, you will be given a small token of appreciation (e.g., a phone card) at the end of the interview.

**Participation**

Your participation in this study is voluntary. If you chose to participate in this study, you may stop your participation at any given point without giving any reasons and without any impact on employment at your institution.

## Appendix O

### Consent Form for Interviews with HCPs and Administrators

**Title of Project:** Acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain relief in neonatal units in Kenya.

**Investigator(s):**

Principal Investigator:

O'Brien Kyololo (RN, MSN), PhD Candidate, University of Toronto, Canada; & Moi University, Eldoret, Kenya.

Co-Investigators:

Bonnie Stevens, RN, PhD (Supervisor), University of Toronto & The Hospital for Sick Children, Toronto, Canada

Denise Gastaldo, BScN, PhD, University of Toronto, Canada

Julia Songok, MD, Moi University, Eldoret, Kenya

**Purpose of the Research:**

The goal of this study is to establish whether it is possible to use low-cost, safe, and effective methods of pain relief in babies undergoing care-related and diagnostic procedures. One way to find out about this is to talk with the health care providers that care for babies that undergone such painful procedures. We intend to establish if these strategies are acceptable to health care professionals, administrators and parents, and whether it is feasible to use them regularly during painful procedures. We want to use this information to develop strategies of helping babies cope with pain associated with procedures.

**Description of the Research:**

We will come to interview you at a time and place that is convenient for you to talk for about 30-60 minutes. We will ask you questions on your views regarding the possibility of implementing and using the strategies routinely in your unit; and the reasons why you think these strategies may, or may not, be doable in your unit.

**Potential Harms:**

We do not think that this study has the potential to harm you in any way.

**Potential Discomforts or Inconvenience:**

The time you will take to participate in this interview may cause you some inconvenience.

**Potential Benefits:**

**To Individual Subjects:**

There is a possibility that you will become more aware of the strategies we are investigating in this study by virtue of being interviewed. A summary of the study results will be sent to your unit once the study is completed.

**To Society:**

Through this study we will be able to better understand alternative, low-cost methods of supporting and helping babies cope during painful procedures.

**Confidentiality:**

Utmost privacy and confidentiality will be observed throughout this study. No identifiable information will be collected; and no information will be shared with anybody or used for purposes other than what is described in this study without your written consent. The

information you provide will only be accessible to members of the research team and will only be used for purposes of the study.

**Reimbursement:**

There will be no monetary reimbursement for taking part in this research. We will provide a small token (e.g. phone card) at the completion of the interview in appreciation of your time.

**Participation:**

Participation in this research is voluntary. If you decide to participate, you can decide to stop at any time without giving any reasons. Your participation may contribute to the understanding of alternative strategies of controlling pain from clinical procedures in babies admitted in a newborn unit. A copy of this consent form will be given to you.

**Consent:**

By signing this form, I agree that:

- 1) The study has been explained to me. All my questions were answered.
- 2) The possible harms and discomforts and the possible benefits (if any) of this study have been explained to me.
- 3) I understand that I have the right not to participate and the right to stop at any time. I am free now, and in the future, to ask any questions about the study.
- 4) I understand that no information that would identify me will be released or printed without asking me first. I hereby consent to participate.

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*Name of Participant*

---

*Signature & Date*

---

*Name of person who obtained consent*

---

*Signature of person who obtained consent & Date*

---

*Witness's name (if person/legal guardian does not read English)*

---

*Witness's signature & date*

## Appendix P

### Consent Form for Audio-Taping of Interview for HCPs and Administrators

**Title of Project:** Acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain relief in neonatal units in Kenya.

**Investigator(s):**

Principal Investigator:

O'Brien Kyololo (RN, MSN), PhD Candidate, University of Toronto, Canada; & Moi University, Eldoret, Kenya.

Co-Investigators:

Bonnie Stevens, RN, PhD (Supervisor), University of Toronto & The Hospital for Sick Children, Toronto, Canada

Denise Gastaldo, BScN, PhD, University of Toronto, Canada

Julia Songok, MD, Moi University, Eldoret, Kenya

**Purpose of the Research:**

The goal of this study is to establish whether it is possible to use low-cost, safe, and effective methods of pain relief in babies undergoing care-related and diagnostic procedures. One way to find out about this is to talk with the health care providers that care for babies that undergone such painful procedures. We intend to establish if these strategies are acceptable to health care professionals and parents, and whether it is feasible to use them regularly for painful procedures. We want to use this information to find strategies of helping babies cope with pain associated with procedures.

