

PAIN MANAGEMENT IN JORDANIAN PICUs

The Influence of Context on Utilizing Research Evidence for Pain Management in
Jordanian Pediatric Intensive Care Units

Ahmad Ismail, BScN, MScN, PhD (c)

Thesis submitted to Graduate and Postdoctoral Studies in partial fulfillment of the requirements
for the PhD degree in Nursing

Graduate and Postdoctoral Studies
University of Ottawa

© Ahmad Ismail, Ottawa, Canada, 2018

Abstract

Background

Little is known about the use of pain management evidence in Jordanian Pediatric Intensive Care Units (PICUs).

Purpose

To assess the existence, content, and the factors influencing the use of pain management evidence in Jordanian PICUs.

Methods

Three studies were guided by the Promoting Action on Research Implementation in Health Services (PARiHS) framework.

1. A scoping review of the literature to identify pain management interventions in the PICU;
2. A cross-sectional and multisite survey to determine the current pain management practices, and the availability and content of practice guidelines in Jordanian PICUs;
3. A correlational and multisite survey to examine the relationship between the contextual factors and nurses' use of pain management research evidence in Jordanian PICUs.

Results

1. Twenty-seven studies were included in the scoping review. The majority of the studies focused mainly on pharmacological interventions (n= 21, 78%). Morphine and fentanyl were the most commonly used pharmacological agents for pain management in the PICUs. The use of non-pharmacological interventions was limited.
2. Four of six eligible PICUs participated in the cross-sectional study. All four units had written pain management guidelines. Fentanyl was the most commonly used pharmacological agent in two units. Intravenous infusions of opioids were not administered for patients on

mechanical ventilation in two units. The use of non-pharmacological interventions was reported in one unit.

3. From the four participating units, 73 nurses completed the correlation study survey. Social capital predicted both the instrumental and conceptual research use for pain management by Jordanian PICU nurses. Structural and electronic resources predicted the instrumental research use for pain management by Jordanian PICU nurses.

Conclusions

Pain management practices and supporting guidelines varied in Jordanian PICUs. Context influences Jordanian PICU nurses' use of research for pain management. Not all of the pain management practices in Jordan are evidence informed. There is an opportunity for improvement in pain management in Jordanian PICUs.

Acknowledgements

I would like to express my gratitude and appreciation to my supervisor (Dr. Denise Harrison) who played a substantial role in my journey. She was the best supervisor who enabled me to focus on success. She encouraged me during time of success and supported me during time of challenge. Her integrity and dedication to my academic development are highly appreciated. She generously gave the right advice at the right time. She was an excellent listener and a consistent person who provided consistent feedback and guidance. She supported and encouraged me to publish my work in conferences as well as in high ranking journals. Her time and effort, motivation, support, and encouragement helped me to develop invaluable knowledge and research skills.

I would like also to thank my co-supervisor (Dr. Viola Polomeno) and my committee members (Dr. Paula Forgeron and Dr. Huda Gharaibeh) for their help and support during my journey. They provided invaluable advice and feedback. Dr. Viola was always welcoming me and found time to meet and support. She gave me the opportunity to talk about my academic life as well as my personal life, which relieved some of the stress I felt. Dr. Paula Forgeron was a true friend who provided priceless feedback and knowledge. She stimulated my critical thinking. That made my work more robust. Dr. Huda Gharaibeh was a great professor who encouraged and supported me. She provided invaluable advice and feedback on my work, especially in the Jordanian setting.

I would like to extend my gratitude to my mentor in the Pain in Childhood Health (PICH) Dr. Allen Finley. Dr. Allen was a great mentor who provided invaluable feedback and advice on my work. He helped in developing and reviewing one study tool I used to collect data, and he provided expert consultation on the articles that were included or excluded in the scoping review. I would like also to thank Sharon Kinney, The Royal Children's Hospital Melbourne, Australia;

Margot Thomas, Children's Hospital of Eastern Ontario Research Institute; Colleen Fitzgibbons, Children's Hospital of Eastern Ontario; Mahmoud Alshalabi, King Fahad Medical City, Riyadh, Saudi Arabia; Ghalib Hashim, King Fahad Medical City, Riyadh, Saudi Arabia for their help in the development and validation of a questionnaire I used. Their feedback they provided on the articles to be included or excluded in the scoping review was highly appreciated. I also thank Amer Aridah (King Hussein Cancer Center, Jordan) for his support in the data collection procedure in King Hussein Cancer Centre. I acknowledge the Canadian Pain Society and the University of Ottawa for their financial support that enabled me to travel and present some of the findings at the Canadian Pain Society Scientific Meeting in Vancouver May 2016 and in Halifax 2017.

My deepest gratitude goes to my wife (Dalia Kiwan) who provided a huge support during my study. She sacrificed her time to help me. She was a true friend who was able to tolerate my busy schedule during the past six years. She played a dual role for my children during my absence. She was a mother and father at the same time. I would like thank my children (Bashar, Karam, and Aws) for their patience and understanding for not giving them the time and effort they needed as children. My special deepest gratitude goes to my father's (AbedAlkareem) soul who passed away in April 2017.

Table of Contents

	Page
Abstract.....	ii
Acknowledgements.....	iv
Table of Contents.....	vi
List of Tables.....	xi
List of Figures.....	xii
1. Chapter One. Introduction.....	1
Statement of the Problem.....	2
Literature Review.....	6
Definitions and effects of pain.....	6
Pain management in PICU.....	9
Knowledge translation.....	21
Conceptual framework.....	23
Pain studies in Jordan.....	28
Evidence Gap.....	36
Research Questions.....	36
Methodology.....	37
Study One.....	38
Study Two.....	39
Study Three.....	40
Ethics.....	42
References.....	43

2. Chapter Two. Pain Management Interventions in the Pediatric Intensive Care

Unit (PICU): A Scoping Review.....	57
Abstract.....	58
Introduction.....	59
Methods.....	61
Literature search.....	61
Article selection.....	61.
Data charting.....	62
Results.....	63
Pharmacological interventions.....	66
Psychological interventions.....	79
Physical interventions.....	81
Others (environmental modification and music).....	82
Discussion.....	82
Acknowledgements.....	88
References.....	89

3. Chapter Three. Pain Management Guidelines in Jordanian Pediatric Intensive

Care Units.....	98
Abstract.....	99
Background.....	100
Materials and Methods.....	102
Design.....	102
Ethics.....	103

Setting and participants.....	103
Data collection instrument.....	103
Data collection procedure.....	104
Statistical analysis.....	105
Results.....	105
Discussion.....	109
Conclusion.....	114
Acknowledgments.....	115
References.....	116
4. Chapter Four. The Influence of Context on Utilizing Research Evidence for Pain Management in Jordanian Pediatric Intensive Care Units.....	122
Abstract.....	123
Introduction.....	124
Review of Literature.....	125
Purpose.....	126
Methods.....	127
Design.....	127
Sample.....	128
Setting.....	129
Instruments.....	130
Demographic data sheet.....	130
Alberta Context Tool.....	131
Conceptual research use.....	133

Instrumental research use.....	133
Data analysis.....	133
Ethics.....	136
Results.....	136
Participant demographics.....	136
Bivariate relationship between contextual factors and research utilization.	140
Relationship between significant variables and research utilization.....	141
Discussion.....	143
Limitations.....	148
Direction for Future Action.....	148
Conclusion.....	149
Acknowledgements.....	149
References.....	150
5. Chapter Five. Integrated Discussion.....	157
Introduction.....	158
Summary of Dissertation Findings.....	159
Study One.....	159
Study Two.....	160
Study Three.....	161
Discussion.....	162
Limitations.....	173
Implications.....	174
Recommendations.....	174

Conclusion.....	177
References.....	179
6. Chapter Six. Contributions of Collaborators.....	188
Contributions of Collaborators.....	189
Research Team Collaborators.....	189
Other Collaborators.....	190
Research Assistants Acknowledgements.....	190
7. Appendices.....	193
Appendix A. Ethics Approvals.....	194
Appendix B. Search Strategy of Study One.....	199
Appendix C. Summary of Studies on Pain Management Interventions Used in the PICU of Study One.....	202
Appendix D. Elsevier Guidelines for Using Published Articles in Dissertation for Non-Commercial Purposes.....	226
Appendix E. Survey of Study Two (Pain Management Practice and Guidelines in Jordanian Pediatric Intensive Care Units (PICU)).....	227
Appendix F. Study Three Questionnaire.....	240
Appendix G. Permission to Use Alberta Context Tool.....	249
Appendix H. The Permission to Use the Conceptual Research Utilization Scale.....	253

List of Tables

	Page
Table 2.1	Design, Intervention Category, and Condition..... 65
Table 2.2	Pain Management Intervention (Used or Tested) Among the 27 Studies 66
Table 3.1	Demographic Characteristics of the Participating PICUs..... 106
Table 3.2	Pain Management Practice and Policies/Guidelines in Jordanian PICUs 107
Table 4.1	Alberta Context Tool Concepts and Scoring..... 132
Table 4.2	Nurse Demographics..... 137
Table 4.3	Pearson Moment Correlation-Continuous Demographics and Research Utilization..... 137
Table 4.4	Independent t Test and One Way Analysis of Variance (ANOVA) for Categorical Demographics and Research Utilization..... 138
Table 4.5	Hospital Type and Contextual Factors..... 139
Table 4.6	Pearson Moment Correlation between Contextual Factors and Research Utilization..... 141
Table 4.7	GEE Results for Instrumental Research Use (IRU) and Conceptual Research Use (CRU) 142
Table 6.1	Summary of Collaborators' Contributions..... 191

List of Figures

	Page
Figure 1.1 Promoting Action on Research Implementation in Health Services (PARiHS) Framework.....	24
Figure 2.1 Flow Diagram of Study Selection Process.....	64

Chapter One

Introduction

Statement of the Problem

Children's pain is considered a public health concern (World Health Organization [WHO], 2012). Children have the right to access appropriate pain management by adequately-educated health care professionals (HCPs) (International Association for Study of Pain [IASP], 2014). However, moderate to severe pain appropriate management is not accessed in all parts of the world. As reported by the IASP, five billion people have no or insufficient access to pain treatment of moderate to severe pain (IASP, 2014). Due to the importance of the issue of pain, it is recommended by some organizations including the American Pain Society, the Department of Veterans Affairs, and the Registered Nurses Association of Ontario (RNAO), to assess pain along with vital signs: Temperature, heart rate, blood pressure, and respiratory rate (American Pain Society Quality of Care Committee, 1995; Department of Veterans Affairs, 2000; National Pharmaceutical Council, 2001; RNAO, 2013).

Pain management in children presents more unique challenges than in adults due to the complex nature of children's pain and their physical, cognitive, and psychosocial development (Srouji, Ratnapalan, & Schneeweiss, 2010). In the Pediatric Intensive Care Unit (PICU), pain management is even more complex due to the nature of the child's critical condition and the inability to obtain self-report in some patients. Self-report of pain is considered by some organizations the gold standard of pain assessment (American Association of Critical-Care Nurses, 2014). However, common treatment modalities used in the PICU can compromise the ability to obtain self-report of pain. These include administration of sedative and paralytic agents, and mechanical ventilation (Oakes, 2011; Turner, 2005). Altered levels of consciousness due to critical conditions and illnesses e.g., head trauma, septicemia, can also limit the ability of children to self-report their pain in the PICU. In the PICU, patients are not only critically ill with

complex conditions; they are children with less developmental capabilities than adults. Despite all of these challenges, HCPs in the PICU should provide effective pain management to critically ill children (IASP, 2014; Playfor et al., 2006).

Pain management is sub-optimal in some parts of the world (IASP, 2014), including access to effective acute pain treatment (IASP, 2014). Acute pain can be a result of trauma, disease, and terminal illness. Such conditions are common in the PICU. Furthermore, some pain medications (e.g., opioids) may not be available in some countries especially in low to middle income countries. Health care professionals and students in health care fields including nursing and medicine receive inadequate or little education about pain in many countries, leading to limited knowledge about pain management (IASP, 2014; Watt-Watson et al., 2009). Policies and guidelines on pain management are not completely established or not evidence informed in some countries (Batiha, 2014; IASP, 2014). Pain research especially knowledge translation (KT) research projects are limited in many countries, and previous KT research has predominantly been conducted in Western countries (Finley, Forgeron, & Arnaout, 2008; IASP, 2014). These challenges to pain management can compound pain management in the PICU. For example, uncontrolled pain is one of the most common major adverse events in the PICU (Agarwal et al., 2010). If effective analgesics including opioids are in limited supply or clinicians do not have adequate knowledge on pain management approaches, critically ill children will continue to suffer unnecessarily. It was also reported that the evidence to support pain management guidelines in the PICU is weak, especially the evidence related to pain treatment interventions (Playfor et al., 2006), highlighting the need to identify effective pain management interventions used or examined for use in the PICU.

Implementing effective available and accessible pain management research evidence is important to effectively manage children's pain (Samuels & Fetzer, 2009). However, in critical care settings such as the PICU, there is a wide gap between evidence and pain care practices (Samuels & Fetzer, 2009). Developing and implementing evidence-based guidelines is one way to improve pain management in the PICU. In addition, a multifaceted approach including education and support for all HCPs involved in PICU patient care, and modification of contextual factors that play an important role in utilizing pain management evidence is needed (RNAO, 2013; Squires et al., 2013).

To design successful interventions aimed at improving the use of research evidence for pain management in the PICU, there is a need to have a clear understanding of the status of pain care being practiced, the evidence being used, the contextual factors that influence the use of evidence, and the type of facilitation needed to ensure successful implementation of this evidence (Kitson et al., 2008; Kitson, Harvey, & McCormack, 1998; Rycroft-Malone, 2004; Rycroft-Malone et al., 2002). Context (the environment in which a HCP works) can have a positive or negative effect on the success of implementation of interventions (Dopson, Fitzgerald, Ferlie, Gabbay, & Locock, 2002; Meijers et al., 2006; Rycroft-Malone, 2004; Stevens et al., 2011).

The RNAO organization (2013) provides four key evidence-based recommendations for organizations to achieve effective pain management (RNAO, 2013). In their pain management guidelines, they highlight the importance of KT and multifaceted strategies to integrate the best evidence on managing pain into practice. They emphasize the necessity of the recognition of pain management as a strategic clinical priority and the need for available resources and organizational and administrative supports to facilitate the uptake of best practice guidelines for

pain management. Furthermore, the RNAO recommends supporting a multi-disciplinary approach to pain care (RNAO, 2013), highlighting the importance of considering pain as a high priority issue and to use multifaceted KT interventions to implement pain management evidence.

Knowledge translation studies have been predominantly conducted in Western countries where contexts may differ compared to low or middle income countries such as Jordan (Finley et al., 2008). For example, resources to support patients' care including human and financial resources are less challenging in Western countries than in low and middle income countries (Finley et al., 2008). Approaches used in Western countries to translate evidence into practice may not succeed in other contexts and other health care systems where resources may be scarce (Finley et al., 2008). Jordan is a low middle income country (The World Bank, 2017). Access to care is challenging for residents to attain, especially for those who do not have the financial resources to pay for their medical care costs (Finley et al., 2008). Hospitals in Jordan can be categorized into five different types based on how they are funded. These five categories are: Ministry of Health hospitals (funded by the government to serve mainly governmental employees and their families free of charge), Royal Medical Services (military hospitals to serve military workers and their families free of charge), private for profit hospitals, not for profit non-governmental hospitals (self-operated and mainly funded by money donated by people), and university hospitals (Jordan Ministry of Health, 2013).

Several studies have been conducted related to pain management in Jordanian hospitals (Abdalahim, Majali, Stomberg, & Bergbom, 2011; Al-Safi, Alkofahi, & El-Eid, 2005; Al Qadire & Al Khalaileh, 2014; Al Qadire, Tubaishat, & Aljezawi, 2013; Ayasrah, O'Neill, Abdalahim, Sutary, & Kharabsheh, 2014; Batiha, 2014; Finley et al., 2008; Forgeron, Finley, & Arnaout, 2005; Massad et al., 2013; Shoqirat, 2015), yet, no research has evaluated the types of

pain management practices used in Jordanian PICUs, and what guidelines are available or used in Jordanian PICUs. In addition, no studies have evaluated the influence of organizational context on research utilization for pain management in Jordanian PICUs.

The main aim of this dissertation is to explore pain management practices in Jordanian PICUs. Three main objectives for this dissertation to achieve this aim are: (1) identify research informed pain management interventions used in the PICU world-wide; (2) describe pain management practices as well as the existence and content of pain management guidelines currently being used in Jordanian PICUs; and (3) understand how contextual factors influence research utilization to guide pain management in Jordanian PICUs. These three objectives of this dissertation were explored in three separate studies. The first study synthesized the pain management interventions used and studied in PICU. The second study established information on current pain management practice and guidelines used in Jordanian PICUs. The third study examined the influence of contextual factors on research use for pain management practices in Jordanian PICUs.

Literature Review

This chapter situates the three studies within the current understanding of commonly used definitions and effects of uncontrolled pain, an overview of the pain management processes for children in the PICU including challenges to pain assessment, treatment and re-assessment, the limitations of applying KT research findings to non-Western settings, and the limitations of research conducted in Jordan relating to pain management in the PICU. The conceptual framework guiding this dissertation will be introduced followed by a discussion of the overall methodology and ethical considerations.

Definitions and Effects of Pain

Two most commonly used definitions to describe and indicate pain are defined by McCaffery (1977) and the International Association for the Study of Pain (IASP). Forty years ago, McCaffery defined pain as "what the patient says it is, and exists whenever the patient says it does" (McCaffery, 1977, p. 11). The second definition by IASP defines pain as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (IASP, 2017, p. 1). Both definitions indicate that pain is mainly a subjective experience; however objective indicators for the presence of pain can be used if the ability of the patient to report it is compromised. Williams and Craig (2016) expanded on the definition of the IASP to include cognitive and social experiences of pain. Self-report of pain can be considered the most important way to communicate the subjective experience about pain to others. However, for sick infants and young children in the PICU, not only are their cognitive and expressive language capabilities not well developed, but they are critically ill and may be unconscious and intubated. Caring for unconscious and intubated infants, children and adults, who cannot self-report, mandate HCPs to use objective measures to assess, treat, and evaluate the effectiveness of pain management interventions. Anand and Craig (1996) proposed that behavioral changes caused by the presence of pain are important indicators to be considered. These behavioral indicators could be masked by commonly used drugs in the PICU such as sedatives and paralytic agents. Physiological measures also such as vital signs of heart rate, respiratory rate, blood pressure, can be compromised by different factors including administration of vasoactive medications, which are commonly used in the critical care settings. PICU HCPs are required to rely on pain assessment measures that consider the age and condition of the child.

Uncontrolled pain in the PICU can lead to negative physiological and psychological outcomes during the hospital stay and after discharge. Depending on the severity of the pain, many systems in the human body react to pain including cardiovascular, respiratory, and immune systems (Anand et al., 2006; Oakes, 2011; Rennick et al., 2004; Thorp & James, 2010; Turner, 2005). Uncontrolled pain can result in increased sympathetic responses that may lead to an increased cardiac effort and oxygen consumption, immunosuppression, raised stress hormones, and delayed wound healing (Thorp & James, 2010). Post-operative pain as a result from pulmonary and/or abdominal surgery can result in an ineffective cough and diminished chest and abdominal movement that can lead to an increased risk of pulmonary infection, reduced gas exchange, requiring an increased duration of respiratory support, including mechanical ventilation (Ismail, 2016; Thorp & James, 2010). Pain is one of the important factors that can lead to a disruption of the normal sleep rhythm (Franck et al., 2010; Kudchadkar, Aljohani, & Punjabi, 2014). Poorly managed pain can lead to negative psychological consequences after discharge and recurrent and severe pain in the PICU can lead to chronic pain (Voscopoulos & Lema, 2010). It was reported that children who were younger, more severely ill and experienced more invasive procedures, had a significantly lower sense of control over health, medical fears, and persistent posttraumatic stress responses for six months following discharge (Rennick, Johnston, Dougherty, & Ritchie, 2002). Rennick et al. (2004) indicated that exposure to high numbers of invasive procedures in the PICU was the most important predictor of negative psychological outcomes following discharge. It was also reported that painful procedures performed in Canadian pediatric hospitals were highest in the PICU. The average number of procedures reported per day was 13 (Stevens et al., 2011), which included painful procedures such as insertion of endotracheal tubes, removal of chest tubes, and insertion of central venous

lines (Stevens et al., 2011). Critically ill children in the PICU are at risk for development of negative consequences since they are exposed to a high number of daily painful procedures and perhaps even more so due to the challenges inherent in assessing pain in this population.

Pain Management in the PICU

Managing pain in critically ill children is a complex task, and HCPs face many challenges to provide optimal pain management for children in the PICU. In this section, pain management processes in the PICU are reviewed, and key challenges affecting the provision of effective pain management are highlighted.

In a published review of key challenges of providing effective pain management in the PICU, the author and Principal Investigator (PI) of this dissertation (Ismail, 2016) described the following:

- Challenges to be considered prior to pain assessment
- Pain assessment
- Pain treatment interventions
- Challenges following provision of pain treatment interventions (re-assessment)

Challenges to be considered prior to pain assessment. Key challenges to be considered prior to pain assessment are related to HCPs' characteristics, patients' and their families' factors, and the PICU setting itself (Ismail, 2016). Healthcare organizations and professionals may consider and, if necessary, modify some of these factors in order to effectively assess and treat pain. If these factors are not considered or modified, they will remain challenges for pain assessment and treatment. For example, a potentially modifiable factor is nurses' knowledge regarding pain management, which may affect their decisions about pediatric pain management (Abu-Saad & Hamers, 1997; Al Qadire & Al Khalailah, 2014; Batiha, 2014; Ismail,

2016; Rush & Harr, 2001). Providing relevant education about the use of appropriate pain assessment tools and evidence-based pain management may improve pain assessment and treatment. The following is a discussion of nursing factors, physician factors, child/parent factors, and PICU environment factors.

There are many reported factors which may influence pediatric nurses', including PICU nurses', pain management decisions. Factors identified in the literature are personal bias, practice traditions, persistence of myths surrounding pediatric pain management, resistance to change, suboptimal knowledge of complex pain syndromes and treatment modalities, inadequate communication between nurses and other HCPs, heavy workloads, and perceived inadequate time to assess and treat pain (Batiha, 2014; Rush & Harr, 2001; Turner, 2005).

The Canadian Association of Critical Care Nurses (CACCN) addressed the key role that critical care nurses play in providing optimal pain assessment and treatment. The CACCN's document entitled 'Standards for Critical Care Nursing Practice' states that a "critical care nurse discerns among pain, anxiety, and delirium as the source of discomfort and implements individualized therapies (pharmacological and non-pharmacological) to prevent and/or alleviate suffering" (Canadian Association of Critical Care Nurses [CACCN], 2009, p. 4). However, little is known about whether the pain care practices of PICU nurses meet this standard or are negatively affected by the above identified factors influencing pain management practices. More specifically, it is not known whether PICU nurses in Jordan meet this standard.

Some challenges to providing effective pediatric pain management can be found in relation to physicians' practices including those in PICUs (Batiha, 2014; Czarnecki et al., 2011; Ismail, 2016; Van Niekerk & Martin, 2003). Examples of these practice challenges are: (1) inadequate medical orders, (2) insufficient premedication orders before procedures, (3)

insufficient time allowed for pre-medication before procedures, (4) low priority given to pain management by medical staff, (5) insufficient communication and cooperation by physicians, and (6) insufficient pain management knowledge held by physician's (Batiha, 2014; Czarnecki et al., 2011; Ismail, 2016; Van Niekerk & Martin, 2003).

At the level of patients and their parents, some factors reported in the literature may compromise pain management in the PICUs. Examples of these factors are: (1) the patient does not want to bother nurses, (2) patients find it difficult to complete pain scales, (3) some patients are reluctant to take pain medications because of the perceived side-effects of these medications, (4) patients report their pain to the doctor, but not to the nurse, and (5) some patients think that pain is a result of God's will, which may compromise the self-motivation to intervene or comply with medical treatment (Batiha, 2014; Czarnecki et al., 2011; Ismail, 2016). Nurses should be aware of these factors, so they can address patients' and/or parents' concerns and work with children, their families and the HCPs team to provide effective pain care in the PICU.

The surroundings and routines are important setting factors that can also influence pain management for children receiving care in the PICU. For example, children often suffer from sleep deprivation and sensory overstimulation due to ongoing activity on a twenty-four hour basis that include admission of new patients, resuscitations, bright lights and unfamiliar noises from machine alarms and phones ringing (Ismail, 2016; Oakes, 2011; Thorp & James, 2010). These environmental activities can make the provision of non-pharmacological interventions, such as physical (e.g. application of heat), psychological (e.g. distraction), and environmental modification (e.g., noise reduction) challenging to implement in the PICU. Nevertheless, the majority of these interventions are directly within the scope of nursing practice to implement (Thomas, Dhanani, Irwin, Writer, & Doherty, 2010) and are recommended (Keogh, Long, &

Horn, 2015; Playfor et al., 2006; Thomas et al., 2010), highlighting the need to consider and modify (where possible) such factors which are important to the overall goals of effective pain management.

Batiha (2014) identified five barriers for pain management related to the administration and resources in critical care units, including PICUs in Jordan, which, as previously stated, is a lower middle income country (The World Bank, 2017). They were a lack of a hospital policy for pain management, nursing staff shortage, a lack of psychosocial support services, a lack of alternative non-pharmacologic therapy for pain management, and a lack of pain management medications. Inadequate financial and human resources influence the capability of some institutions to provide optimal pain management in the intensive care units including the PICU. However, it is explicitly stated in the Declaration of Montreal as it relates to access to pain management being a fundamental human right, that hospital administrators have a role and responsibility in providing a structure to support appropriate pain management within their institutions:

The obligation of governments and all health care institutions, within the scope of the legal limits of their authority and taking into account the health care resources reasonably available, to establish laws, policies, and systems that will help to promote, and will certainly not inhibit, the access of people in pain to fully adequate pain management. Failure to establish such laws, policies, and systems is unethical and a breach of the human rights of people harmed as a result (IASP, 2014, p. 1).

Challenges to be considered during pain assessment. Pediatric patients are a heterogeneous group and therefore, a one-size fits-all approach for assessment and treatment is not possible (Johnson, Miller, & Hagemann, 2012). Children's pain assessment presents unique

challenges that require the consideration of the child's age, cognitive and communication skills, developmental level, previous pain experiences, and associated beliefs. Assessment of pain in children is complex, and involves physiological, psychological, behavioral, social and developmental factors (Gélinas, Fortier, Viens, Fillion, & Puntillo, 2004; Ismail, 2016; Oakes, 2011; Ramelet, Abu-Saad, Rees, & McDonald, 2004; Srouji et al., 2010; Twycross, 2009). Additionally, in the PICU, clinicians have to take into consideration the critical nature of their illness and the child's ability to participate in the assessment of pain.

When self-report of pain cannot be obtained from patients, clinicians rely on observed physiological measures, such as heart rate, and behavioral measures, such as facial expression (Ambuel, Hamlett, Marx, & Blumer, 1992; Bai, Hsu, Tang, & Van Dijk, 2012; Playfor et al., 2006; Ramelet et al., 2007; Van Hulle Vincent, Wilkie, & Wang, 2011). Various factors affect the accuracy of relying on physiological and behavioral indicators. Observed measures of pain can provide helpful information, however scores predominantly reflect the intensity of behaviors or physiologic responses used for the detection of pain. As a result of that, the intensity score could be overrated by reflecting behaviors resulting from fear and distress (Ismail, 2016; Ljungman, Kreuger, Gordh, & Sörensen, 2006) or be under-rated due to illness and treatments that dampen behavioral responses to pain (Herr, Coyne, McCaffery, Manworren, & Merkel, 2011). Physiological variables are also at risk of being influenced by factors other than pain, such as the administration of inotropic vasoactive drugs which are commonly used in the PICU (Johansson & Kokinsky, 2009; Mattsson, Forsner, & Arman, 2011). For example, the administration of dopamine, a first line vasopressor used in hypotensive patients (Marinosci, De Robertis, De Benedictis, & Piazza, 2012) may increase the heart rate above the normal range which could overrate a pain score based on physiological parameters, and sedatives such as

midazolam can mask behavioral signs of pain. When a self-report of pain is unattainable due to the developmental stage of the patient or illness related factors, clinicians may base their assessment of pain on multiple physiological or behavioral factors (Dorfman, Rempel, Scott, & Hartling, 2014; Ismail, 2016), leading to differences in pain assessment. These differences in assessment of pain could lead to significant differences in the pain treatment (e.g., fluctuations in the administration of analgesia).

When ventilatory support is needed for children in the PICU, reliable pain assessment is even more difficult because of the need for analgesia, sedation, and neuromuscular blocking agents to provide comfort and facilitate mechanical ventilation (Gélinas et al., 2004; Ismail, 2016; Johansson & Kokinsky, 2009; Oakes, 2011). The PICU staff should assume the presence of pain in a ventilated patient who has a risk of discomfort (e.g., a patient with an endotracheal tube). Distinguishing pain from other expressions related to illness, treatment, and sedation is a challenge for PICU HCPs, which in turn adds to the complexity and difficulty of pain management in the PICU. There is difficulty in determining whether the changes are related to pain or other experiences, such as fear (Ranger et al., 2013). Changes in physiological measures (e.g., blood pressure, heart rate, and oxygen saturation) and changes in behavioral measures (e.g., crying) often are interpreted as pain-related (Mattsson et al., 2011). HCPs face challenges when trying to determine whether these changes in physiological and behavioral measures are caused by pain or other factors that are common in the PICU, such as delirium, agitation, hypoxia, fear, and anxiety. Therefore, it is recommended that pain as the cause of these indicators should first be ruled out before considering other factors (Ismail, 2016; Oakes, 2011).

A number of composite pain assessment tools exist which are used in the PICU. The most common pain assessment scales used in the PICU are the COMFORT and the FLACC (Face,

Legs, Activity, Cry, and Consolability) scales (Ambuel et al., 1992; Harris et al., 2016; Ismail, 2016; Johansson & Kokinsky, 2009; Merkel, Voepel-Lewis, Shayevitz, & Malviya, 1997; Oakes, 2011; Voepel-Lewis, Zanotti, Dammeyer, & Merkel, 2010). The FLACC pain scale has been recommended to assess pain in critically ill children who are unable to self-report pain (Voepel-Lewis, Zanotti, Dammeyer, & Merkel, 2010). The FLACC scale is a uni-dimensional (behavioral) scale and can be used for a wide range of children (Bai et al., 2012; Crellin, Harrison, Santamaria, & Babl, 2015; Manworren & Hynan, 2003; Merkel et al., 1997; Voepel-Lewis et al., 2010). In 2006, a revised version of the FLACC (FLACC-R) scale was developed to allow for more accurate assessment of pain in cognitively impaired children (Malviya, Voepel-Lewis, Burke, Merkel, & Tait, 2006). In the revised FLACC scale, the five categories (Face, Legs, Activity, Cry, and Consolability) are unchanged. Some descriptors associated with pain in individuals with cognitive impairment were added, mainly in the legs and activity categories such as marked increase in leg spasticity and head banging (Malviya et al., 2006). In addition, an open-ended descriptor under each of the five categories was added, allowing caregivers or parents to record individualized pain behavior the patient may exhibit (Malviya et al., 2006). In 2009, the original version of the FLACC scale was modified to become the modified FLACC scale that can be used for patients unable to vocalize such as ventilated children in the PICU (Johansson & Kokinsky, 2009). In the modified FLACC scale, the five categories (Face, Legs, Activity, Cry, and Consolability) are the same as the original FLACC. The modification includes that the assessor observes the facial expressions in order to score the cry items e.g., facial expressions of crying or moaning (Johansson & Kokinsky, 2009).

The COMFORT scale is a pain assessment tool originally developed for use in the PICU in the early 90's and now commonly used in the PICU. The COMFORT scale is a bi-

dimensional scale including two physiological and six behavioral indicators for the presence of pain (Ambuel, Hamlett, Marx, & Blumer, 1992). The physiological indicators are blood pressure and heart rate, and the behavioral indicators are alertness, calmness and agitation, respiratory response, physical movement, muscle tone, and facial tension. As physiological variables are affected by many factors other than the presence of pain such as the use of inotropic and vasoactive drugs (Johansson & Kokinsky, 2009), physiological indicators of pain were excluded in the modified behavioral version of the COMFORT scale (COMFORT-B). This modification reportedly increased the reliability of the scale when used to assess pain in children in the PICU (Carnavale & Razack, 2002; Ista, van Dijk, Tibboel, & de Hoog, 2005). The COMFORT-B scale has been validated for distress and pain in critically ill children, ventilated and non-ventilated, from 0 to 18 years (Ista, et al., 2005). However, assessment of behavioral indicators is not always attainable, for example, for children receiving neuromuscular blockade agents. In addition, the COMFORT and the COMFORT-B scales may not be reliable assessment tools for children with severe cognitive impairment, severe hypotonia or other conditions where the child's behavioral responses are altered (Bear & Ward-Smith, 2006; Ismail, 2016; Ista, van Dijk, et al., 2005; Johansson & Kokinsky, 2009; Oakes, 2011; van Dijk, Peters, van Deventer, & Tibboel, 2005). This highlights ongoing challenges with assessing pain in the PICU.

Challenges to be considered during pain treatment. There is no one approach that suits all for critically ill children's pain treatment (Ismail, 2016; Johnson et al., 2012). Careful selection of pharmacological and non-pharmacological interventions suited to PICU patients is required to manage children's pain in the PICU in the most optimal way. Pain treatment interventions should be appropriate to the child's age and level of development, and consider the complexity of the child's condition in the PICU (Ismail, 2016). In the last two decades, much has

been learnt about the concept of pain and an enriched understanding of the pathophysiology of pain in children has led to major advances in pain management, especially in intensive care units (Ismail, 2016; Özyazicioğlu & Arikan, 2008; Sloman, Wruble, Rosen, & Rom, 2006; Turner, 2005). For example, topical anesthetics are now available that play a major role in minimizing the pain of venipuncture, arterial cannulation, and other painful procedures (Turner, 2005). In addition, critically ill children in the PICU can receive aggressive analgesia and sedation, yet titrated to the specific needs of the children (Playfor et al., 2006; Turner, 2005).

Based on the severity of pain and the condition of the patient, the type and the route of administration of pharmacological agents can be chosen (Playfor et al., 2006; Thomas et al., 2010; WHO, 2012). There are medications that are safely used in the PICU to treat mild to severe pain which are aligned with the WHO analgesic ladder. The WHO recommends acetaminophen and ibuprofen for children in mild pain and opioid analgesics for moderate to severe pain (WHO, 2012). Morphine and fentanyl are the most commonly recommended medications to use for severe pain (Playfor et al., 2006; Thomas et al., 2010). Other agents have been used in the PICU less frequently than morphine and fentanyl (e.g., tramadol) dexmedetomidine, and remifentanyl. Availability, safety, risk of adverse effects, cost, risk of development of withdrawal symptoms, and drug tolerance are the main determinants to using agents other than morphine and fentanyl (Akinci, Kanbak, Guler, & Aypar, 2005; Chrysostomou et al., 2009; Maldini, Radesic, Javorovic, & Fattorini, 1997).

Opioid infusion using Patient Controlled Analgesia (PCA) has been recommended for non-ventilated alert older children (more than seven years old) as this mode of delivery may allow them to individualize their pain control with the goal of optimal pain control with fewer side effects (Hayes, Dowling, Peliowski, Crawford, & Johnston, 2016; Playfor et al., 2006).

Local and regional anesthetic techniques are appropriate in some situations (e.g., painful procedures, post-operatively) (Bauchner, May, & Coates, 1992; Butkovic et al., 2007; Playfor et al., 2006; Ross, Smith, Tolo, & Khemani, 2011), and have the added benefit of providing analgesia with minimal side effects compared to systemic opioids (Guedes, Rebelo, Oliveira, & Neves, 2012).

Pharmacokinetics and pharmacodynamics of medications to be used for pain and discomfort management may be significantly altered in critically ill children (Ismail, 2016; Oakes, 2011). Opioids can relieve pain, but they have systemic effects to be considered, such as suppression of respiration and constipation (Thorp & James, 2010). Drug toxicity is a problem in critically ill patients especially in patients with hepatic and renal compromise. For example, morphine clearance is reduced with these conditions resulting in an accumulation of active metabolite of morphine (morphine 6-glucouronide). Accumulation of morphine 6-glucouronide can lead to respiratory depression (Zaliecckas & Weldon, 2015) and morphine stimulates the release of histamine that can lead to vasodilation and hypotension (Playfor et al., 2006). Withdrawal symptoms can develop as a result of rapid discontinuation or weaning of morphine infusion (Playfor et al., 2006), highlighting the need to choose the appropriate opioid, dose and weaning strategy that fits each child's condition. Such medications need titration under close observation and selection, administration and weaning of those medications require HCPs to have up to date knowledge about their comparative effects, characteristics, and limitations.

An important factor to consider when using opioids and sedatives for more than a few days is the risk of the development of withdrawal symptoms. Withdrawal syndrome is frequently not recognized or under-recognized and undermanaged (Playfor et al., 2006). The risk of development of withdrawal syndrome should be considered within five to seven days or less of

continuous infusion of opioid or benzodiazepine (Da Silva, Reis, Fonseca, & Fonseca, 2016; Harris et al., 2016; Playfor et al., 2006). The doses of these agents can be gradually tapered off and the dose decrease should be no more than 5% to 10% each day (Playfor, 2008; Playfor et al., 2006). When reducing opioids and sedatives, a scoring system such as the Withdrawal Assessment Tool-1 (WAT-1) may be used to alert HCPs to withdrawal symptoms (Franck, Scopettuolo, Wypij, & Curley, 2012; Harris et al., 2016).