**Description of the Research:**

We will come to interview you at a time and place that is convenient for you. We will ask you questions on your views regarding the possibility of implementing and using some simple and low-cost strategies routinely for pain relief in babies admitted in the newborn unit. The interview which will last 30-60 minutes will be audio-taped with your permission.

**Potential Harms:**

We do not think that this study has the potential to harm you in any way.

**Potential Discomforts or Inconvenience:**

The time you will take to participate in this interview may cause you some inconvenience.

**Potential Benefits:**

**To Individual Subjects:**

There is a possibility that you will become more aware of the strategies we are investigating in this study by virtue of being interviewed. A summary of the study results will be sent to you/your unit once the study is completed.

**To Society:**

Through this study we will be able to better understand alternative, low-cost methods of supporting and helping babies cope during painful procedures.

**Confidentiality:**

Utmost privacy and confidentiality will be observed throughout this study. No identifiable information will be collected; and no information will be shared with anybody or used for purposes other than what is described in this study without your written consent. The

information you provide will only be accessible to members of the research team and will only be used for purposes of the study.

**Reimbursement:**

There will be no monetary reimbursement for taking part in this research. We will, however, provide a small token (e.g. phone card) at the completion of the interview in appreciation of your time.

**Participation:**

Participation in research is voluntary. If you decide to participate, you can decide to stop at any time without giving any reasons. Your participation may contribute to the understanding of alternative strategies of controlling pain from clinical procedures in babies admitted in a newborn unit. A copy of this consent form will be given to you.

**Consent:**

By signing this form, I agree that:

- 1) The study has been explained to me. All my questions were answered.
- 2) The possible harms and discomforts and the possible benefits (if any) of this study have been explained to me.
- 3) I understand that I have the right not to participate and the right to stop at any time. I am free now, and in the future, to ask any questions about the study.
- 4) I understand that no information that would identify me will be released or printed without asking me first. I hereby consent to participate.

---

*Name of Participant*

---

*Signature & Date*

---

*Name of person who obtained consent*

---

*Signature of person who obtained consent & Date*

---

*Witness's name (if person/legal guardian does not read English)*

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*Witness's signature & date*



## Appendix Q

### Demographic Questionnaire for HCPs

1. Your profession

1) Nurse ☐

2) Doctor ☐

3) Clinical Officer ☐

4) Nutritionist ☐

2. For how long have you been working as a health care professional?

0-2 years ☐

3-5 years ☐

6-10 years ☐

> 10 years ☐

3. How much of that time have you been working in this unit? \_\_\_\_\_ years (and/or months)

4. Were you observed by our research team while performing a painful procedure on a

neonate?

Yes ☐

No ☐

## Appendix R

### Consent Form for Interviews with Mothers

**Title of Project:** Acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain relief in neonatal units in Kenya

**Investigator(s):**

Principal Investigator:

O'Brien Kyololo (RN, MSN), PhD Candidate, University of Toronto, Canada; & Moi University, Eldoret, Kenya.

Co-Investigators:

Bonnie Stevens, RN, PhD (Supervisor), University of Toronto & The Hospital for Sick Children, Toronto, Canada

Denise Gastaldo, BScN, PhD, University of Toronto, Canada

Julia Songok, MD, Moi University, Eldoret, Kenya

**Purpose of the Research:**

The aim of this study is to find out whether it is possible to use inexpensive, simple and safe strategies to help babies cope with pain associated with procedures when they are in hospital. One way to find out about this is to talk with parents of babies that have undergone such painful procedures to diagnose their conditions and monitor their health status. We intend to establish if these strategies are acceptable to health care professionals and parents, and whether it is possible to use them regularly for painful procedures. We want to use this information to develop ways of helping babies cope with pain associated with procedures.

**Description of the Research:**

We will come to interview you at a time and place that is convenient for you to talk for about 30-60 minutes. We will ask you questions on your views on whether it is possible to use the strategies routinely on babies (like yours); and the reasons why you think these strategies may, or may not, be acceptable to and usable by parents.

**Potential Harms:**

We do not think that this study has the potential to harm you or your baby in any way.

**Potential Discomforts or Inconvenience:**

The time you will take to participate in this interview may cause you some inconvenience.

**Potential Benefits:**

**To Individual Subjects:**

There is a possibility that you will gain new information about how you can help your baby cope during painful procedures by virtue of being interviewed. A summary of the study results will be sent to the unit where your baby was admitted unit once the study is completed. If you need a summary of the results please inform us, provide mailing address and we will send a copy to you.

**To Society:**

Through this study we will be able to better understand alternative, low-cost methods of supporting and helping babies cope during painful procedures.

**Confidentiality:**

Utmost privacy and confidentiality will be observed throughout this study. No identifiable information about you or your baby will be collected; and no information will be shared with anybody or used for purposes other than what is described in this study without your written permission. The information you provide will only be accessible to members of the research team and will only be used for purposes of the study.

**Reimbursement:**

There will be no monetary reimbursement for taking part in this research. We will provide a small non-monetary token (e.g. a phone card) at completion of the interview in appreciation of your time.

**Participation:**

Participation in this research is voluntary. If you decide not to take part in study, your decision will not affect the quality of care your baby receives in the hospital now or in future. If you decide to participate, you can decide to stop at any time without giving any reasons. Your participation may contribute to our understanding of alternative strategies of reducing pain from clinical procedures in babies. A copy of this consent form will be given to you.

**Consent:**

By signing this form, I agree that:

- 1) The study has been explained to me. All my questions were answered.
- 2) The good and bad things about this study have been explained to me.
- 3) I know I can stop being a part of study anytime and it won't make any difference to how the doctors and nurses take care of me at this or any other hospital.
- 4) I can ask any questions at any time about the study.
- 5) I know that nobody will know I have been in a study without asking me about it first. I will take part in this study.

---

*Name of Participant*

---

*Signature & Date*

---

*Name of person who obtained consent*

---

*Signature of person who obtained consent & Date*

---

*Witness's name (if person/legal guardian does not read English)*

---

*Witness's signature & date*

## Appendix S

### Consent Form for Audio-Taping of Interview for Mothers

**Title of Project:** Acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain relief in neonatal units in Kenya

**Investigator(s):**

Principal Investigator:

O'Brien Kyololo (RN, MSN), PhD Candidate, University of Toronto, Canada; & Moi University, Eldoret, Kenya.

Co-Investigators:

Bonnie Stevens, RN, PhD (Supervisor), University of Toronto & The Hospital for Sick Children, Toronto, Canada

Denise Gastaldo, BScN, PhD, University of Toronto, Canada

Julia Songok, MD, Moi University, Eldoret, Kenya

**Purpose of the Research:**

The aim of this study is to find out whether it is possible to use inexpensive, simple and safe strategies to help babies cope with pain associated with procedures when they are in hospital. One way to find out about this is to talk with parents of babies that have undergone such painful procedures to diagnose their conditions and monitor their health status. We intend to establish if these strategies are acceptable to health care professionals and parents, and whether it is possible to use them regularly for painful procedures. We want to use this information to develop ways of helping babies cope with pain associated with procedures.

**Description of the Research:**

We will come to interview you at a time and place that is convenient for you to talk for about 30-60 minutes. The interview will be tape-recording with your written permission. We will ask you questions on your views on whether it is possible to use the strategies routinely on babies (like yours); and the reasons why you think these strategies may, or may not, be acceptable to and usable by parents.

**Potential Harms:**

We do not think that this study has the potential to harm you or your baby in any way.

**Potential Discomforts or Inconvenience:**

The time you will take to participate in this interview may cause you some inconvenience.

**Potential Benefits:**

**To Individual Subjects:**

There is a possibility that you will gain new information about how you can help your baby cope during painful procedures by virtue of being interviewed. A summary of the study results will be sent to the unit where your baby was admitted once the study is completed. In case you need a summary of the results please inform us, provide mailing address and we will send a copy to you.

**To Society:**

Through this study we will be able to better understand alternative, low-cost methods of supporting and helping babies cope during painful procedures.

**Confidentiality:**

Measures to protect your privacy and to uphold your confidentiality will be observed during and after the interview. No identifiable information about you or your baby will be collected; and no information will be shared with anybody or used for purposes other than what is described in this study without your written permission. The information you provide will only be accessible to members of the research team and will only be used for purposes of the study.