Non-pharmacological pain reducing interventions include physical, psychological, music and environmental interventions. Examples of these interventions are mental imagery, hypnosis, touch, frequent position change, parental education and involvement, application of heat, stroking, music, environmental modification and, for infants, use of pacifiers and administration of small volumes of sweet solutions (sucrose or glucose) (Bauchner et al., 1992; Harrison, Beggs, & Stevens, 2012; Ismail, 2016; Kline et al., 2010; Oakes, 2011; Playfor et al., 2006; Renfrow, 2009; Rennick et al., 2011; Sharek et al., 2006; Thomas et al., 2010). The use of non-pharmacological interventions is however limited in the PICU compared to pharmacological interventions (Thomas et al., 2010). It was reported that only 16 of 38 PICUs (42%) used non-pharmacological interventions to reduce pain during invasive procedures (Bauchner et al., 1992) in North America. A more recent study from the United States of America (USA) showed similar results that the use of non-pharmacological interventions is limited in the PICU (Renfrow, 2009). A review of 100 charts of infants and children in the PICU showed that the most commonly used non-pharmacological methods were quiet environment (27%), dim lights (12%), limiting visitors (9%), and music (9%). A combination of pharmacological and non-pharmacological interventions may lead to improved pain management compared to either pharmacological or non-pharmacological interventions alone (Sharek et al., 2006). More research is needed to

examine the effect of combination of pharmacological and non-pharmacological interventions on pain reduction compared to only pharmacological interventions.

Challenges to be considered post treatment. Following administration of pharmacological agents or use of physical or psychological pain management strategies, evaluation of the effectiveness of interventions requires re-assessment. It is recommended to evaluate the effect of the pharmacological intervention based on the drug's half-life (Harris et al., 2016). Based on that, increasing or decreasing of the rate and dose of the drug can be considered (Harris et al., 2016). When pain remains present after the implementation of interventions, other possible causes for unrelieved pain should be identified. One strategy to identify ongoing causes of pain is to actively involve the child when possible, and his/her parents in the child's pain management plan (Ismail, 2016; Oakes, 2011; Rennick et al., 2011) as they may be able to identify sources of pain, typical behaviors when in pain, and success of approaches used.

A multidisciplinary approach with collaboration amongst various parties involved in the patient's care is required for optimal pain management (Connelly & Schanberg, 2006; RNAO, 2013). The multidisciplinary team may include nurses, intensive care specialists, anesthesiologists, pediatricians, pharmacists, and psychologists. Each institution needs to determine the best multidisciplinary approach suited for its patient population, organizational culture and staffing mix. There are many factors affecting the provision of effective pain management in the PICU. These factors need to be identified, considered, discussed and modified if possible. Although many patients present a challenge for pain management within the PICU, there are evidenced based treatments that can be used within this setting to meet the needs of these critically ill children (Ismail, 2016). However, knowledge on evidenced based treatment is not always known by clinicians. Therefore, the RNAO (2013) recommended using

multifaceted KT strategies for improving pain management to help HCPs to uptake and implement the best available evidence.

Knowledge Translation

Effective pain management includes basing care on evidenced informed nursing, medicine, and other members of the multi-disciplinary HCPs group pain care practices. The preceding discussion focused on the pain management process and factors that influence effective pain management in the PICU. The preceding discussion highlighted the many challenges to pain care present within the PICU but also identified that there are evidenced informed practices that are available to optimize pain management in the PICU. However, a major challenge is how to move research and evidence into the care area, as evidenced informed effective strategies are not always used. The RNAO evidence-based pain management guideline highlights the need to use effective multifaceted KT strategies (RNAO, 2013) to move evidenced informed pain management strategies into practice.

Knowledge Translation (KT), defined by the Canadian Institutes of Health Research (CIHR), is “a dynamic and iterative process that includes synthesis, dissemination, and exchange and ethically-sound application of knowledge to improve the health of Canadians, provide more effective health services and products and strengthen the health care system” (CIHR , 2016, p. 1). The field of KT encompasses various terms depending on the country and the time in the fields’ history, however all terms are related to moving knowledge into action (Sudsawad, 2016). For example, in Europe, the terms research utilization or implementation science are often used, while in the USA, the terms implementation, research use, dissemination, knowledge transfer and uptake are often used. In Canada, the terms knowledge translation, knowledge transfer and

exchange are commonly used (Straus, Tetroe, & Graham, 2013). Within this dissertation, the term KT is used broadly to capture the variations in terms.

Knowledge translation has been described as an interactive process between the knowledge creators who discover new knowledge and the users who use this knowledge to yield better outcomes (Bowen & Graham, 2013; CIHR, 2016; Sudsawad, 2016). Many KT initiatives fail to engage users as they focus only on dissemination (pushing the information out) strategies (Bowen & Graham, 2013). For effective KT, there needs to be continuous interaction and dialogue between knowledge creators and users during all stages of the research process (CIHR 2013; Sudsawad, 2016). In addition, in order to conduct impactful research, researchers need to address important questions of concern to the knowledge users, and integrate contextual evidence into their research (Bowen & Graham, 2013). As these recommendations apply to the proposed research in this dissertation, pain management in Jordanian PICUs may be more effective when it is guided by one or more of the used and tested KT frameworks or models. Knowledge users (e.g., PICU nurses or patients) should have a fundamental role in any KT project to be conducted in order to move the best pain management evidence into practice. Involvement and interaction between knowledge creators and users should be encouraged.

Knowledge translation theories, models, and frameworks have been used in the field of health, including nursing, for six purposes: (1) to synthesize knowledge and transform research findings to improve patient outcomes and the quality of care; (2) to describe the mechanisms by which individual, small group, and organizational contexts affect diffusion, uptake, and adoption of new knowledge and innovation; (3) to formalize the process of ongoing interactions among practitioners, researchers, policy makers, and consumers to facilitate both the generation and application of new knowledge; (4) to assist in the identification of suitable variables, outcomes,

and measures in order to have more effective KT initiatives; (5) to assist in guiding the evaluation of KT processes; and (6) to identify the aspects that structure the design and interpretation of dissemination research (Mitchell, Fisher, Hastings, Silverman, & Wallen, 2010; Rycroft-Malone, 2007; Rycroft-Malone & Bucknall, 2010). There are a large number of theories, models, and frameworks in the field of KT. Mitchell et al (2010) critically reviewed 47 theories, models, and frameworks focusing on KT. A commonly used framework which has undergone substantial testing is the Promoting Action on Research Implementation in Health Services (PARiHS), which was first developed by Kitson, Harvey, and McCormack (1998). This framework informed the three studies within this dissertation.

Conceptual Framework Informing This Study

The PARiHS is a conceptual framework describing the implementation of research in practice (Kitson et al., 1998; Rycroft-Malone, 2004; Rycroft-Malone & Bucknall, 2010) (Figure 1.1). According to the framework, successful implementation of research into practice is a function of the interplay of three core elements: (1) level and nature of the evidence to be used, (2) context or environment in which the research is to be placed, and (3) facilitation: the method by which the research implementation process is to be facilitated. Facilitation is the type of support that is needed to support change including people's attitude and ways of practice. People in roles of facilitators support others to understand what should be changed and ways to change in order to achieve the desired outcome (Kitson et al., 1998). The three elements of evidence, context and facilitation are considered to have equal importance in determining the success of research use. Each of the elements is positioned on a low-to-high continuum, and the framework predicts that the most successful implementation occurs when all elements are on the high end of the continuum (Kitson et al., 1998; Rycroft-Malone, 2004; Rycroft-Malone & Bucknall, 2010).

Within the PARIHS framework, evidence is considered to be a combination of research, clinical experience, patient experience, and local data or information. Context refers to the environment or setting in which people receive health-care services or the environment or setting in which the proposed change is to be implemented. Facilitation is the approach, by which people make things easier for others, and the facilitators have a key role in helping individuals and teams understand what and how they need to change to put the evidence into practice. There are three aspects of facilitation: (1) purpose, (2) roles, and (3) skills and attributes (Kitson et al., 1998; Rycroft-Malone, 2004; Rycroft-Malone & Bucknall, 2010). Although all three elements affect change, the understanding of context is limited outside of Western countries. Given that components of context (e.g., leadership) are influenced by social culture, context is critical in understanding practices outside of the Western countries' context, including nursing pain management practices in Jordanian PICUs.



Figure 1.1. The PARIHS Framework from Kitson et al., 1998

The PARiHS framework has been used in the health field to evaluate the influence of context in the implementation of research into practice in many settings. For example, Gibb (2013) scanned the context of the work culture in the aged care setting, and its influence on the readiness of the workers to advance towards team-based quality care provision. Guided by the PARiHS framework, the readiness of the HCPs to work as a team was assessed via interviews, individual surveys, and the observation of practice. One important result of the study indicated that environmental scanning is needed before implementing any new change in aged care. Environmental scanning helps to identify the contextual strengths to be capitalized on and the pitfalls to be avoided or modified (Gibb, 2013). In another example, using the PARiHS framework, Doran et al. (2012) investigated the role of the organizational context and nurses' characteristics to explain the variation in nurses' use of personal digital assistants and mobile tablets for accessing evidence-based information and best practice guidelines (BPGs). The results of the study showed that willingness to implement research, structural and electronic resources, organizational slack time, and breadth of device functions available on the device had positive effects on the frequency of using the BPGs. Organizational slack was described as the unit cushion of resources including staffing, time, and space. Culture, structural and electronic resources and breadth of device functions had a positive effect on the frequency of using the Nursing Plus database and organizational culture and breadth of device functions had a positive effect on the frequency of using the drug dictionary loaded in the devices (Doran et al., 2012). These contextual factors need to be identified in settings such as PICUs in Jordan in order to be considered or modified before embarking on KT projects with the aim of implementing new changes to improve pain management. These contextual factors may be different based on the setting and the topic (e.g., pain management in the Jordanian PICU setting compared to non

PICUs). Knowing which factors may have a positive impact, which may have a negative impact, and which factors may have no effect on the use of evidence for pain management in Jordanian PICUs is important in the planning of KT strategies.

Organizations vary in the implementation of research into practice. Some organizations are more flexible and ready to change than others (Samuels & Fetzer, 2009). Positive contextual factors such as supportive leadership, sufficient staffing, positive collaborative relationships, nurse's control over practice, and accountability were found to correlate with increased use of research informed pain management interventions (Samuels & Fetzer, 2009). Cummings, Hutchinson, Scott, Norton, and Estabrooks (2010) examined the relationship between characteristics of context and research utilization amongst nurses working in pediatric units. Nurses who reported more positive perceptions of their context, including culture, leadership, and evaluation, reported higher instrumental and conceptual research use. Instrumental research use was defined as the direct application of research findings and conceptual research use was defined as practitioners becoming aware of research findings which alter their way of thinking and practicing (Cummings et al., 2010). Organizational culture and the proportion of nurses having a baccalaureate degree or higher were reported to be predictors of instrumental research use in Canadian pediatric hospitals. Factors such as leadership, culture, evaluation, formal interactions, informal interactions, and organizational slack-space were reported predictors of conceptual research use in Canadian pediatric hospitals (Squires et al., 2013). These factors may be different in other contexts (e.g., Jordanian PICUs) and when the use of research is applied for specific issues (e.g., pain management).

The PARiHS framework has been used to guide previous studies and projects in relation to pain management, however most previous studies have been conducted in Western countries.

For example, in one study conducted in the USA, the PARIHS framework was used to develop and implement an evidence-based practice change by integrating the Faces Pain Scale-Revised (FPS-R) as the standard instrument to measure children's pain intensity (Obrecht, Vincent, & Ryan, 2014). Nurses' perception of the context (the practice environment) was high. For the evidence (FPS-R), the perception of nurses regarding the strength of evidence significantly increased from low to moderate after the FPS-R implementation ($p = 0.002$) (Obrecht, Vincent, & Ryan, 2014). In another study conducted in the USA, the PARIHS framework was used to assess practices and factors that may influence chronic pain management in a multisite community health centre in order to develop KT initiatives for chronic pain (Anderson, Wang, & Zlateva, 2012). Reviewing the health records charts, and surveying the staff, authors found gaps in adherence to standards for pain practice and documentation including variability in the prescription of opioids and staff dissatisfaction with the available resources to manage chronic pain. Based on the findings of the assessment phase, it was recommended that a multifaceted interventional strategy was required to improve chronic pain management. This strategy included increasing access to specialty consultation, providing pain-specific education for HCPs, and improving documentation of pain management in the electronic records (Anderson et al., 2012). As indicated by Kitson et al. (2008), the PARIHS framework can be used as a preliminary measure of evidence and context, and then using the gathered data to determine the best facilitation method. Decision makers then can tailor KT strategies to the local context.

In Canada, the PARIHS framework was used to frame a CIHR funded multi-site study entitled Translating Research on Pain in Children (TROPIC), conducted in eight Canadian hospitals from 2006 to 2012. The project determined current pain practices in hospitalized children and evaluated the influence of organizational context on clinical and process pain

outcomes. The Alberta Context Tool (ACT), developed and based on the PARIHS framework, was used for assessing contextual factors in the pediatric hospitals, which influenced the utilization of research (Squires et al., 2013). Based on the use of the ACT in this project, it was reported that significant predictors for pain research use in practice at the individual level were research use in the past and belief suspension-implement (perception of the ability to suspend beliefs to utilize research evidence). It was unclear how belief suspension leads to research use therefore the authors recommended that future research should explore this. At the context level, significant predictors of research use were culture and the proportion of nurses holding baccalaureate degree or higher (Squires et al., 2013). Significant predictors of conceptual research use at the individual nurse level included: belief suspension-implement, problem solving ability, and use of research in the past. At the hospital unit (context) level, significant predictors of conceptual research use included leadership, culture, evaluation, formal interactions, informal interactions, organizational slack-space, and unit specialty. These examples of studies using the PARIHS framework were set in North America. In Jordan however, research studies including pain studies that have used the PARIHS framework are limited.

Pain Studies in Jordan

Several studies have been conducted relating to pain management in Jordanian hospitals in different settings. Three studies (two published in one paper) were conducted by the same team using KT methodology, aimed at developing and implementing a pediatric pain program at one cancer hospital in Jordan (Finley et al., 2008; Forgeron et al., 2005). Another two descriptive studies were related to neonatal pain management in Jordanian neonatal intensive care units (NICU) (Abdel Razeq, 2016; Abdel Razeq, Akuma, & Jordan, 2016) and two further studies

focused on pain management in critical care settings (Al Sutari, Abdalrahim, Hamdan-Mansour, & Ayasrah, 2014; Ayasrah et al., 2014; Batiha, 2014), one of which included the PICU (Batiha, 2014). Five studies were related to adult pain management in surgical, medical, and oncology wards (Abdalrahim et al., 2011; Al Khalaileh & Al Qadire, 2012; Al Qadire & Al Khalaileh, 2014; Al Qadire et al., 2013; Shoqirat, 2015).

As part of a KT project aimed at developing and implementing a pediatric pain management program for children with cancer, Forgeron et al. (2005) conducted two studies about cancer pain in children in Jordan. The first study determined baseline status of pain and pain management practices for children with cancer. This study included a sample of 35 children at King Hussein Cancer Centre which is a nonprofit health centre in Jordan. The findings showed a high prevalence of pain among Jordanian children with cancer, with 57% of children reporting having pain on the day of assessment as assessed by the research team. The second study was conducted by the same team who explored the parental attitudes and beliefs regarding the meaning of pain and their child's pain management. Through interviews with 22 parents, thematic analysis revealed six themes: (1) pain can and should be managed, (2) parents believe that the pain is God's will, (3) the parent's worst pain was emotional pain due to the child's diagnosis, (4) parents believe that their presence could ameliorate their children's pain, (5) there is a desire for shared decision making, and (6) it is the child's responsibility to express pain. The team's findings of the two studies informed a third study. The same team, using an action research approach, developed, implemented, and evaluated a pediatric cancer pain management program. The investigators used semi-structured and unstructured interviews to plan, implement, and evaluate the introduction of a pediatric pain management service. As a result of interviewing HCPs, four themes emerged as barriers to change practices regarding child's pain assessment and

treatment: (1) there are misconceptions about opioids and addiction, (2) self-report is not necessary, (3) non-pharmacological methods are best, and (4) policy development leads to more effective and efficient change than education. It is worth mentioning that participants felt that Arab, Middle Eastern, and Muslim cultures were not barriers to improving pain management. As a result of this last study, new pain management policies were developed; teaching sessions took place; family education materials were created; and a pediatric pain management curriculum for HCPs was developed and delivered (Finley et al., 2008). This KT project for pediatric cancer pain management was published ten years ago (Finley et al., 2008). However, studies conducted since this series of projects in other settings and hospitals indicate that pain management is still suboptimal in Jordan and there are many barriers to consider and overcome.

Abdel Razeq (2016) and Abdel Razeq et al. (2016) indicated that pain management in Jordanian NICUs was suboptimal. Abdel Razeq et al. (2016) surveyed 184 neonatal nurses working in 18 NICUs in Jordan. Neonatal nurses' knowledge regarding pain management was reported to be inadequate and beliefs were not based on evidence. Fifty three percent of the nurses believed that neonates experience less pain than adults, 91% believed that neonates require less analgesia than adults, and 59% believed that analgesia is dangerous for neonates. These inaccurate beliefs held by the nursing staff may negatively affect the pain management neonates receive. Furthermore, the use of pain assessment scales by neonatal nurses was also limited. The most commonly used scales were the FLACC and the Neonatal Pain, Agitation, and Sedation (N-PASS) scales. Pain scales were used by only 42% of the neonatal nurses, and they were used less in the governmental run hospitals than other hospitals, highlighting the need to explore factors affecting the use of pain assessment scales in governmental hospitals. Pharmacological interventions were the most common strategies used to control pain in neonates

in Jordan. Eighty eight percent of participants reported using pharmacological interventions. The most commonly used agents were acetaminophen (52%), locally applied lidocaine (45%), midazolam (which has no analgesic properties) (41%), and fentanyl (28%), highlighting that critically ill neonates receive little analgesia. Reasons behind the findings were not explored but consistent appropriate pain assessment using validated pain scales (which were used by only 42% of the nurses) is considered the first step in selecting the appropriate analgesics. The study reported limited use of non-pharmacologic interventions. Examples of interventions ‘sometimes’ used (actual percentage of use was not reported) were pacifiers, containment, and pacifiers dipped in sweet solutions; highlighting the need to identify factors influencing the use of non-pharmacological pain interventions. The same 184 Jordanian NICU nurses (reported in the previous study) completed a questionnaire on the barriers to neonatal pain care. Abdel Razeq (2016) reported that the barriers to neonatal pain management were underuse of structured pain measurements (72%), inadequate inter-professional appreciation of any input into pain management (72%), inadequate knowledge about pain medication for neonates (66%), fear of adverse effects of medications (50%), and inadequate training on neonatal pain (24%). These studies highlighted the need to improve practices by conducting a KT project aimed at increasing the use of the best evidence available for neonatal pain management. The information from these two studies is helpful in assessing the status and the barriers of neonatal pain management in Jordanian NICUs. Future interventions can be developed and tailored to this context. Although NICUs have some similarities to PICUs, there are differences as well (e.g. age of children, types of conditions) which means that these findings are not necessarily transferable.