**Reimbursement:**

There will be no monetary reimbursement for taking part in this research. We will, however, provide a small non-monetary token at the completion of the interview in appreciation of your time.

**Participation:**

Participation in this research is voluntary. If you decide not to take part in study, your decision will not affect the quality of care your baby receives in the hospital now or in future. If you decide to participate and to be audio-taped, you can decide to stop at any time without giving any reasons. Your participation may contribute to our understanding of alternative strategies of reducing pain from clinical procedures in babies. A copy of this consent form will be given to you.

**Consent:**

By signing this form, I agree that:

- 1) The study has been explained to me. All my questions were answered.
- 2) The good and bad things about this study have been explained to me.
- 3) I know I can stop being a part of study anytime and it won't make any difference to how the doctors and nurses take care of me at this or any other hospital.
- 4) I can ask any questions at any time about the study.
- 5) I know that nobody will know I have been in a study without asking me about it first. I will take part in this study.

---

*Name of Participant*

---

*Signature & Date*

---

*Name of person who obtained consent*

---

*Signature of person who obtained consent & Date*

---

*Witness's name (if person/legal guardian  
does not read English)*

---

*Witness's signature & date*

## Appendix T

### Demographic Questionnaire for Mothers

1. Gender of participant

Female ☐

Male ☐

2. Age \_\_\_\_\_

3. Highest educational level attained

Primary ☐

Secondary ☐

Tertiary ☐

None ☐

4. Religion    Christian ☐    Muslim ☐    Other (specify) \_\_\_\_\_

5. Apart from this baby, how many other children do you have? \_\_\_\_\_

6. For how long was your baby hospitalized? \_\_\_\_\_ days

## Appendix U

### Interview Guide for HCPs

#### Introduction

Thank you for your time to contribute to this research project. The aim of this study is to find ways of helping neonates cope with pain associated with procedures.

(a) I have spent some time in the unit trying to learn more about how we can help babies cope with pain during procedures. Now I would like to know your perceptions regarding how pain is managed.

Tell me about how babies undergoing procedures in the unit are helped to cope with the pain?

*Probe:* Is (are) there any strategies that are used more than others? Are there any strategies you think may have benefited babies in the unit that are not currently being used? Why do you think such strategies are not so commonly used?

(b) I am now going to show you photographs to discuss whether you think they would be acceptable and doable in the unit with babies undergoing painful procedures (*sequentially introduce photograph of (a) KC, (b) FT, (c) swaddling, (d) NNS/pacifier, (e) breastfeeding/breast milk, and lastly (f) oral sucrose/glucose*):

1. When you look at this photograph to what extent do you relate with what is happening in the picture with your daily practice?

*Probe:* Do you think that this strategy is being/ could be used to relief pain in babies undergoing a procedure? Do you see it being widely adopted by staff? Why? (Why not?)

(c) In your own opinion, from the set of pictures we have discussed which ones do you think would be easily embraced by the staff and easily used in the unit?

*Probe:* Why do you think (specify method) would (or would not) be easily implementable in your unit.

*Probe:* What would be the main factors that may influence (promote or prevent) use of these interventions, routinely, for pain relief with babies in the unit?

*Probe:* What do you think could be done for staff in the unit to embrace and routinely use this intervention [referring to a photo or set of photos] on babies?

(d) Is there anything else you would like to share with me or recommend (regarding other ways that could be used to help babies cope with pain care in the unit)?

## Appendix V

### Interview Guide for Administrators

#### Introduction

Thank you for finding time in contributing to this research project. The study is aimed at finding ways of helping babies cope with pain associated with procedures.

(a) I have spend some time in the unit trying to learn more about how babies can be helped to cope with pain during procedures. Now I would like to know your perceptions as a ... (unit manager, head physician, director of nursing services) regarding how pain in neonates is managed in the unit.

1. Tell me about expectations of the administration regarding helping babies cope during painful procedures?
2. What are your views regarding parents' participation in neonatal care (including pain care) in the unit?

*Probe:* Do you think parents would be comfortable calming their babies during painful procedures?

3. What forms of support would be available to HCPs and parents if they wanted to implement strategies to improve pain management practices in the unit?

*Probe:* Educational opportunities, time, resources and access to current evidence, mentorship, information to parents, etc.?

(b) In next part of this interview, I am going to show you some photographs which we are going to discuss further (*sequentially introduce photograph of (a) KC, (b) FT, (c) swaddling, (d) NNS/pacifier, (e) breastfeeding/breast milk, and lastly (f) oral sucrose/glucose*):

When you look at this photograph to what extent do you relate with what is happening in the picture being practiced in the unit?

*Probe:* What can you say about such a process being acceptable among staff for pain relief in babies?

*Probe:* Do you see it being easily doable and widely adopted by staff? Why? (And why not?)

(c) In your opinion as an administrator, from the set of pictures we have discussed are there any that could be implemented in the unit?

*Probe:* Why do you think (specify method) would (or would not) be easily implementable in your unit.

*Probe:* What should be changed to make the procedure implementable in the unit?

(d) From your position as a manager what else you would like to share with me or recommend (regarding helping staff to improve how the manage pain in babies under their care in the unit)?



## Appendix W

### Interview Guide for Mothers

#### Introduction

Thank you for your time to participate in this interview. We are carrying out a study to help us understand ways of helping babies admitted hospitals cope with pain associated with procedures.

(a) I would like to know what you think about how your baby was helped when he/ she was undergoing painful procedures.

1. Were you involved in calming your baby during procedures? How?
2. Were you expecting HCPs to involve you when performing painful procedures on your baby? How?
3. Would other parents have wished to participate in calming their babies also? Why? (Or why not?)

(b) Now I am going to show you some photographs which we are going to discuss further (*sequentially introduce a photograph of (a) KC, (b) FT, (c) swaddling, (d) NNS/pacifier, (e) breastfeeding/breast milk, and lastly (f) oral sucrose/glucose*):

1. When you look at this picture what do you think is going on and to what extent do you relate with what is happening in the photo?

*Probe:* Do you see it being used by other mothers/parents (and HCPs) to console babies who are in pain? Why/Why not?

(c) As a parent, from the set of pictures we have discussed which ways do you think would be easily embraced and used by mothers to help their babies cope with pain?

*Probe:* Why do you think (specify method) would (or would not) be well received by most mothers?

*Probe:* What do you think should be done (by staff and administration) to make it easy for parents to calm their babies routinely during painful procedures using this method?

(d) Is there anything else you would like to share with me on how parents (mothers) could be assisted in order to help their babies cope with pain? Or how hospitals could make it possible for parents to calm their babies when in pain?

## Appendix X

### Coding Structure

<b>HCPs</b>	<b>Administrators</b>	<b>Mothers</b>
Pain treatment	Administration's expectation	How much pain neonate has undergone
Rarely managed	Pain should be treated	A lot of pain
Management strategies often used	Parents to be involved	Sources of the pain
Sucking (Finger)	Parents to be prepared for their roles	IV cannulation
Mother holding baby	Documentation of procedures	NGT placement
Talking to baby	Not fully documented	Blood sampling
Breastfeeding	What must be documented?	Nasal cannulation
Why Pain relief strategies are not used	Pharmacological analgesia	Injections
Lack of knowledge about intervention	Invasive procedures	Pain affects mother
Attitude	Pain relief for invasive	Emotional
Misconception	procedures	Psychological
Neonates do not feel pain	Administration of treatment	Feeling helpless
Analgesics interferes with diagnosis	Unlikely to be fully documented	Pain during hospitalization
Pain not a priority	Less invasive procedures	Not expected
Lack of resources	Number of procedure attempts	Pain expected as part of treatment
Documentation of procedures	Timing of procedure	Pain relief during procedures
Frequency of documentation	Nonpharmacological analgesia	Soothing (talking to) baby
Selective documentation	Why pain is not treated	Not given anything for pain relief
Always documented	Lack of knowledge about strategies	Breastfeeding after the procedure
Routine care activities	Lack of protocols	Involvement during procedures
Pharmacological analgesia	Attitudes - neonates do not feel pain	Not involved
Invasive procedures	Competing care priorities	Prefers to be involved
Unlikely to be documented	Workload	Acceptability and feasibility of
Less invasive procedures	Acceptability and feasibility of	interventions
Full description of procedure	interventions	Kangaroo care
Number of attempts	Kangaroo care	Familiar
Nonpharmacological analgesia	Practiced, not for pain relief	Makes baby very comfortable
Interventions	Acceptable and feasible	Unfamiliar