In the Jordanian critical care units including the PICU, many barriers to effective pain management have been reported. Batiha (2014) conducted semi-structured interviews with 37

nurses working in Jordanian critical care units (adults and pediatrics). Results highlighted three levels of barriers for pain management. The first level was related to the patients and their families. This included: fear of pain medications' side effects; difficulties in completing pain scales; reporting pain to the doctors not to the nurses; patients' beliefs that pain is a result of God's will, so they should accept it without intervening or complying with medical treatment, and patient's worry from bothering nurses. The second level was related to the nurses. This included: patient sedation that prevent nurses from conducting pain assessment; frequent complaints from patients (that may compromise the nurse judgment of the existence pain); inconsistent practices around administering as needed pain (prn) medications; time limitations; limited communication; fear of side effects of pain drugs; physicians' lack of trust in the nursing assessment of pain in critically ill patients, and lack or inadequate staff knowledge of pain management. The third level of barriers was related to the hospital and included: lack of pain assessment tools; nursing staff shortage; lack of psychosocial support services; lack of non-pharmacologic therapy (e.g., cold and hot compresses), and lack of available analgesics. This study by Batiha (2014) implies that pain management in the Jordanian critical care units is suboptimal, and highlights the need for a KT project that assesses the status of pain management in Jordanian critical care units, explores the barriers as well as the facilitators for providing effective pain management, and determines the best facilitative interventions to achieve improved pain management and overcome the barriers.

Another study conducted in adult Jordanian critical care units also indicated that pain management was suboptimal. Ayasrah, O'Neill, Abdalrahim, Sutary, and Kharabsheh (2014) reviewed 301 medical records from six ICUs in Jordan, searching for pain assessment indicators used by both physicians and nurses, pain management strategies used only by nurses, and

indicators used by nurses to evaluate the effectiveness of the pain management interventions.

The documentation of pain assessment was reported to be inadequate: 34% of the medical records contained nurses' pain assessment, and only 25% contained physicians' pain assessment.

Observable indicators of pain were documented by both nurses and physicians more than self-report. In the physicians' documentation, reaction to physical examination, body movements, and compliance with the ventilator were the most frequent documented indicators for the presence of pain (49%, 16%, and 12% respectively). Nurses' documentation revealed that body movements, compliance with the ventilator, respiratory responses, and cardiovascular responses were the most frequent indicators of pain recorded (41%, 28%, 23%, and 19% respectively).

Nurses documented both pharmacological and non-pharmacological strategies for pain management. Of 115 pain episodes, pharmacological interventions were documented in 78%.

Sedatives were used in 42% of the pain episodes, analgesics alone in 27% of pain episodes, and sedatives and analgesics used together were documented in 10% of pain episodes. The most common non-pharmacological strategies documented by nurses in this study were endotracheal suctioning (27%) and positioning (10%). Interestingly, endotracheal tube suctioning was viewed in this study as a pain relieving procedure (Ayasrah et al., 2014), although is also described as a painful procedure (Sönmez Düzkeya & Kuğuoğlu, 2015). This study suggests that painful procedures in Jordanian adult ICUs receive little pain management interventions. As there are validated pain assessment tools which can be used for pain assessment for adults, and recommendations for pain treatment exist, this study also highlights the need for a KT project aiming to identify, tailor, implement, and evaluate the use of the best evidence available for pain management for critically ill adults in Jordan.

Although not related to pain management in children, Jordanian nurses' knowledge regarding pain management in adults has been reported to be suboptimal (Abdalahim et al., 2011; Al Qadire & Al Khalaileh, 2014). Al Qadire and Al Khalaileh conducted two studies focusing on pain management in Jordan. They investigated nurses' knowledge and attitudes toward pain management as perceived by nurses working in adult medical, surgical, oncology, gynecology, intermediate and intensive care units. The Knowledge and Attitudes Survey (KAS) Regarding Pain, developed by Ferrell, McGuire, and Donovan (1993) was used to capture information toward pain management. A sample of 211 nurses from four different hospitals in Jordan answered the 40-item questionnaire. The average correct answer score was 19.3 out of 40 (48%) which may not be surprising as 52% of nurses reported no previous pain education in the last five years (Al Qadire & Al Khalaileh, 2014). The same team explored barriers for cancer pain management as perceived by the nurses. A modified and Arabic translated version of an optimal pain management barriers questionnaire developed by Ward et al. (1993) and revised by Gunnarsdottir et al. (2002) was completed by 96 oncology nurses. This includes four subscales: physiological, fatalism, communication, and harmful effects. The questionnaire items are Likert scale type questions ranging from zero (do not agree at all) to five (agree very much). The findings suggest that nurses perceived a high level of fear in cancer pain management which was mainly related to concern about the harmful effects of pain medications (mean 2.7 and SD 1.1), e.g., addiction; and the physiological effects of pain medications (mean 2.6 and SD 1.1), e.g., drowsiness (Al Khalaileh & Al Qadire, 2012). These findings are concerning as there is a high prevalence of cancer pain in Jordanian adults (Al Qadire et al., 2013), which is not likely to improve if nurses have inaccurate beliefs and knowledge about pain management. Using an Arabic version of the Brief Pain Inventory-short form (BPI) which captures pain severity

experience and the impact of pain on daily functions, it was reported that 73.3% out of 162 adult oncology patients had severe pain at the time of the survey, and 31% of patients did not receive any kind of treatment for their pain (Al Qadire et al., 2013). These results highlight the sub-optimal pain management for those in Jordan with cancer pain related to inaccurate beliefs and knowledge about pain management held by Jordanian nurses.

Abdalahim et al. (2011) also explored Jordanian nurses' knowledge and attitudes towards pain in adult surgical wards before and after implementation of a postoperative management program at a university hospital in Jordan. A 21-item questionnaire was distributed to 65 registered nurses in two surgical wards at the University Hospital of Jordan which represents the only university health centre in Jordan. The results suggest that a major change in the knowledge and attitude scores occurred after the implementation of the postoperative management program. In terms of knowledge, correct pain assessment scores increased from an average of 10/21 (46%) to 16/21 (75%). In addition, Shogrita (2015) explored the barriers perceived by nurses concerning post-operative pain management in Jordanian surgical wards. Using four focus group discussions, Shogrita interviewed 25 registered nurses working in adult surgical wards and identified two categories of barriers. The first category, defined as 'Within the bedside,' described problems perceived by nurses as occurring from patients and families such as patients over-seeking attention of nurses, and families interfering with care. The second category defined as 'Within nursing' described perceived barriers such as shortage of nursing and the imbalance of power between nurses and physicians. These findings suggest that there is a need to address multidisciplinary collaboration as well as partnering with patients and families in order to improve pain management in Jordan.

In conclusion, previous pain related studies in Jordanian pediatric and adult healthcare settings have focused on examining knowledge and attitudes of Jordanian nurses toward pain management, explored pain management barriers and pain care practices, and examined the effectiveness of a postoperative pain management education program as well as policies and educational initiatives to improve pediatric cancer pain. Knowledge gaps remain in terms of assessing the status of pain management in Jordanian PICUs, identifying guidelines to support pain management in the PICU, and understanding the relationship between contextual factors and research utilization for pain management in Jordanian PICUs. Pain management in Jordanian PICUs will potentially benefit from identifying pain treatment interventions used or tested in the PICU internationally. By reviewing and synthesizing the research literature of pain treatment interventions in the PICU, establishing a baseline of current pain management practices and available guidelines used in Jordanian PICUs, and obtaining a beginning understanding of the contextual factors that influence research utilization to guide pain management in Jordanian PICUs, this research will contribute information on important existing knowledge gaps with the ultimate aim of improving pain management for critically ill children.

Evidence Gaps

There is a lack of current synthesized evidence on effective pain management strategies in the PICU. Limited knowledge exists on current pain management practices and guidelines in Jordan especially in Jordanian PICUs. Also, little is understood about the relationship between contextual factors and research utilization for pain management in general and in PICUs in particular in Jordan. The following research questions therefore were addressed in this dissertation.

Research Questions

1. Which pain management interventions are used, and shown to be effective for patients in the Pediatric Intensive Care Unit (PICU)?
2. What are the current pain management practices and guidelines in Jordanian PICUs?
3. Context
 - a) What is the relationship between the contextual factors (leadership, culture, evaluation, social capital, informal interactions, formal interactions, structural and electronic resources, and organizational slack) and instrumental research use for pain management in Jordanian PICUs?
 - b) What is the relationship between the contextual factors (leadership, culture, evaluation, social capital, informal interactions, formal interactions, structural and electronic resources, and organizational slack) and conceptual research use for pain management in Jordanian PICUs?

To answer these research questions, three studies were conducted. The first study mapped the literature on the pain management interventions used in the PICUs globally. The second and third studies were conducted in Jordan. The second study assessed current pain management practices and supporting guidelines in Jordanian PICUs, and the third study examined the influence of contextual factors on utilization of research for pain management in Jordanian PICUs.

Study Methodology

The PARIHS framework guided the planning and conduct of this dissertation. The PARIHS framework consists of three main constructs: (1) evidence, (2) context, and (3) facilitation. These three elements have a dynamic relationship, and each is positioned on a “high” to “low” continuum. After a review of the use of the PARIHS framework for one decade, Kitson

et al. (2008) concluded that the best use of the PARIHS framework is as a preliminary measure of evidence and context. Based on the results collected on evidence and context, the best facilitation method can be determined. In this dissertation, the PARIHS framework was used as a preliminary measure of evidence and context regarding pain management in Jordanian PICUs. The first two studies focused on the evidence and the third study focused on the context. The gathered information can be used in the future for partnering with knowledge users and decision makers to determine the most appropriate facilitation method to improve evidence informed pain management in Jordanian PICUs.

Study One (Identifying Pain Treatment Evidence in the PICU)

Study One was a scoping review aimed at mapping and synthesizing the research literature on pain treatment interventions in the PICU setting. The scoping review is a useful method to gather, organize and then develop a picture of an existing topic e.g., pain treatment interventions in the PICU. Results from this study were used to compare and contrast with the pain management practice in Jordanian PICUs. Arksey and O'Malley's framework guided the scoping review (Arksey & O'Malley, 2005). This framework consists of five major steps: (1) the research question, (2) relevant studies, (3) study selection, (4) charting the data, (5) collating, summarizing, and reporting the results. Searching for primary research articles was conducted in five databases from their inception to the end of 2015 (CINAHL, EMBASE, MEDLINE, PsychINFO, and ProQuest Dissertations & Theses Global). Two independent reviewers conducted titles and abstracts screening, full text screening, and data extraction. A third reviewer resolved any disagreements. Reference lists from the screened full text articles were also searched. A panel of eight experts in the fields of research, pain, and child health was consulted on the articles to be included in the review (see Chapter 2 for study details).

Study Two (Utilization of Evidence in Jordanian PICUs)

The second study used a cross-sectional phone survey design to assess pain management practices and capture the existence and content of pain management guidelines currently being used in Jordanian PICUs. The cross-sectional design helps to gather and analyze data from a population or a representative sample at a specific time such as Jordanian PICUs. The phone survey can facilitate access to a geographically dispersed sample such as different PICUs in different places in Jordan. The target sample was the six PICUs in Jordan, with the head nurse or his/her nominee being invited to complete the phone survey. The six Jordanian PICUs were identified from the website of the Jordanian Ministry of Health. The six hospitals in Jordan with a PICU are: King Abdulla University Hospital, Jordan University Hospital, King Hussein Cancer Centre, Al-Bashir Hospital, Princess Rahma Hospital, and Queen Rania Pediatric Hospital (Jordan Ministry of Health, 2013). Descriptive statistics were used to analyze the data (see Chapter 3 for study details).

After obtaining Research Ethics Board (REB) approval from the University of Ottawa and from four of the six hospitals in Jordan, the principal investigator (PI) called each Jordanian PICU and asked to speak to the head nurse or his/her nominee. The study and its significance were explained, and the head nurse determined who was best to complete the survey (she/he or nominate another nurse). A suitable appointment time was made with each participant for the administration of the telephone survey. The participants were assured that their participation was voluntary and they were free to withdraw at any time.

A questionnaire was developed by the investigator for the purpose of this study and includes 50 items relating to; demographic characteristics of each unit (e.g. number of beds, number of staff nurses, number of physicians, number of other HCPs who are involved in

patient's care in Jordanian PICUs); pain assessment and treatment items (e.g. frequency of pain assessment, availability of clinical guidelines, availability of pain assessment tools, and 11 items relating to opioids and sedatives); and systems used for documentation of pain assessment and management. The questionnaire was developed in a three phase approach to assess the validity of the questions. First, items were developed based on existing published literature (Amigoni, Catalano, Vettore, Brugnaro, & Pettenazzo, 2012; Oakes, 2011; Playfor et al., 2006; RNAO, 2013; Thorp & James, 2010). The questionnaire was then reviewed by a panel of nine experts in the fields of research, pain, and child health. Following experts' review, the questionnaire was modified to improve clarity and reduce redundant items. Third, the revised questionnaire was reviewed by the panel, which resulted in no further modifications. The survey was administered by phone and data were analyzed using the Statistical Package for Social Sciences (SPSS) version 24 for descriptive statistics. Descriptive statistics summarized the categorical, nominal, and ratio and interval variables. Examples of categorical and nominal variables were: type of hospital, and existence of a pain management policy. Examples of ratio and interval level variables were: number of beds, number of staff nurses, and number of physicians. Responses to open ended survey question were described and summarized in relation to the question they answered.

Study Three (Exploration of Context in Jordanian PICUs)

The third study design was a correlational cross-sectional survey to expand upon the understanding about contextual factors that influence research utilization to guide pain management in Jordanian PICUs. The correlational cross-sectional design can help in collecting and analyzing data from a representative sample and then examine the relationship that exists between the variables such as contextual factors that were collected from Jordanian nurses PICU

sample. Registered nurses working in the Jordanian PICUs that participated in Study Two were recruited to complete the study questionnaire. The tool for this study was a questionnaire consisting of four instruments: 1) Demographic Data Sheet; 2) Alberta Context Tool (ACT); 3) Instrumental Research Utilization Items; and 4) Conceptual Research Utilization Scale. The Demographic Data Sheet, developed by the investigator for the purpose of this study, included items such as age, sex, education, experience, position, and hospital type.

The Alberta Context Tool (ACT), developed based on the PARIHS framework, provides a comprehensive, specific, and objective instrument for assessing the contextual factors that influence the utilization of research to inform practice. The Acute Pediatric Care Version of the ACT is a standardized measure consisting of 57 items capturing data on 10 factors that make up the element of context: (1) leadership, (2) culture, (3) evaluation, (4) social capital, (5) informal interactions, (6) formal interactions, (7) structural and electronic resources, (8) organizational slack – staffing, (9) organizational slack – space, and (10) organizational slack – time (Estabrooks, Squires, Cummings, Birdsell, & Norton, 2009). Two questions developed by the researchers were used to measure Instrumental Research Use (IRU) in Jordanian PICUs. The two questions also used a 5-point Likert frequency scale (1 “Never” to 5 “Almost Always”) and asked about the frequency of using research-based policies or guidelines for pain assessment and pain treatment on the last typical workday. Pain management is operationalized to include both pain assessment and pain treatment (Ismail, 2016) thus two distinct questions were required. Conceptual research use for pain management in Jordanian PICUs was examined using a modified version of the Conceptual Research Use (CRU) scale (Squires et al., 2011). It included five items scored on a 5-point Likert frequency scale (1 “Never” to 5 “Almost Always”).

The mode of this study was a paper or online survey. Nurses had the opportunity to complete a paper-based or web-based survey based on their preference. Data were analyzed using the IBM-SPSS version 24 for descriptive statistics, and bivariate and multivariate analyses. Pearson's correlation coefficient was used to examine the relationship between each continuous (demographic and contextual) factor and the IRU for pain assessment and pain treatment, and CRU for pain management. Independent t test and one-way analysis of variance (ANOVA) were used to examine the differences among the independent groups of the categorical demographic factors on IRU for pain assessment, IRU for pain treatment, and CRU for pain management. The generalized estimating equation (GEE) was used to model the significant contextual and demographic variables on IRU and CRU correcting for the unit. A p value < 0.10 was chosen to identify all possible important predictors from bivariate analysis to include in the GEE analysis. (See Chapter four for study details).

Ethics

Ethics approval for Study Two and Study Three was obtained from the PI's affiliated University (file number: h05-15-03) and from four of the six hospitals in Jordan with PICUs (file numbers: MOH REC 150085 (covered two ministry of health hospitals), 15 KHCC 70, and 13/3 12055 (Appendix A). The other two hospitals did not respond to the request to participate in the study, or to complete their ethics application. Participants were assured that their participation was voluntary and anonymous. In addition, they have been assured that their responses will be treated confidentially. Data storage and destruction following the required period of time following analysis of the data comply with the ethical requirements (five years after final approval for publications accepted).

References

- Abdalahim, M., Majali, S., Stomberg, M., & Bergbom, I. (2011). The effect of postoperative pain management program on improving nurses' knowledge and attitudes toward pain. *Nurse Education in Practice, 11*, 250-255.
- Abdel Razeq, N. M. (2016). Barriers that impede the provision of pain care to neonates by nurses in Jordan. *Journal of Obstetric, Gynecologic & Neonatal Nursing, 45*(3), 371–377.
- Abdel Razeq, N. M., Akuma, A. O., & Jordan, S. (2016). Status of neonatal pain assessment and management in Jordan. *Pain Management Nursing*.
- Abu-Saad, H., & Hamers, J. (1997). Decision-making and pediatric pain: a review. *Journal of Advanced Nursing, 26*, 946–952.
- Agarwal, S., Classen, D., Larsen, G., Tofil, N. M., Hayes, L. W., Sullivan, J. E., ... Sharek, P. (2010). Prevalence of adverse events in pediatric intensive care units in the United States. *Pediatric Critical Care Medicine : A Journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies, 11*(5), 568–78.
- Akinci, S. B., Kanbak, M., Guler, A., & Aypar, U. (2005). Remifentanil versus fentanyl for short-term analgesia-based sedation in mechanically ventilated postoperative children. *Paediatric Anaesthesia, 15*(10), 870–878.
- Al Khalaileh, M., & Al Qadire, M. (2012). Barriers to cancer pain management: Jordanian nurses' perspectives. *International Journal of Palliative Nursing, 18*(11), 535–6, 538–40.
- Al Qadire, M., & Al Khalaileh, M. (2014). Jordanian nurses knowledge and attitude regarding pain management. *Pain Management Nursing, 15*(1), 220–228.
- Al Qadire, M., Tubaishat, A., & Aljezawi, M. M. (2013). Cancer pain in Jordan: prevalence and adequacy of treatment. *International Journal of Palliative Nursing, 19*(3), 125–30.