Kangaroo care	Challenge to routine use	Experience with KC in the unit
Practiced in the unit (not for pain)	Space	Practiced it (not for pain relief)
Acceptable and feasible	Mother uncomfortable doing	Can practice during procedures
Acceptable	KC during procedure	Some mothers may be
Makes baby comfortable	Unable to access procedure site	uncomfortable doing KC during procedures
No cost	Swaddling	Swaddling
Already part of care	Practiced in the unit	Familiar
Challenges to routine use	Challenge to routine use	Calms baby during procedure
Cannot perform procedure in KC	Availability of linen	Not practiced during procedures
Mothers' willingness to do KC	Acceptable	Facilitated tucking
Space	Facilitated tucking	Familiar practice
Swaddling	Not commonly practiced	Restraint
Familiar practice	Acceptable	Makes baby comfortable
Offers comfort to baby	Challenges to routine use	Can support baby during procedure
Acceptable and feasible	Staff to hold the baby	Challenge to routine use
Less costly	Parents uncomfortable	Uncomfortable holding the
Practical even at home	holding the baby	baby during procedures
Challenges to routine use	Non-nutritive sucking	Non-nutritive sucking
Linen	Not commonly practiced in the unit	Familiar
Skills on how to swaddle	Challenge to routine use	Not familiar
Facilitated tucking	Institutional policies	Not practiced in the unit
Stabilizes baby during procedures	Availability	Practiced at home
Mother can do it	Hygiene issues	Unacceptable
Why not routinely used	Sustainability	Breastfeeding
Workload	Breastfeeding	Distracts baby from pain
Mothers not present for FT	Practiced routinely	Practiced for pain relief after
HCPs uncomfortable doing FT	Acceptable	procedure
Staff shortage	Natural	Can breastfeeding during
Non-nutritive sucking	Feasible	procedures
Not practiced in the unit	Oral sucrose	Concern about routine use
Unacceptable for routine use	Alternative used (10% dextrose)	Choke
Challenges to routine use	Practiced - exchange transfusion	Oral sucrose
Availability	Not used during procedures	Unfamiliar
Risk of spread of infections	No protocols on its use	Feasible interventions
Against unit policy	Lack of awareness on its use	Kangaroo care

Breastfeeding	during procedures	Breastfeeding
Routinely practiced for nursing	Not available	Swaddling
Pain relief after procedure	Feasible interventions	Positioning (FT)
Challenges to routine use	Kangaroo care	Reason for choice of interventions
Fear of choking baby	Breastfeeding	Intervention works
Mother not present	Positioning (FT)	Readily available
Space	Swaddling	Comfortable practicing
Acceptable and feasible	Reason for being feasible	They cost nothing
Readily available, no cost	Available	Implementing interventions in the unit
Familiar to the baby	Less costly	Making mothers aware of the
Oral sucrose	Easy to implement	interventions
Not routinely used in unit	Strategies to implement interventions	Mothers to remain with babies during
Availability	Inform staff about interventions	procedures
Not captured in protocols	Improving on staffing	Involving mothers during procedures
Risk of contamination	Making interventions available	Being compassionate to mothers
Lack of knowledge as analgesia	Policy change on timing of	
10% dextrose as alternative	procedures	
During exchange transfusion	Regular reminders about interventions	
Making interventions feasible		
Sensitize HCPs		
Pain treatment interventions		
Neonates feel pain		
Reminders		
Oral		
Pictorial		
Create awareness among mothers		
Right to be involved		
How they can help their babies		
Importance of calming their babies		
Availing resources		
Personnel		
Interventions		
Policy change		
Scheduling of procedures		
Clustering procedures		

## Appendix Y

### Consent Form for Taking Photographs Mothers

**Title of Project:** Acceptability and feasibility of behavioural and sweet-tasting solution interventions for procedural pain relief in neonatal units in Kenya.

**Investigator(s):**

Principal Investigator:

O'Brien Kyololo (RN, MSN), PhD Candidate, University of Toronto, Canada; & Moi University, Eldoret, Kenya.

Co-Investigators:

Bonnie Stevens, RN, PhD (Supervisor), University of Toronto & The Hospital for Sick Children, Toronto, Canada

Denise Gastaldo, BScN, PhD, University of Toronto, Canada

Julia Songok, MD, Moi University, Eldoret, Kenya

**Purpose of the Research:**

The aim of this study is to find out whether it is possible to use inexpensive, simple and safe strategies to help babies cope with pain associated with procedures when they are in hospital. One way to find out about this is to talk with parents of babies that have undergone such painful procedures to diagnose their conditions and monitor their health status. We intend to establish if these strategies are acceptable to health care professionals and parents, and whether it is possible to use them regularly for painful procedures. We want to use this information to develop ways of helping babies cope with pain associated with procedures.

**Description of the Research:**

We will interview health care providers, administrators and parents to gauge their perceptions on how feasible and acceptable it is to use the interventions. To interview them we will use pictures of mothers (and HCPs) supporting and consoling their babies using the strategies we are investigating. We will ask you to be photographed holding your baby (a baby) in one or more of the positions we are studying. More than one picture of you may be taken and it is anticipated that the photograph session will last 10-15 minutes.

**Potential Harms:**

We do not think that this study or allowing you to be photographed has the potential to harm you in any way.

**Potential Discomforts or Inconvenience:**

Being photographed with your baby by a person unknown to you; and being photographed holding your baby in some of the intimate positions (e.g. skin-to-skin, breastfeeding) may be uncomfortable. The time you will take to participate in this interview may cause you some inconvenience.

**Potential Benefits:****To Individual Subjects:**

There is a possibility that you will become more aware of the strategies we are investigating by being photographed holding your baby in such positions. A summary of the study results will be sent to you once the study is completed.

**To Society:**

Through this study we will be able to better understand alternative, low-cost methods of supporting and helping babies cope during painful procedures.

**Reimbursement:**

There will be no monetary reimbursement for taking part in this research. We would be pleased to provide you with a picture of you and your baby.

**Participation:**

Participation in research by being photographed is voluntary. If you decide to participate, you can decide to stop at any time without giving any reasons. Your participation may contribute to the understanding of alternative strategies of controlling pain from clinical procedures in babies admitted in a newborn unit. A copy of this consent form will be given to you.

**Confidentiality:**

The pictures produced from this study will be stored in a secure, locked location. Only members of the research team (and maybe the SickKids monitor, or employees of the company sponsoring the study or the regulator e.g., Health Canada) will have access to them. Following completion of the study the pictures will be kept as long as required in the SickKids “Records Retention and Destruction” policy. They will either be destroyed according to this same policy or used for educational purposes in future if you agree.

**Consent:**

By signing this form,

- 1) I also agree to be photographed for this study. These photographs will be used to explore ways of helping babies copy with pain associated with procedures
- 2) I understand that I have the right to refuse to take part in this study. I also have the right to withdraw from this part of the study at any time, e.g., before or even after the photographs are made. My decision will not affect the health care my baby receives at this hospital.
- 3) I am free now, and in the future, to ask questions about the picture taking.
- 4) I have been told that my medical records will be kept private. You will give no one information about me, unless the law requires you to.
- 5) I understand that no information about me or my baby (including these pictures) will be given to anyone or be published without first asking my permission.”
- 6) I have read and understood items 1 to 5 of this consent form. I agree, or consent, to having my picture taken as part of the study.

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*Printed Name of Subject*

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*Subject's signature & date*

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*Printed Name of person who explained consent*

*Signature & date*

\_\_\_\_\_  
*Printed Witness' name (subject does not read English)*

\_\_\_\_\_  
*Witness' signature & date*

*In addition, I agree or consent for these photograph to be used for:*

- 1. Other studies on the same topic* ☐
- 2. Teaching and demonstration at SickKids.* ☐
- 3. Teaching and demonstration at meetings outside SickKids.* ☐
- 4. Not to be used for anything else.* ☐

*In agreeing to the use of the photographs for other purposes, I have been offered a chance to view the photographs. I also have the right to withdraw my permission for other uses of the photographs at any time.*

\_\_\_\_\_  
*Printed Name of Subject*

\_\_\_\_\_  
*Subject's signature & date*

\_\_\_\_\_  
*Printed Name of person who explained consent*

\_\_\_\_\_  
*Signature & date*

\_\_\_\_\_  
*Printed Witness' name (subject does not read*

\_\_\_\_\_  
*Witness' signature & date*