- Al-Safi, S. A., Alkofahi, A. S., & El-Eid, H. S. (2005). Public response to chest pain in Jordan. *European Journal of Cardiovascular Nursing*, 4(2), 139–144.
- Al Sutari, M. M., Abdalrahim, M. S., Hamdan-Mansour, A. M., & Ayasrah, S. M. (2014). Pain among mechanically ventilated patients in critical care units. *Journal of Research in Medical Sciences : The Official Journal of Isfahan University of Medical Sciences*, 19(8), 726–32.
- Ambuel, B., Hamlett, K., Marx, C., & Blumer, J. (1992). Assessing distress in pediatric intensive care environments: The COMFORT scale. *Journal of Pediatric Psychology*, 17, 95-109.
- American Pain Society Quality of Care Committee. (1995). Quality improvement guidelines for the treatment of acute pain and cancer pain. *Journal of the American Medical Association*, 274(23), 1874–1880.
- American Association of Critical-Care Nurses. (2014). Assessing pain in the critically ill adult. Retrieved September 21, 2016, from <http://www.aacn.org/wd/practice/content/practicealerts/assessing-pain-critically-ill-adult.pcms?menu=practice>
- Amigoni, A., Catalano, I., Vettore, E., Brugnaro, L., & Pettenazzo, A. (2012). Practice of analgesia and sedation in Italian pediatric intensive care units: Did we progress? *Minerva Anestesiologica*, 78(12), 1365–1371.
- Anand, K. J. S., & Craig, K. D. (1996). New perspectives on the definition of pain. *Pain*, 67(1), 3–6.
- Anand, j., Aranda, V., Berde, B., Buckman, S., Capparelli, V., Carlo, W., ... Walco, A. (2006). Summary proceedings from the neonatal pain-control group. *Pediatrics*, 117, 9-22.

- Anderson, D., Wang, S., & Zlateva, I. (2012). Comprehensive assessment of chronic pain management in primary care: A first phase of a quality improvement initiative at a multisite Community Health Center. *Qual Prim Care, 20*, 421-33.
- Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *International Journal of Social Research Methodology, 8*(1), 19–32.
- Ayasrah, S., O'Neill, T., Abdalrahim, M., Sutary, M., & Kharabsheh, M. (2014). Pain assessment and management in critically ill intubated patients in Jordan: A prospective study. *International Journal of Health Sciences, Qassim University, 8*(3), 287–298.
- Bai, J., Hsu, L., Tang, Y., & Van Dijk, M. (2012). Validation of the COMFORT behavior scale and the FLACC scale for pain assessment in Chinese children after cardiac surgery. *Pain Management Nursing, 13*, 18-26.
- Batiha, A.-M. (2014). Pain management barriers in critical care units: A qualitative study. *International Journal of Advanced Nursing Studies, 3*(1), 1–5.
- Bauchner, H., May, A., & Coates, E. (1992). Use of analgesic agents for invasive medical procedures in pediatric and neonatal intensive care units. *The Journal of Pediatrics, 121*(4), 647–649.
- Bear, L., & Ward-Smith, P. (2006). Interrater reliability of COMFORT scale. *Pediatric Nursing, 32*, 1208-1225.
- Bowen, S., & Graham, I. D. (2013). Chapter 1 . 2 Integrated knowledge translation. In S. E. Straus, J. Tetroe, & I. D. Graham (Eds.), *Knowledge Translation in Health Care: Moving from Evidence to Practice* (second). West Sussex.
- Butkovic, D., Kralik, S., Matolic, M., Kralik, M., Toljan, S., & Radesic, L. (2007). Postoperative analgesia with intravenous fentanyl PCA vs epidural block after thoracoscopic pectus

excavatum repair in children. *British Journal of Anaesthesia*, 98(5), 677–681.

Canadian Association of Critical Care Nurses. (2009). Standards for critical care nursing practice. Retrieved July 7, 2017, from <http://www.caccn.ca/en//pdfs/CACCN%20STND%20CRIT%20CARE%202009.pdf>

Canadian Institutes of Health Research. (2016). Knowledge translation and commercialization. Retrieved July 7, 2017, from <http://www.cihr-irsc.gc.ca/e/29418.html#2>

Chrysostomou, C., Sanchez De Toledo, J., Avolio, T., Motoa, M. V, Berry, D., Morell, V. O., ... Munoz, R. (2009). Dexmedetomidine use in a pediatric cardiac intensive care unit: can we use it in infants after cardiac surgery? *Pediatric Critical Care Medicine : A Journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies*, 10(6), 654–660.

Connelly, M., & Schanberg, L. (2006). Latest developments in the assessment and management of chronic musculoskeletal pain syndromes in children. *Current Opinion in Rheumatology*, 18, 496-502.

Crellin, D. J., Harrison, D., Santamaria, N., & Babl, F. E. (2015). Systematic Review of the FLACC scale for assessing pain in infants and children: is it reliable, valid, and feasible for use? *Pain*, 156(11), 2132–2151.

Cummings, G. G., Hutchinson, A. M., Scott, S. D., Norton, P. G., & Estabrooks, C. A. (2010). The relationship between characteristics of context and research utilization in a pediatric setting. *BMC Health Services Research*, 10, 168–177.

Czarnecki, M., Simon, K., Armus, C., Berg, K., & Xiang, Q. (2011). Barriers to paediatric pain management: A nursing perspective. *Pain Management Nursing*, 12, 154-162.

- Da Silva, P. S. L., Reis, M. E., Fonseca, T. S. M., & Fonseca, M. C. M. (2016). Opioid and benzodiazepine withdrawal syndrome in PICU patients: Which risk factors matter? *Journal of Addiction Medicine, 10*(2), 110–116.
- Department of Veterans Affairs. (2000). Pain as the 5th vital sign toolkit. Retrieved February 28, 2014, from https://www.va.gov/PAINMANAGEMENT/docs/Pain_As_the_5th_Vital_Sign_Toolkit.pdf
- Dopson, S., Fitzgerald, L., Ferlie, E., Gabbay, J., & Locock, L. (2002). No magic targets! Changing clinical practice to become more evidence based. *Health Care Manage Rev, 27*, 35-47.
- Doran, D., Haynes, B. R., Estabrooks, C. A., Kushniruk, A., Dubrowski, A., Bajnok, I., ... Bai, Y. Q. C. (2012). The role of organizational context and individual nurse characteristics in explaining variation in use of information technologies in evidence based practice. *Implementation Science : IS, 7*(1), 122.
- Dorfman, T., Rempel, G., Scott, S., & Hartling, L. (2014). Pain assessment in mechanically ventilated PICU patients: It's complicated. *Pediatric Pain Letter, 16*, 3-7.
- Estabrooks, C., Squires, J., Cummings, G., Birdsell, J., & Norton, P. (2009). Development and assessment of the Alberta Context Tool. *BMC Health Services Research, 9* (234).
- Finley, G., Forgeron, P., & Arnaout, M. (2008). Action research: Developing a pediatric cancer pain program in Jordan. *Journal of Pain and Symptom Management, 35*, 447-454.
- Forgeron, P., Finley, A., & Arnaout, M. (2005). Pediatric pain prevalence and parents' attitudes at a cancer hospital in Jordan. *Journal of Pain and Symptom Management, 31*, 440-448.
- Franck, L., Le Moullec, D., Batjom, E., Libert, N., Tourtier, J., De Rudnicki, S., & Borne, M.

- (2010). How did you sleep in the ICU? *Critical Care*, 14(Suppl 1), P432.
- Franck, L. S., Scoppettuolo, L. A., Wypij, D., & Curley, M. A. Q. (2012). Validity and generalizability of the Withdrawal Assessment Tool-1 (WAT-1) for monitoring iatrogenic withdrawal syndrome in pediatric patients. *Pain*, 153(1), 142–148.
- Gélinas, C., Fortier, M., Viens, C., Fillion, L., & Puntillo, K. (2004). Pain assessment and management in critically ill intubated patients: A retrospective study. *Am J Crit Care*, 13, 126-136.
- Gibb, H. (2013). An environmental scan of an aged care workplace using the PARIHS model: Assessing preparedness for change. *Journal of Nursing Management*, 21(2), 293–303.
- Guedes, L., Rebelo, H., Oliveira, R., & Neves, A. (2012). Regional analgesia in intensive care. *Brazilian Journal of Anesthesiology*, 62(5), 719-730.
- Harrison, D., Beggs, S., & Stevens, B. (2012). Sucrose for procedural pain management in infants. *Pediatrics*, 130, 1–8.
- International Association for Study of Pain. (2017). IASP taxonomy. Retrieved January 10, 2017, from <https://www.iasp-pain.org/Taxonomy#Pain>.
- International Association for Study of Pain. (2014). Declaration of Montréal. Retrieved February 25, 2014, from <http://www.iasp-pain.org/Advocacy/Content.aspx?ItemNumber=1821&navItemNumber=582>
- Ismail, A. (2016). The challenges of providing effective pain management for children in the pediatric intensive care unit. *Pain Management Nursing*, 17(6), 372–383.
- Ista, E., Van Dijk, M., Tibboel, D., & de Hoog, M. (2005). Assessment of sedation levels in pediatric intensive care patients can be improved by using the COMFORT “behavior” scale. *Pediatric Critical Care Medicine*, 6, 58-63.

- Johansson, M., & Kokinsky, E. (2009). The COMFORT behavioural scale and the modified FLACC scale in paediatric intensive care. *Nurs Crit Care, 14*,122-30
- Johnson, P., Miller, J., & Hagemann, T. (2012). Sedation and analgesia in critically ill children. *AACN Advanced Critical Care, 23*, 415-434.
- Jordan Ministry of Health. (2013b). Annual statistical reports. Retrieved April 1, 2014, from <http://www.moh.gov.jo/EN/Pages/Periodic-Newsletters.aspx>
- Hayes, J., Dowling, J. J., Peliowski, A., Crawford, M. W., & Johnston, B. (2016). Patient-controlled analgesia plus background opioid infusion for postoperative pain in children: A systematic review and meta-analysis of randomized trials. *Anesthesia and Analgesia*.
- Herr, K., Coyne, P. J., McCaffery, M., Manworren, R., & Merkel, S. (2011). Pain assessment in the patient unable to self-report: Position statement with clinical practice recommendations. *Pain Management Nursing, 12*(4), 230–250.
- Keogh, S. J., Long, D. a, & Horn, D. V. (2015). Practice guidelines for sedation and analgesia management of critically ill children: a pilot study evaluating guideline impact and feasibility in the PICU. *BMJ Open, 5*(3), e006428.
- Kitson, A., Harvey, G., & McCormack, B. (1998). Enabling the implementation of evidence based practice: A conceptual framework. *Quality in Health Care, 7*, 149-158.
- Kitson, A., Rycroft-Malone, J., Harvey, G., McCormack, B., Seers, K., & Titchen, A. (2008). Evaluating the successful implementation of evidence into practice using the PARIHS framework: Theoretical and practical challenges. *Implementation Science : IS, 3*, 1.
- Kline, W. H., Turnbull, A., Labruna, V. E., Haufler, L., Devivio, S., & Ciminera, P. (2010). Enhancing pain management in the PICU by teaching guided mental imagery: A quality-improvement project. *Journal of Pediatric Psychology, 35*(1), 25–31.

- Kudchadkar, S. R., Aljohani, O. A., & Punjabi, N. M. (2014). Sleep of critically ill children in the pediatric intensive care unit: A systematic review. *Sleep Medicine Reviews, 18*(2), 103-110.
- Ljungman, G., Kreuger, A., Gordh, T., & Sorensen, S. (2006). Pain in pediatric oncology: Do the experience of children and parents differ from those of nurses and physicians? *Upsala Journal of Medical Sciences, 111*, 87-95.
- Maldini, B., Radesic, L., Javorovic, B., & Fattorini, I. (1997). Postoperative analgesia with tramadol in children recovering from major surgery. *Paediatrica Croatica, 41*(1), 29-32.
- Malviya, S., Voepel-Lewis, T., Burke, C., Merkel, S., & Tait, A. R. (2006). The revised FLACC observational pain tool: Improved reliability and validity for pain assessment in children with cognitive impairment. *Paediatric Anaesthesia, 16*(3), 258-265.
- Manworren, R. C. B., & Hynan, L. S. (2003). Clinical validation of FLACC: preverbal patient pain scale. *Pediatric Nursing, 29*(2), 140-146.
- Marinosci, G., Robertis, E., Benedictis, G., & and Piazza, O. (2012). Dopamine use in intensive care: are we ready to turn it down? *Transl Med UniSa, 11*(4), 90-94.
- Massad, I. M., Mahafza, T. M., Abu-Halawah, S. A., Attyyat, B. A., Al-Ghanem, S. M., Almostafa, M. M., & Sal-Oweidi, A. S. (2013). Postoperative pain is undertreated: results from a local survey at Jordan University Hospital. *Eastern Mediterranean Health Journal, 19*(5), 485-489.
- Mattsson, J., Forsner, M., & Arman, M. (2011). Uncovering pain in critically ill non-verbal children: Nurses' clinical experiences in the pediatric intensive care unit. *J Child Health Care, 15*, 187-198.
- McCaffery, M. (1977). Pain relief for the child. *Pediatric Nursing, 3*, 11-16.

Meijers, J., Janssen, M., Cummings, G., Wallin, L., Estabrooks, C., & Halfens, R. (2006).

Assessing the relationships between contextual factors and research utilization in nursing: Systematic literature review. *J Adv Nurs*, 55(5), 622-635.

Merkel, S. I., Voepel-Lewis, T., Shayevitz, J. R., & Malviya, S. (1997). The FLACC: A

behavioral scale for scoring postoperative pain in young children. *Pediatric Nursing*, 23(3), 293–297.

Mitchell, S. A., Fisher, C. A., Hastings, C. E., Silverman, L. B., & Wallen, G. R. (2010). A

thematic analysis of theoretical models for translational science in nursing: Mapping the field. *Nursing Outlook*, 58(6), 287–300.

National Pharmaceutical Council. (2001). Pain: Current understanding of assessment,

management and treatments. Retrieved February 28, 2014, from

<https://www.npcnow.org/publication/pain-current-understanding-assessment-management-and-treatments>

Oakes, L. (2011). *Compact Clinical Guide to Infant and Child Pain Management*. New York,

NY: Springer Publishing.

Obrecht, A. Van Hulle Vincent, C. Ryan, S. (2014). Implementation of evidence-based practice

for a pediatric pain assessment instrument. *Clin Nurse Spec*, 28, 97-104.

Playfor, S. D. (2008). Analgesia and sedation in critically ill children. *Archives of Disease in*

Childhood: Education and Practice Edition, 93, 87-92.

Playfor, S., Jenkins, I., Boyles, C., Choonara, I., Davies, G., Haywood, T., ... Wolf, A. (2006).

Consensus guidelines on sedation and analgesia in critically ill children. *Intensive Care Medicine*, 32(8), 1125–1136.

Ramelet, A., Rees, N. W., McDonald, S., Bulsara, M. K., & Huijer Abu-Saad, H. (2007).

- Clinical validation of the Multidimensional Assessment of Pain Scale. *Paediatric Anaesthesia*, 17(12), 1156–1165.
- Ramelet, A., Abu-Saad, H., Rees, N., & McDonald, S. (2004). The challenges of pain measurement in critically ill young children: a comprehensive review. *Australian Critical Care*, 17, 33-45.
- Ranger, M., Johnston, C., Rennick, J., Limperopoulos, C., Heldt, T., & du Plessis, A. (2013). A multidimensional approach to pain assessment in critically ill infants during a painful procedure. *Clin J Pain*, 29(7), 613–620.
- Registered Nurses Association of Ontario (2013). Assessment and management of pain. Retrieved September 21, 2016, from <http://rnao.ca/sites/rnao-ca/files/AssessAndManagementOfPain2014.pdf>
- Renfrow, T. (2009). *Pediatric intensive care unit pain management in extubated postoperative infants and children. ProQuest Dissertations and Theses.*
- Rennick, J. E., Johnston, C. C., Dougherty, G., Platt, R., & Ritchie, J. A. (2002). Children's psychological responses after critical illness and exposure to invasive technology. *Journal of Developmental & Behavioral Pediatrics*, 23(3), 133–144.
- Rennick, J. E., Lambert, S., Childerhose, J., Campbell-Yeo, M., Filion, F., & Johnston, C. C. (2011). Mothers' experiences of a Touch and Talk nursing intervention to optimise pain management in the PICU: A qualitative descriptive study. *Intensive and Critical Care Nursing*, 27(3), 151–157.
- Rennick, J., Morin, I., Kim, D., Johnston, C., Dougherty, G., & Platt, R. (2004). Identifying children at high risk for psychological sequelae after pediatric intensive care unit hospitalization. *Pediatric Critical Care Medicine*, 5, 358-63.

- Ross, P., Smith, B. M., Tolo, V. T., & Khemani, R. G. (2011). Continuous infusion of bupivacaine reduces postoperative morphine use in adolescent idiopathic scoliosis after posterior spine fusion. *Spine*, *36*(18), 1478–83.
- Rush, S., & Harr, J. (2001). Evidence-based pediatric nursing: Does it have to hurt. *AACN Clin*, *12*, 597-605.
- Rycroft-Malone, J., Kitson, A., Harvey, G., McCormack, B., Seers, K., Titchen, A., & Estabrooks, C. (2002). Ingredients for change: Revisiting a conceptual framework. *Quality and Safety in Health Care*, *11*, 174–180.
- Rycroft-Malone, J. (2004). The PARIHS framework - a framework for guiding the implementation of evidence-based practice. *J Nurs Care Qual*, *19*, 297-304.
- Rycroft-Malone, J. (2007). Theory and knowledge translation: Setting some coordinates. *Nursing Research*, *56*(4 Suppl), S78-85.
- Rycroft-Malone, J., & Bucknall, T. (2010). *Theory, frameworks, and models : laying down the groundwork. Models and frameworks for implementing evidence-based practice : linking evidence to action*. Oxford: Wiley-Blackwell.
- Samuels, J., & Fetzer, S. (2009). Evidence-Based pain management: Analyzing the practice environment and clinical expertise. *The Journal for Advanced Nursing Practice*, *23*, 245-251.
- Sharek, P. J., Wayman, K., Lin, E., Strichartz, D., Sentivany-Collins, S., Good, J., ... Cox, K. (2006). Improved pain management in pediatric postoperative liver transplant patients using parental education and non-pharmacologic interventions. *Pediatric Transplantation*, *10*(2), 172–177.

- Shogrita, N. (2015). 'We are nurses, they are doctors': barriers to nurses' roles in pain management following surgery in Jordan. *Int J Nurs Pract*, 21(2), 200-206.
- Sönmez Düzükaya, D., & Kuğuoğlu, S. (2015). Assessment of Pain During Endotracheal Suction In the Pediatric Intensive Care Unit. *Pain Management Nursing*, 16(1), 11–19.
- Squires, J. E., Estabrooks, C. A., Scott, S. D., Cummings, G. G., Hayduk, L., Kang, S. H., & Stevens, B. (2013). The influence of organizational context on the use of research by nurses in Canadian pediatric hospitals. *BMC Health Services Research*, 13(1), 351.
- Squires, J. E., Estabrooks, C. A., Newburn-Cook, C. V., & Gierl, M. (2011). Validation of the conceptual research utilization scale: an application of the standards for educational and psychological testing in healthcare. *BMC Health Services Research*, 11(1), 107.
- Srouji, R., Ratnapalan, S., & Schneeweiss, S. (2010). Pain in children: assessment and nonpharmacological management. *International journal of pediatrics*, 2010, 474838.
- Stevens, B., Riahi, S., Cardoso, R., Ballantyne, M., Yamada, J., Beyene, J., & Ohlsson, A. (2011). The influence of context on pain practices in the NICU: perceptions of health care professionals. *Qualitative Health Research*, 21, 757-770.
- Straus, S., Tetroe, J., & Graham, I. (2013). Knowledge translation: What it is and what it isn't. In S. E. Straus, J. Tetroe, & I. D. Graham (Eds.), *Knowledge Translation in Health Care: Moving from Evidence to Practice* (second) (pp. 3-13). West Sussex.
- Sudsawad, P. (2016). Knowledge translation: Introduction to models, strategies, and measures. Retrieved July 7, 2017, from http://ktdrr.org/ktlibrary/articles_pubs/ktmodels/index.html
- The World Bank. (2017). Jordan Country Reclassification. Retrieved April 18, 2018, from <http://www.worldbank.org/en/country/jordan/brief/qa-jordan-country-reclassification>

- Thomas, M., Dhanani, S., Irwin, D., Writer, H., & Doherty, D. (2010). Development, dissemination and implementation of a sedation and analgesic guideline in a pediatric intensive care unit ... It takes creativity and collaboration. *Dynamics*, *21*, 16-25.
- Thorp, J., & James, S. (2010). Pain management in the intensive care unit. In A. Kopf, & N. Patel, (Eds.), *Guide to Pain Management in Low- Resource Settings* (pp. 283-291). IASP: Seattle.
- Turner, H. (2005). Complex pain consultations in the Pediatric Intensive Care Unit. *Advanced Practice in Acute and Critical Care*, *16*, 388-395.
- Twycross, A. (2009). Pain: A bio-psycho-social phenomenon. In A. Twycross, J. Dowden, & E. Bruce, E., (Eds.), *Managing pain in children: a clinical guide* (pp. 29-38). Oxford, UK: Wiley-Blackwell.
- Van Dijk, M., Peters, J., Van Deventer, P., & Tibboel, D. (2005) The COMFORT Behavior Scale: A tool for assessing pain and sedation in infants. *American Journal of Nursing*, *105*, 33–36.
- Van Hulle Vincent, C., Wilkie, D., & Wang, E. (2011). Pediatric nurses' beliefs and pain management practices: An intervention pilot. *Western Journal of Nursing Research*, *33*, 825–845.
- Van Niekerk, L., Hons, B., & Martin, F. (2003). The impact of the nurse-physician relationship on barriers encountered by nurses during pain management. *Pain Management Nursing*, *4*, 3–10.
- Voepel-Lewis, T., Zanolli, J., Dammeyer, J., & Merkel, S. (2010). Reliability and validity of the face, legs, activity, cry, consolability behavioral tool in assessing acute pain in critically ill patients. *Am J Crit Care*, *19*, 55-61.

- Voscopoulos, C., & Lema, M. (2010). When does acute pain become chronic? *British Journal of Anaesthesia*, *105*, i69–i85.
- Watt-Watson, J., McGillion, M., Hunter, J., Choiniere, M., Clark, A. J., Dewar, A., ... Webber, K. (2009). A survey of prelicensure pain curricula in health science faculties in Canadian universities. *Pain Research and Management*, *14*(6), 439–444.
- Williams, A. C., & Craig, K. D. (2016). Updating the definition of pain. *Pain*, *157*(11), 2420–2423.
- World Health Organization. (2012). WHO guidelines on the pharmacological treatment of persisting pain in children with medical illnesses. Retrieved September 21, 2016, from http://apps.who.int/iris/bitstream/10665/44540/1/9789241548120_Guidelines.pdf
- Zalieckas, J., & Weldon, C. (2015). Sedation and analgesia in the ICU. *Seminars in Pediatric Surgery*, *24*(1), 37–46.

Chapter Two

Pain Management Interventions in the Pediatric Intensive Care Unit (PICU): A Scoping Review

This manuscript has been submitted for publication in the Intensive & Critical Care Nursing Journal and is currently under review. It was written based on the journal format.

Authors: Ahmad Ismail, Paula Forgeron, Viola Polomeno, Huda Gharaibeh, William Dagg, & Denise Harrison.

Abstract

Objective: To map research based pain management interventions used in the PICU.

Methods: Five Databases were searched from their inception to end 2015 (CINAHL, EMBASE, MEDLINE, PsychINFO, and ProQuest Dissertations & Theses Global). Reference lists from the screened full text articles were reviewed. Two independent reviewers conducted titles and abstracts screening, full text screening, and data extraction. A third reviewer resolved any disagreements.

Results: 7047 articles were identified, 100 underwent full text screening and 27 included in the final review (25 from the search and two from reference lists). Seventeen articles (63%) were non-experimental studies, and 10 (37%) were experimental, of which 8 were randomized controlled trials (RCTs). Interventions were categorized into: Pharmacological, physical, psychological, and others. The majority of the articles solely focused on pharmacological interventions (n= 21, 78%), one on physical, and one on psychological interventions. Four studies included more than one category of interventions. The majority of the studies focused on post-operative pain management (n=18, 67%), six (22%) on mechanically ventilated patients including analgesia and sedation management, two on trauma, and one on invasive procedures. Morphine and fentanyl were the most commonly used and studied pharmacological agents and Dexmedetomidine was studied in the context of pain control after cardiac surgery.

Discussion: The majority of the studies focused on medications and post-operative pain management. The majority were non clinical trials. More research, including clinical trials, is warranted to determine the effectiveness of non-pharmacological (physical, psychological, and others) interventions for pain management in the PICU.

INTRODUCTION

Access to appropriate pain management is one of the essential human rights (International Association for Study of Pain, 2015). Health care organizations and HCPs should consider pain, including children's pain in the Pediatric Intensive Care Units (PICUs), as a high priority issue (Registered Nurses Association of Ontario (RNAO), 2013). Pain management in the PICU has been reported to be suboptimal (Agarwal et al., 2010; Grant et al., 2012; LaFond et al., 2014). For example, uncontrolled pain was one of the most common major adverse events reported in PICUs in the United States of America (USA), of which 82% of these pain events were considered preventable (Agarwal et al., 2010).

Physical and psychological harmful consequences can develop as a result of uncontrolled pain in the PICU (Ismail, 2016; Oakes, 2011; Rennick et al., 2004; Thorp and James, 2010; Turner, 2005). Pain can escalate the responses of the sympathetic nervous system, leading to an elevation in stress hormone levels, increased cardiac effort and oxygen consumption, and delayed wound healing (Thorp and James, 2010). Pain resulting from surgery (e.g., abdominal and thoracic surgery) can lead to reduced abdominal and chest wall movement as well as an ineffective or inability to cough, contributing to difficulties in weaning from mechanical ventilation and an increased risk of respiratory infections (Thorp and James, 2010). At an organizational level, these consequences can prolong the length of stay in the PICU, subsequently increasing the burden on the health care system, including the costs of health care.

Recurrent pain as a result of hospitalized children's exposure to invasive procedures in the PICU (average of 13 procedures/day, (Stevens et al., 2011)) is an important factor for the development of negative psychological outcomes post discharge from the PICU (e.g., medical fears and posttraumatic stress disorder) (Rennick et al., 2002). Exposure to high numbers of

invasive procedures in the PICU has been reported as the most important predictor of negative psychological outcomes following discharge from the PICU (Rennick et al., 2004). In addition, poorly managed recurrent pain in the PICU has the potential to lead to chronic pain (Ismail, 2016; Voscopoulos and Lema, 2010). These consequences of untreated or poorly treated pain highlight the need to provide appropriate interventions to effectively manage children's pain in the PICU.

Healthcare professionals face many challenges in providing effective pain management in the PICU (Ismail, 2016). Patients in the PICU are not only children; they are critically ill with complex conditions. Pain management in the PICU is more challenging than in adults or in other settings due to critically ill children's differences in physical, cognitive, and psychosocial development (Gelinas et al., 2004; Ismail, 2016; Oakes, 2011; Srouji et al., 2010; Turner, 2005). In addition, self-report of pain (considered the gold standard for pain assessment) is compromised by the condition of the patient, administration of pharmacological agents and use of supportive devices. Some examples that may compromise older children's ability to self-report pain in the PICU are head trauma, with accompanying altered and changing levels of consciousness, the use of sedative and neuromuscular blocking agents, and mechanical ventilation (American Association of Critical-Care Nurses, 2014; Gelinas et al., 2004; Ismail, 2016; Oakes, 2011; Turner, 2005). Regardless of these challenges, effective pain management should be integral to the care for critically ill children in the PICU (International Association for Study of Pain, 2015; Playfor et al., 2006).

Health care professionals working in the PICU can benefit from research findings to provide effective pain management (RNAO, 2013; Rycroft-Malone, 2004; Samuels and Fetzer, 2009). In critical care settings, however, there is a wide gap between clinical practice and the

findings of research (Samuels and Fetzer, 2009). In addition, there are concerns regarding the quality of research findings used to create recommendations for pain management in the PICU. In 2006, Playfor et al. stated “the quality of evidence available in the literature to support these recommendations is poor” (p. 1133). Identifying, summarizing and synthesizing the available research on pain management interventions used in the PICU is needed to inform future directions for practice and research. Therefore, the aim of this study is to identify research based pain management interventions used in the PICU, by conducting a scoping review on pain management interventions evaluated and used in the PICU.

METHODS

Arksey and O’Malley’s framework for scoping reviews guided this study (Arksey and O’Malley, 2005). The five steps of this framework include: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data, and (5) collating, summarizing, and reporting the results.

Literature Search

The specific question for this review was: “Which pain management interventions are evaluated and used for patients in the Pediatric Intensive Care Unit (PICU)?” The search strategy included five databases (CINAHL, EMBASE, MEDLINE, PsychINFO, and ProQuest Dissertations & Theses Global), reference lists of included studies, and consultations with pain experts. The search was conducted by a medical librarian using the following search terms: Pain, pain treatment, pain intervention, Pediatric Intensive Care Unit, children, child, critically ill, critical care, critical illness, and terminal illness (Appendix B) as well as database specific subject headings. There was no date limit in terms of publication time.

Article Selection

The citations from the electronic data search were uploaded into the Covidence software (Covidence, 2017). Duplicates were identified by Covidence and then removed. Two independent reviewers (AI and WD) screened the titles and abstracts to identify articles that met the inclusion criteria. The inclusion criteria were: (1) studies with a primary focus on pain management interventions studied or used in the PICU; (2) published in English; (3) quantitative designs; (4) primary research; and (5) patients from 0 to 18 years of age in the PICU. The exclusion criteria were: (1) books, book chapters, conference papers or abstracts, editorials, and commentaries; (2) studies primarily focused on sedation; and (3) studies primarily focused on sedatives or opioid withdrawal. A third independent reviewer (DH) resolved disagreements at this stage of screening. All articles screened for inclusion were read in full by the two reviewers (AI and WD) to ensure that they met the inclusion criteria and disagreements at the full text stage were resolved by the third reviewer (DH).

Reference list of articles retained after full text review were read to determine other potential studies not found in the database searches, and subjected to the same screening method as described above. Two additional articles were identified through the reference lists of full text articles reviewed. Furthermore, a panel of eight experts from the fields of research, pain and child health were consulted to identify additional articles not captured by the search. This panel included three nursing professors working at a Canadian university, a nursing professor at a university in Jordan, a pediatric anesthesiologist working at a Canadian hospital, a senior lecturer and nurse research consultant working at a children's hospital in Australia, a clinical nurse specialist working at a Canadian PICU, and a PICU charge nurse working at a hospital in Saudi Arabia. The panel agreed on the articles included and they did not suggest any additional articles.

Data Charting

In keeping with the process for data extraction described by Arksey and O'Malley, two independent reviewers were involved in data extraction. Using a customised data extraction form the first reviewer extracted the following data: authors' names, year of publication, country where the study was conducted, aim of the study, study design, sample characteristics, data collection methods and outcome measures, pain management intervention(s), and the major findings. The second reviewer read each article and reviewed the data extraction forms to ensure accuracy of the data extraction.

To aid in the reporting of the findings, four *a priori* categories were established to organize the findings to better understand the state of the science based on intervention type. These four main categories are: pharmacological interventions; psychological interventions; physical interventions; and others e.g., music. Some studies contained data related to more than one category.

RESULTS

As shown in Figure 2.1, after duplicates were removed, 5969 records were screened, 100 full-text records were assessed for eligibility, and 27 studies were included in this study. Figure 2.1 shows the flow chart of the search strategy and the number of articles reviewed and excluded at each stage.

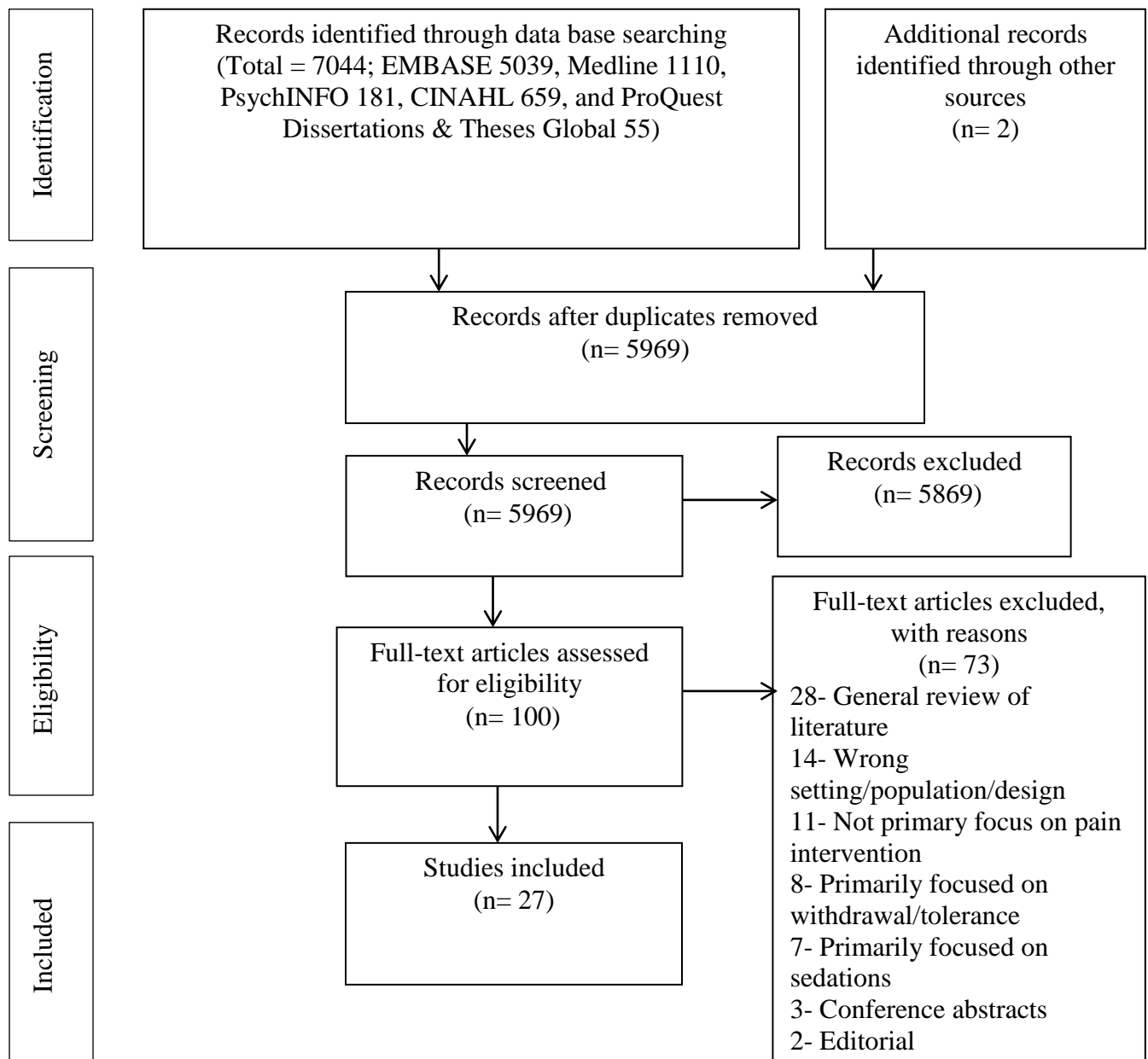


Figure 2.1. Flow Diagram of Study Selection Process

Twenty seven studies relating to pain management interventions used in the PICU were identified and categorized according to the type of intervention (pharmacological, psychological, physical, and others) (Akinci et al., 2005; Amigoni et al., 2012; Bauchner et al., 1992; Benini et al., 2010; Butkovic et al., 2007; Chrysostomou et al., 2009, 2006; Chu et al., 2006; Coffman et

al., 1997; DeBerry et al., 2005; Van Dijk et al., 2002; Horvath et al., 2015; Kline et al., 2010; Larson et al., 2013; Lieh-Lai et al., 1999; Maldini et al., 1997; Van Der Marel et al., 2001; Naguib et al., 2012; Prins et al., 2008; Reiter et al., 2012; Renfrow, 2009; Ross et al., 2011; Sharek et al., 2006; Shayevitz et al., 1996; Sheridan et al., 2001; Weldon et al., 1993; Wu et al., 2009). Twenty five articles were included from database search and two from reference lists. Seventeen studies (63%) were non-experimental, and 10 (37%) were experimental, of which 8 (30%) were randomized controlled trials (RCTs). The majority of the studies focused on pharmacological interventions (n= 21, 78%), one on physical, one on psychological interventions, and four studies included more than one category of interventions. As seen in Table 2.1, the majority of the studies mainly focused on post-operative pain management (n=18, 67%), six (22%) on mechanically ventilated children including analgesia and sedation management, two (7%) on trauma, and one (4%) on invasive procedures (Table 2.1). Studies included in this review were published between 1992 and 2015. Thirteen studies (48%) were published between 2000 and 2009, eight between 2010 and 2015, and six between 1990 and 1999. Appendix C lists and summarizes the 27 studies included in this review.

Table 2.1. Design, Intervention Category, and Condition

Design	N (%)
Descriptive	11 (41%)
Randomized controlled trial (RCT)	8 (30%)
Case control	4 (15%)
Nonrandomized controlled trial	2 (7%)
Cohort	2 (7%)
Category of intervention	
Pharmacological	21 (78%)
Physical	1 (4%)
Psychological	1 (4%)
More than one category	4 (15%)
Condition studied	
Post-operative	18 (67%)
Mechanically ventilated children	6 (22%)

Trauma	2 (7%)
Invasive procedures	1 (4%)

Pharmacological Interventions

The most commonly reported pharmacological agents for pain control used in different conditions were opioids, including morphine and fentanyl. Other agents less frequently used for pain management included remifentanyl, tramadol, dexmedetomidine, acetaminophen, hydromorphone and ketorolac. Regional (bupivacaine) and local anesthetic agents (lidocaine) were reported on in three studies (Table 2.2).

Table 2.2. Pain Management Intervention (Used or Tested) Among the 27 Studies

Intervention	N (%)
Medication	
Morphine	10 (37%)
Fentanyl	14 (52%)
Dexmedetomidine	4 (15%)
Acetaminophen	3 (11%)
Remifentanyl	2 (7%)
Tramadol	2 (7%)
Bupivacaine (Regional)	2 (7%)
Lidocaine (Local)	1 (4%)
Psychological	
Mental imagery	3 (11%)
Hypnosis	2 (7%)
Detailed inquiry	1 (4%)
Physical	
Acupuncture	2 (7%)
Stroking	1 (4%)
Soothing	1 (4%)
Positioning	1 (4%)
Swaddling	1 (4%)
Others	
Music	1 (4%)
Environmental modification	1 (4%)

Morphine

Morphine was one of the most commonly reported pharmacological agents used for pain management in critically ill children. Ten studies conducted in different countries used or evaluated the utilization of morphine in a wide range of patients and different conditions such as post-operative pain, invasive procedures, and mechanically ventilated patients (Bauchner et al., 1992; Chu et al., 2006; Coffman et al., 1997; Van Dijk et al., 2002; Larson et al., 2013; Lieh-Lai et al., 1999; Reiter et al., 2012; Shayevitz et al., 1996; Sheridan et al., 2001; Weldon et al., 1993).

Morphine postoperatively in PICU patients. Morphine was evaluated or used to manage children's pain after different kinds of surgeries, administered by different methods (intravenous, epidural, continuous infusion, intermittent infusion, PCA, and nurse-controlled analgesia (NCA), and evaluated in different countries. Three studies evaluated morphine post cardiac surgery (Chu et al., 2006; Lieh-Lai et al., 1999; Shayevitz et al., 1996), one study post spinal surgery (Weldon et al., 1993), and one post thoracic and abdominal surgeries (Van Dijk et al., 2002). In 1996, a retrospective case control study conducted in the USA on post cardiac surgery aimed to determine if epidural morphine could give comparable outcomes to intravenous fentanyl infusion for children aged 5 to 19 years (Shayevitz et al., 1996). Using numerical pain intensity scores from 0 to 10 (Ross and Ross, 1988), pain scores in the children who received epidural morphine were significantly lower than in children who received intravenous fentanyl on postoperative day one (median = 2 compared to median = 3.5, $p = 0.03$). These results highlighted that epidural analgesia resulted in better pain control than systematic opioids post cardiac surgery. No adverse effects of bleeding in the epidural space or respiratory depression were observed in children who received epidural morphine and there were no statistically significant differences in nausea and

vomiting in the two groups. Pruritus was however more common in the epidural morphine group compared to the intravenous fentanyl group (56% compared to 41%, $p = 0.4$).

In 1999, an RCT conducted in the USA compared a single dose of intravenous ketorolac to intravenous morphine after major surgical procedures (cardiovascular, spinal, neurosurgical, and reconstructive) in children aged 3 to 18 years. Pain was assessed at 6 hours after the analgesic dose. Using the Children's Hospital of Eastern Ontario Pain Scale (CHEOPS) (McGrath et al., 1985) and/or the Oucher scale (Beyer et al., 1992), there was no significant difference in pain scores between children who received ketorolac and those who received morphine ($p = 0.2$) (Lieh-Lai et al., 1999). There were also no significant differences between the two groups in terms of adverse effects ($p \geq 0.05$) with the exception of vomiting which was more common in the ketorolac group ($p \leq 0.05$).

A third study, a blinded RCT conducted in a PICU in Taiwan, compared the outcomes of an intraoperative (at the time of closure of the sternum) dose of morphine versus equivalent dose of tramadol (1mg of tramadol equivalent to 0.1mg of morphine) in children one to six years of age during the immediate postoperative period after cardiac surgery (Chu et al., 2006). In the PICU, those who received morphine in the operating room at time of wound closure received NCA with bolus doses of morphine post operatively and those who received tramadol in the OR at the time of closure received bolus doses of tramadol. Using the CHEOPS (McGrath et al., 1985) for pain assessment, scored by a research fellow at fixed time points, there was no difference in pain intensity between the two groups during the 48 hours observation period. However, time to waking and time to extubation were shorter in the tramadol group compared to the morphine group (20.8 ± 17.5 minutes versus 35.2 ± 20.3 minutes, $p = 0.02$), and ($30.5 \pm$

21.3 minutes versus 47.5 ± 15.8 , $p = 0.01$) respectively (Chu et al., 2006). There were no differences between groups in adverse effects such as desaturation and vomiting.

An RCT conducted in the USA more than two decades ago compared PCA intermittently boluses as needed administered morphine with continuous infusion, plus intermittent doses as needed following spinal surgery for alert patients aged 11 to 18 years (Weldon et al., 1993). Using the 0-100 mm visual analog pain scale (VAS) every two hours to assess pain in the first 72 hours post-surgery, there was no significant difference between the PCA and the PCA plus continuous infusion in pain intensity. There was also no difference between the PCA and the PCA plus continuous infusion of morphine groups in terms of total dosage received and adverse effects.

In another study conducted in the Netherlands, an RCT including 181 children aged zero to three years, compared intermittent intravenous morphine ($30 \mu\text{g}/\text{kg}$ every three hours; $n=93$) and continuous intravenous infusion of morphine ($10 \mu\text{g}/\text{kg}/\text{h}$; $n=88$) post major thoracic and abdominal surgery (Van Dijk et al., 2002). Using a 0 to 10 cm VAS scale every 3 hours in the first 24 hours after surgery (scored by nurses), no significant difference in pain scores were found between the two groups. The VAS median was 1.9 cm for continuous morphine and the interquartile range (IQR) was (1.1–2.8) compared to 1.8 cm and (1.2–2.6) for intermittent morphine ($p = 0.84$). The authors did not compare the incidence of adverse events of morphine between the two groups.

Morphine in ventilated PICU patients. Morphine has been assessed in mechanically ventilated children with different conditions. In the USA, a chart review study assessed the use of morphine among ventilated children with conditions including respiratory failure/pneumonia (32%), malignancy (18%), trauma (15%), children requiring Extracorporeal Membrane

Oxygenation (ECMO) (13%), seizures (5%), infection (4%), and others (2%) (Reiter et al., 2012). Morphine and fentanyl were the first line opioids used in 90% of the children versus hydromorphone which was used as a first line opioid in 10% of them. Using the Face, Legs, Activity, Cry, and Consolability (FLACC) behavioral pain scale (Voepel-Lewis et al., 2010), the average pain scores per patient course was 1.004 ± 0.71 . The majority of the patients received additional medications that may interfere with the accuracy of the FLACC in this study e.g., 89% of the children received continuous midazolam infusion. Morphine has also been used as the main analgesic for patients requiring sedation during mechanical ventilation (sedoanalgesia management). In Australia, one study evaluated the outcome of the introduction of a pain and sedation guideline on clinical practice in a single PICU (Larson et al., 2013). Two hundred and fifty-nine patients' charts (birth to 18 years) were audited before and after introduction of the guidelines (147 pre-and 112 post). Commonly used agents were morphine, fentanyl and midazolam. Consistent with the guidelines, the dosage and administration of these agents remained constant post guideline audits; however the use of oral clonidine increased as per the recommendations in the new guideline. A retrospective review study for children admitted with burns, aged 6 months to 16 years requiring mechanical ventilation for greater than seven days, was conducted in the USA (Sheridan et al., 2001). Morphine was used to manage pain and midazolam for sedation in all patients, adjusted to comfort. The bedside nurse adjusted doses of the medications to reach a state described as "lightly asleep but arousable" (p 151). In these patients, the dose of morphine was higher than the usual dose, suggesting that nurses assessed these children as requiring more opioids for pain than benzodiazepines for sedation.

Morphine for invasive procedures. The use of morphine has also been included in a study of analgesics during invasive procedures. In Canada and the USA, a descriptive study

published 25 years ago (Bauchner et al., 1992) captured the use of analgesics for invasive procedures in 38 PICUs, however the effectiveness of the analgesics were not evaluated. Analgesics were used in PICUs for central line placement (92%), chest tube insertion (92%), bone marrow aspiration (79%), paracentesis (71%), arterial line placement (66%), and lumbar puncture (50%). The most commonly used analgesics were lidocaine, morphine, and fentanyl (Bauchner et al., 1992). Finally, another descriptive study conducted in the USA two decades ago, found that morphine was the most commonly administered analgesic by PICU nurses for critically ill children (Coffman et al., 1997). Among 112 observations, nurses most frequently administered morphine (53%) followed by meperidine (16%), and fentanyl (11%). However, it was not mentioned if nurses chose or participated in the decision of analgesics selection. These ten studies indicated that morphine was used and studied in various ways for critically ill children's pain in the PICU.

Fentanyl

In addition to morphine, fentanyl was also one of the more commonly studied and used pharmacological agents for pain management in the PICU. Fourteen studies conducted in different countries indicated that fentanyl was used for a wide range of patients and different conditions such as post-operative pain, invasive procedures, and patients requiring sedation and analgesia e.g., mechanically ventilated patients (Akinci et al., 2005; Amigoni et al., 2012; Bauchner et al., 1992; Benini et al., 2010; Butkovic et al., 2007; Chrysostomou et al., 2009; Coffman et al., 1997; DeBerry et al., 2005; Horvath et al., 2015; Larson et al., 2013; Naguib et al., 2012; Reiter et al., 2012; Renfrow, 2009; Shayevitz et al., 1996).

Fentanyl postoperatively. Fentanyl was used (alone or in combination with other agents) to manage children's pain after different kinds of surgery including cardiac, spinal and thoracic

surgeries in seven studies (Akinici et al., 2005; Butkovic et al., 2007; Chrysostomou et al., 2009; Horvath et al., 2015; Naguib et al., 2012; Renfrow, 2009; Shayevitz et al., 1996). Four studies described or evaluated its use following cardiac surgery for patients aged two days to 19 years (Chrysostomou et al., 2009; Horvath et al., 2015; Naguib et al., 2012; Shayevitz et al., 1996). Of these, one study compared fentanyl and morphine (Shayevitz et al., 1996) which, as discussed earlier in this paper, indicated that intravenous (IV) infusion of fentanyl was less effective than lumbar epidural infusion of morphine for pain relief (Shayevitz et al., 1996). Three studies examined the use of fentanyl using the FLACC scale which permits comparison of pain scores across the three studies (Chrysostomou et al., 2009; Horvath et al., 2015; Naguib et al., 2012). A retrospective review conducted in the USA indicated that fentanyl administered by continuous infusion or NCA provided effective pain control after cardiac surgery in infants aged two to 90 days, based on FLACC scores (Naguib et al., 2012). Another study indicated that fentanyl was the most commonly used agent added to dexmedetomidine (selective alpha 2-agonist with sedative and analgesic properties (Chrysostomou et al., 2006)) to provide effective pain control in children following cardiac surgery (Horvath et al., 2015), and a further study showed no additional benefit, based on FLACC scores, among infants when fentanyl was added to dexmedetomidine (Chrysostomou et al., 2009). The study conducted in the USA, which reviewed charts of 33 infants' records following cardiac surgery for hypoplastic left heart (Naguib et al., 2012), compared Fentanyl administered by NCA in 21 infants (64%) to continuous infusion in 12 (36%) infants. The NCA dosing was 0.5 µg/kg (lockout of 10–20 minutes) with an hourly limit of one to two µg /kg/h, and the continuous infusion was 0.5 µg/kg/h. Using the FLACC scale, pain scores were lower than 5 for 93% of the time, and no infant had a pain score greater than seven in both groups. The NCA was used more in extubated

infants (12 of the 13 patients compared to nine of 20 infants who were not extubated) and fentanyl requirements were lower in extubated infants. One infant developed respiratory depression, one pruritus, and one was deemed overly sedated however it was not stated if these adverse events occurred in the NCA or continuous infusion patients. Fentanyl was used in combination with dexmedetomidine in two studies after cardiac surgery (Chrysostomou et al., 2009; Horvath et al., 2015). Using the FLACC or the CRIES (a behavioral pain assessment tool used in neonatal populations) scales, there was no difference in pain scores among infants younger than one year who received dexmedetomidine alone or who received dexmedetomidine combined with fentanyl ($p = 0.62$) (Chrysostomou et al., 2009). Pain scores ranged from no pain to mild pain in 90% of the infants (Chrysostomou et al., 2009). The second retrospective study reported that 92 (86%) children between the ages of 3 days to 17.5 years who underwent cardiac surgery received dexmedetomidine plus fentanyl. The average FLACC score was 2 (mild pain) (Horvath et al., 2015). In addition, as reported earlier in this review, in one study, lumbar epidural infusion of morphine achieved better pain relief than IV infusion of fentanyl after cardiac surgery (Shayevitz et al., 1996).

Fentanyl has been also used after spinal, thoracic and abdominal surgeries in three studies (Akinci et al., 2005; Butkovic et al., 2007; Renfrow, 2009) . In Turkey, fentanyl and remifentanyl infusions were compared for short term analgesia post orthopedic spinal surgery in children requiring mechanical ventilation (Akinci et al., 2005). Using the behavioural pain scale (BPS) (Payen et al., 2001), there was no difference in pain scores between patients who received fentanyl or remifentanyl. However, in the remifentanyl patients, the mean heart rate was higher than in the fentanyl patients ($p = 0.017$). In Croatia, an RCT compared thoracic epidural infusion of bupivacaine plus fentanyl to PCA with fentanyl alone in children and adolescents between the

ages of 8 to 19 years post thoracoscopic surgery (Butkovic et al., 2007). There were no differences in patients' 10-point VAS scores between the epidural block and PCA during the first 48 hours post-surgery. Pain scores in both groups of children ranged from low to moderate pain (VAS scores 1.9 to 5). Three of the 14 patients in the epidural group developed pruritus compared to none in the PCA group, and two developed nausea compared to four of the 14 patients in the PCA group. A descriptive study conducted in the USA found that fentanyl was used after 28% of the surgical procedures (e.g., abdominal surgery) in extubated postoperative infants and children age 6 months to 17 years. (Renfrow, 2009)

Fentanyl in ventilated patients. The use of fentanyl has been reported as a key analgesic agent for patients requiring sedation (sedoanalgesia management) during mechanical ventilation. Three studies of pain and sedation management practices in PICU of which two were conducted in Italy and one in Australia, indicated that fentanyl was primarily used when combined with sedatives (Amigoni et al., 2012; Benini et al., 2010; Larson et al., 2013). In Italy, one of the studies described the practice of analgesia and sedation in 24 Italian PICUs (Amigoni et al., 2012). The most commonly used IV opioid for continuous infusion was fentanyl (67%). Another study from Italy (Benini et al., 2010) found that the first treatment of choice was the combination of benzodiazepines and opioids (86%), while the first choice of analgesics was fentanyl and the second choice was either morphine or remifentanyl. In Australia, a study on sedation-analgesia management showed that morphine and fentanyl were the most commonly used agents for analgesia (Larson et al., 2013).

Fentanyl has been used for pain and sedation management during mechanical ventilation and ECMO. In the USA, one study indicated that fentanyl (in addition to morphine) was used as the first line opioid in 90% of mechanically ventilated children with different conditions (Reiter

et al., 2012), and fentanyl was reported in another study to be the most commonly used pain medication in 46 ECMO centres in the USA (62%). The preferred route of administration was via a central venous catheter (76%) and the most commonly administered method was via continuous infusion (92%) (DeBerry et al., 2005).

Fentanyl in other conditions. Fentanyl has been used for pain management during invasive procedures and for children following trauma. The use of fentanyl for reducing pain during invasive procedures was reported in one study. A study conducted in Canada and the USA over two decades ago, showed that fentanyl was one of the most commonly used pharmacological analgesics (in addition to morphine and locally administered lidocaine) (Bauchner et al., 1992) during invasive procedures e.g., central line insertion. In 1997, one study indicated that fentanyl was administered to the children in the PICU who were experiencing pain as a result of trauma (Coffman et al., 1997).

Remifentanil

The use of remifentanil was reported in only two studies (Akinci et al., 2005; Benini et al., 2010). As stated above, one study compared fentanyl with remifentanil infusions for short term analgesia post orthopedic spinal surgery in children requiring mechanical ventilation (Akinci et al., 2005) and no difference in pain scores was found. The second study from Italy, reporting analgesia and sedation practices in 19 PICUs, showed that remifentanil was the second choice for analgesia after fentanyl (Benini et al., 2010).

Tramadol

The use of tramadol was reported in two clinical trials (Chu et al., 2006; Maldini et al., 1997). In Croatia in 1997, a non-randomized-clinical trial compared the efficacy of intermittent and continuous administration of tramadol in 42 children (one month to 16 years) after major

surgery e.g., abdominal surgeries (Maldini et al., 1997). Physiological and behavioral responses (Schaffer et al., 1986) were used to assess infants' and toddlers' pain. A VAS scale, from no pain to very severe pain (Lowe et al., 1991) was used to assess the preschool children's pain and self-reported VAS for older children and adolescents. All 24 children (100%) who received continuous administration of tramadol achieved satisfactory pain control versus 61% who received intermittent tramadol (Maldini et al., 1997) as reported by the investigators; however actual pain scores were not reported. A number of adverse effects of tramadol were reported for both groups. The most commonly reported adverse effects in the intermittent group were face flushing (six children), dry mouth (three children), and fatigue (three children). One child had a serious adverse reaction resulting in cardiovascular collapse. In the continuous administration group, the most common adverse effects were fatigue (eight children), nausea/vomiting (five children), and sweating (four children). The second trial found that tramadol provided an equivalent analgesic efficacy as morphine post cardiac surgery (Chu et al., 2006). Heart rate and arterial blood pressure did not differ between the tramadol and morphine groups. Vomiting was reported in six of the 20 children in the tramadol group and five of 20 in the morphine group. These two studies indicated that tramadol can be used for post-operative pain management in children. However, adverse effects may limit the usefulness of this medication for pain management.

Dexmedetomidine

Four studies conducted in the USA demonstrated the effectiveness of using dexmedetomidine for pain management after cardiac surgery, either as a primary or adjunct analgesic (Chrysostomou et al., 2009, 2006; Horvath et al., 2015; Naguib et al., 2012). The total number of patients who received dexmedetomidine in these four studies was 250 and included

spontaneously breathing and mechanically ventilated patients. The age of the children ranged from newborn to 17.5 years. The FLACC scale was the main scale used for pain assessment. One study described the experience of using dexmedetomidine in a single PICU in children aged 7 to 9 years (Chrysostomou et al., 2006). The participants included spontaneously breathing (n = 33) as well as mechanically ventilated patients (n=5). The VAS (Wong et al., 1999) and the FLACC (Merkel et al., 1997) pain scores were low, indicating mild pain ($M = 1.5 \pm 0.9$). However, six patients (15%) had documented hypotension and one patient had an episode of bradycardia. Hypotension was resolved by decreasing or discontinuing the infusion of dexmedetomidine and bradycardia was resolved by discontinuing the infusion. Another study found no difference in pain scores among infants who received dexmedetomidine alone or in combination with sedatives/analgesics e.g., fentanyl (Chrysostomou et al., 2009). Dexmedetomidine provided an adequate level of sedation as well as analgesia alone or in combination with other low-dose sedatives/analgesics (Chrysostomou et al., 2009). A third study indicated adequate pain control as indicated by mean FLACC scores less than 2 when using dexmedetomidine plus an opioid agent (e.g., fentanyl). However, dexmedetomidine was discontinued in seven of the 107 children (6.5%) due to adverse events, most commonly, bradycardia. In the fourth study, dexmedetomidine was used as an adjunct to fentanyl in five patients and led to a decrease in fentanyl use compared to fentanyl alone (28 patients) (Naguib et al., 2012). These studies indicated that dexmedetomidine may be used as a primary or adjunct analgesic for both spontaneously breathing and mechanically ventilated patients following cardiac surgery. However, careful monitoring of adverse effects, especially bradycardia, is required.

Acetaminophen

Three studies reported the use of acetaminophen in the PICU (Van Der Marel et al., 2001; Prins et al., 2008; Renfrow, 2009). Two RCTs from the Netherlands examined the effectiveness of acetaminophen after craniofacial surgery in non-ventilated infants and children (6 months to two years). The two trials used a 10-cm VAS (McGrath et al., 1985) scale completed by trained intensive care nurses. The first trial compared rectally to orally administered acetaminophen in 40 infants and children and found that rectally administered acetaminophen provided superior analgesia (Van Der Marel et al., 2001). Rectal and oral doses were the same (20mg/kg every 6 hours) in both groups. Eleven of the 20 patients in the rectal group and 12 of the 20 in the oral group vomited once or twice. After exclusion of the patients who vomited from the oral group, pain scores did not differ between the two groups. The second trial compared 15-minute infusion of intravenous acetaminophen (propacetamol) to rectal acetaminophen (paracetamol) in 26 infants and children (Prins et al., 2008). The mean VAS scores on a 0-10 cm scale were less than four in most (22/26) children. Nine children in the rectal group received additional midazolam versus only three in the intravenous group, suggesting that rectally administered acetaminophen provided less effective analgesia than when administered intravenously. Another study assessed the pain management practices with extubated postoperative infants and children (6 months to 17 years) (Renfrow, 2009) by means of a retrospective chart review including 100 children who had undergone 32 different surgical procedures. The most commonly administered analgesics were acetaminophen (52%) and acetaminophen with codeine (28%). Pain intensity based on either the FLACC scale (55% of cases) or the Wong Baker Faces Pain Scale (44% of the cases), both of which are scored on a 0 to 10 point scale, was low (less than 4) for the first 48 hours in 97% of the cases (Renfrow, 2009). The Wong Baker scale includes a series of faces ranging from a happy face “0” to a

crying face “10”. These three studies indicate that acetaminophen is useful for some types of pain in the PICU and intravenous acetaminophen may be even more effective than rectal or oral.

Bupivacaine and Lidocaine

Utilization of regional anesthetic (bupivacaine) was reported in two studies. The first one was a retrospective study including children aged 10 to 18 years post spinal surgery. The audit included 129 children who received bupivacaine and 115 children who did not (Ross et al., 2011). Bupivacaine was infused via a catheter in the paraspinal muscle placed during surgery. Using one of 3 10-point scales (VAS, FLACC, or the Wong-Baker Faces Scale) for pain assessment, there was no difference in pain scores between the children who received bupivacaine and those who did not (mean pain intensity scores were less than 3). However, children who received bupivacaine were less likely to require morphine infusions (32.6% versus 85.2%, $p < 0.001$). The second study, an RCT conducted in Croatia, compared epidural infusion (with bupivacaine plus fentanyl) and PCA (with fentanyl) in patients aged between 8 to 19 years post thoracoscopic surgery (Butkovic et al., 2007). Based on a 10 point VAS, there were no significant differences in pain scores between the groups. In a study conducted in 38 Canadian and American PICUs, the use of local anesthetic (lidocaine) during invasive procedures (e.g., central line insertion) was reported as one of the most commonly used pharmacological analgesics during invasive procedures (Bauchner et al., 1992).

Psychological Interventions

The use of psychological interventions in the PICU for pain management was reported in only four studies, all conducted in North America (Bauchner et al., 1992; Coffman et al., 1997; Kline et al., 2010; Sharek et al., 2006). All four were non-experimental studies. Guided imagery was reported in three studies. Firstly, the effectiveness of teaching guided imagery compared to

detailed inquiry were evaluated in 44 children ranging in ages from 10 to 17 years, following non-intentional injuries e.g., closed head injury as a result of motor vehicle accident (Kline et al., 2010). Guided imagery (24 children) involved encouraging the children to have pleasant images, while detailed inquiry (20 children) was a practice inquiring about the children's pain-related experiences, allowing the child to express his/her feelings, and providing information on pain management by interventionists who were trained and supervised by the primary investigator (Kline et al., 2010). Using the Wong-Baker Faces Pain Scale (0-10) for young children (aged 3 to 7 years) and a 0 to 10 Likert pain rating scale for older children (8 years and older), pain ratings were lower in the guided imagery group compared to the detailed inquiry. The difference was largest for boys (for boys, the mean score decreased from 5.46 to 3.26 and for girls from 5.22 to 4.55). The second study from the USA (Sharek et al., 2006) was an historical case-control study to determine the impact of implementing a combination of psychological, physical, and pharmacological interventions (such as positioning, guided imagery, hypnosis, and parental education) on pain control post liver transplantation. Comparisons were made between two groups: The group of children who received the combination of interventions (n = 14, mean age = 5.3 years) and a control group who underwent liver transplantation before introduction of the intervention when only pharmacological pain interventions were provided (n = 13, mean age = 4.4 years). Using the FLACC, Wong Baker Faces, or 0–10 numerical pain rating scales, average pain scores were significantly lower in the children who received the combination of interventions (2.12 versus 2.84) ($p \leq 0.05$) compared to the control group. In addition, parental perception of their children's pain, using a 5-point Likert scale from one (lowest level of pain) to five (highest level of pain), were significantly lower for the children who received the intervention (2.1 versus 3.1) ($p \leq 0.05$). The third study from Canada and the USA (Bauchner et

al., 1992) designed to capture the frequency of use of psychological pain interventions found that only 16 of 38 PICUs (42%) used psychological interventions to control pain during invasive procedures (e.g., guided imagery). Other psychological interventions reported were hypnosis, detailed inquiry, parent's presence and distraction (Bauchner et al., 1992; Coffman et al., 1997; Kline et al., 2010). These four studies highlight that psychological interventions were not widely used in the PICU, and studies of their use were only published in North America.

Physical Interventions

Physical interventions to reduce pain in the PICU were reported in only four studies (Bauchner et al., 1992; Coffman et al., 1997; Sharek et al., 2006; Wu et al., 2009), three of which also included psychological interventions, and previously discussed (Bauchner et al., 1992; Coffman et al., 1997; Sharek et al., 2006). Three were observational studies (Bauchner et al., 1992; Coffman et al., 1997; Sharek et al., 2006) and the fourth was a nonrandomized clinical trial (Wu et al., 2009). The four studies were conducted in North America. The studies reported on acupuncture were two studies (Sharek et al., 2006; Wu et al., 2009). Two studies reported the use of positioning (Coffman et al., 1997; Sharek et al., 2006), stroking and soothing (one study) (Bauchner et al., 1992), distraction, touch, holding, and rocking (one study) (Coffman et al., 1997). One nonrandomized clinical trial from USA examined acupuncture for acute postoperative pain management on 20 children, aged 7 months to 18 years (Wu et al., 2009). Eleven patients had posterior spinal fusion surgery and nine patients had other surgeries. Using a self-report 0 to 10-point numeric pain scale (Brislin and Rose, 2005) or the FLACC scale (if self-report could not be obtained), mean pain scores were significantly reduced after four hours of the first acupuncture session ($p \leq 0.05$) in both surgical type groups. The mean pain score reduced from 3.7 to 1.7 in the posterior spinal fusion surgery patients and from 2.5 to 0.3 in the general

surgical patients. A second observational study conducted across Canada and the USA found that 16 of 38 PICUs (42%) reported using physical interventions, such as stroking or soothing, to reduce pain during invasive procedures (e.g., chest tube insertion, bone marrow aspiration, central line insertion, arterial line insertion, and paracentesis) (Bauchner et al., 1992). Another observational study conducted in the USA on children post liver transplantation showed that implementing a combination of pharmacological as well as physical (e.g., positioning, swaddling, and acupuncture) and psychological (e.g. guided imagery) interventions lowered mean pain scores to 2.12 compared to 2.84 of the control group who received only the pharmacological intervention ($p \leq 0.05$) (Sharek et al., 2006). Although these results are from only three studies conducted in North America, the combination of the physical, psychological, and pharmacological interventions resulted in improved pain control than pharmacological strategies alone.

Others (Environmental Modification and Music Therapy)

Music therapy and environmental modifications were reported in only two observational studies (Coffman et al., 1997; Renfrow, 2009). A study from the USA reviewed 100 charts of extubated infants and children (6 months to 17 years) following surgery (Renfrow, 2009). Methods reported were environmental, such as a quiet environment (27%), dim lights (12%), limiting visitors (9%), and music (9%) (Renfrow, 2009). These studies just reported the use of these interventions not the effectiveness.

DISCUSSION

This scoping review included 27 studies published over a period of three decades, most of which focused on pharmacological interventions for post-operative pain management in the PICU. This review showed that morphine and fentanyl were the most commonly used

pharmacological agents for pain management in the PICU. That is not surprising since the majority of children in the PICU experience moderate to severe pain as a result of different pain sources, requiring opioid analgesics. Pain can be a result of the underlying illness, surgery, trauma, injury, invasive procedures, or supportive respiratory and monitoring systems (Ismail, 2016; Stevens et al., 2011). Morphine and fentanyl are the most studied opioids in terms of efficacy, dose, methods of administration, and adverse effects. The WHO recommends administration of opioid analgesics for moderate to severe pain in children (WHO, 2012). Playfor and colleagues (2006) recommend either morphine or fentanyl by continuous intravenous infusion for severe pain. Other agents (e.g., tramadol and remifentanyl) have been used and studied less frequently than morphine and fentanyl. Nevertheless, there is a paucity of clinical trials that illustrate the efficacy of opioids in PICU patients.

In this review, morphine was used for pain management for a wide range of patients in terms of age and illnesses requiring surgery, invasive procedures, and patients requiring mechanical ventilation. Morphine was reported to be administered by different routes and methods, both continuous and intermittent. This scoping review indicates that there are other pharmacological agents that have been used in children in the PICU and although some may be comparable in terms of pain reduction in comparison to morphine, the paucity of clinical trials makes it difficult to know if the results are due to an inherent bias in the study design. For example, ketorolac and tramadol were shown to have a comparable analgesic efficacy as morphine in the relief of moderate to severe postoperative pain in critically ill children (Chu et al., 2006; Lieh-Lai et al., 1999). However, there is insufficient evidence on the safety and effectiveness of these agents, compared to other analgesics in the PICU and most of the studies are limited by small sample sizes and heterogeneity of the patient population. Only two trials on

the use of tramadol in the PICU, one in 1997 and one in 2006 (Chu et al., 2006; Maldini et al., 1997) and one trial on the use of ketorolac in 1999, were identified (Lieh-Lai et al., 1999). More research on these agents is needed especially on their safety and effectiveness for management of severe pain for children in the PICU.

This review shows that fentanyl has also been widely used in the PICU for management of post-operative pain, during invasive procedures, and for mechanically ventilated patients. Findings from studies suggest that other pharmacological agents may be comparable in its analgesic effects compared to fentanyl such as morphine, remifentanyl, and dexmedetomidine, albeit the studies are small and not all are RCTs. Remifentanyl was used in only two studies for short term analgesia post orthopedic spinal surgery in children requiring mechanical ventilation (Akinci et al., 2005) and as a second choice after fentanyl to combine with sedatives (Benini et al., 2010). Prolonged administration of remifentanyl may increase the risk of development of tolerance (Playfor et al., 2006). Dexmedetomidine has been used as primary or adjunct agent post cardiac surgery (Chrysostomou et al., 2009, 2006; Horvath et al., 2015; Naguib et al., 2012), however withdrawal symptoms from dexmedetomidine can occur after a short period of administration (Carney et al., 2013; Zalieckas and Weldon, 2015). Dexmedetomidine has been shown to increase the risk of bradycardia and hypotension (Chrysostomou et al., 2006; Horvath et al., 2015), highlighting safety concerns for use of this medication. These agents are still less known, and may have significant adverse effects, including tolerance and withdrawal, that have not been sufficiently studied. More research is needed especially on safety, side effects, and withdrawal with dexmedetomidine and remifentanyl in the PICU.

Based on this review, both morphine and fentanyl were the most widely used analgesics for pain management in different conditions, and they were reported to be effective in terms of

pain reduction in the PICU. There was no study included in this review that compared equivalent doses of morphine and fentanyl using the same route of administration (e.g., intravenous). More research is needed to compare morphine to fentanyl for pain reduction in terms of efficacy, effectiveness, and adverse effects including withdrawal symptoms, using the same route of administration and considering morphine equivalent dose.

Acetaminophen was shown to reduce pain in the PICU after craniofacial surgery in non-ventilated infants and children less than two years old (Van Der Marel et al., 2001; Prins et al., 2008). Intravenous administration was more effective than oral or rectal administration to reduce pain (Van Der Marel et al., 2001; Prins et al., 2008). The WHO recommends paracetamol (acetaminophen) for children experiencing mild pain and to use it concurrently if possible with opioids (WHO, 2012). Playfor and colleagues recommend acetaminophen as an adjunct to opioids for first line treatment in some cases (Playfor et al., 2006) which may reduce the opioid analgesic requirement. Further research on the comparable and additive analgesic benefits of acetaminophen for moderate to severe pain control in the PICU, especially when compared to systemic opioids alone is warranted. Moreover, we did not find any studies that examine adjunct therapy in terms of opioid sparing approaches to pain management in the PICU.

This review highlighted the role of regional and local anesthetic use in the PICU. The number of studies examining the use of epidural and regional blocks is limited in this setting. Lumbar epidural infusion of morphine was more effective for pain relief after cardiac surgery than intravenous fentanyl infusions (Shayevitz et al., 1996) and bupivacaine (regional anesthetic) effectively reduced pain post spinal and thoracoscopic surgery (Butkovic et al., 2007; Ross et al., 2011). In addition, lidocaine is one of the most commonly used pharmacological analgesics in the PICU for invasive procedures (e.g., central line placement and chest tube insertion)

(Bauchner et al., 1992). However, there were no studies included in this review of regional anesthesia, such as peripheral nerve blocks. Given that patients in the PICU are exposed daily to a large number of painful procedures (Stevens et al., 2011), there is a need to further study pharmacological approaches to managing procedural pain in this setting.

Implementing non-pharmacological (physical, psychological, and others) strategies as appropriate to reduce pain and discomfort for children in the PICU, such as noise reduction, massage, distraction and guided imagery, music, positioning, application of heat, presence of parents and relatives at the bedside, hypnosis and normalization of sleep pattern, are recommended (Keogh et al., 2015; Kline et al., 2010; Playfor et al., 2006; Sharek et al., 2006; Thomas et al., 2010). The majority of non-pharmacological interventions are within the scope of nurses' practice and leverage readily modifiable variables that contribute to increased pain (Ismail, 2016; Thomas et al., 2010). However, this scoping review showed that there was very few efficacy, effectiveness or observational studies of non-pharmacological interventions, highlighting the need for more research on the use of non-pharmacological interventions in the PICU.

This scoping review rigorously and transparently mapped the primary quantitative research regarding the pain management interventions used or examined in the PICU. We identified many gaps in the literature, and summarised research findings. However, there are a number of limitations, including the fact that all the articles identified from the literature search are published in English. It is not known if a broader search may have identified studies published in other languages. Secondly, this study focused on quantitative designs, which could lead to missing qualitative studies on pain treatment interventions in the PICU. Although, qualitative studies are not designed to evaluate or compare the effectiveness of interventions,

they can provide insights into the design of interventions, as well as barriers, facilitators, and preferences of treatments. Findings of this study may therefore not be generalizable beyond the quantitative and English studies.

This scoping review identified pain management interventions used in the PICU, the results of which can be used to support HCPs in the PICU in terms of using the research findings for pain management. Future research on non-pharmacological pain interventions is warranted as there is little known in this area and these interventions may not have the same degree of associated risk as pharmacological approaches in PICU patients with complex conditions. Future research should identify and control the effect of potential confounders that may affect the pain assessment accuracy when using pain management interventions. For example, sedatives administration (e.g., midazolam), can compromise the capture of observable pain behavior. The most common pain scales e.g., the FLACC and COMFORT behavior scales depend on the observable indicators of pain which may be affected by sedatives administration. This can lead to underestimation of the pain intensity scores, leaving children with unnecessary pain.

This scoping review identified a number of specific questions which warrant systematic reviews to build a high quality evidence to use for pain management in the PICU. Examples of potential systemic reviews are: 1) the effectiveness of non-pharmacological pain interventions in reducing pain, and 2) the comparative effectiveness of different pharmacological interventions, such as morphine, fentanyl, dexmedetomidine, remifentanyl, ketorolac, and intravenous acetaminophen.

In conclusion, pharmacological pain management interventions are the most commonly studied and used in the PICU. Morphine and fentanyl are the most commonly used and studied pharmacological agents. Other agents used and studied included dexmedetomidine, remifentanyl,

acetaminophen, and tramadol. However, safety and paucity of literature are the main limitations to using these agents. Non-pharmacological interventions are not widely studied or used in the PICU, and they were mainly studied in North America. Although combinations of different interventions may lead to better pain control in the PICU, there were too few studies identified to confirm this finding. As the majority of the studies included in this review were non clinical trials, further high quality rigorous research is warranted to determine the usefulness and effectiveness of interventions for pain management in the PICU.

ACKNOWLEDGEMENTS

We acknowledge: (1) Allen Finley, Centre for Pediatric Pain Research, IWK Health Centre; (2) Sharon Kinney, The Royal Children's Hospital Melbourne, Australia; (3) Colleen Fitzgibbons, Children's Hospital of Eastern Ontario Research Institute Inc.; and (4) Mahmoud Alshalabi, King Fahad Medical City, Riyadh, Saudi Arabia.

References

- Agarwal, S., Classen, D., Larsen, G., Tofil, N.M., Hayes, L.W., Sullivan, J.E., Storgion, S.A., Coopes, B.J., Craig, V., Jaderlund, C., Bisarya, H., Parast, L., Sharek, P., 2010. Prevalence of adverse events in pediatric intensive care units in the United States. *Pediatr. Crit. Care Med.* 11, 568–78. <https://doi.org/10.1097/PCC.0b013e3181d8e405>
- Akinci, S.B., Kanbak, M., Guler, A., Aypar, U., 2005. Remifentanyl versus fentanyl for short-term analgesia-based sedation in mechanically ventilated postoperative children. *Paediatr. Anaesth.* 15, 870–878. <https://doi.org/10.1111/j.1460-9592.2005.01574.x>
- American Association of Critical-Care Nurses, 2014. Assessing Pain in the Critically Ill Adult [WWW Document]. URL <https://www.aacn.org/clinical-resources/practice-alerts/assessing-pain-in-the-critically-ill-adult> (accessed 3.2.17).
- Amigoni, A., Catalano, I., Vettore, E., Brugnaro, L., Pettenazzo, A., 2012. Practice of analgesia and sedation in Italian pediatric intensive care units: Did we progress? *Minerva Anestesiol.* 78, 1365–1371.
- Arksey, H., O'Malley, L., 2005. Scoping studies: towards a methodological framework. *Int. J. Soc. Res. Methodol.* 8, 19–32. <https://doi.org/10.1080/1364557032000119616>
- Bauchner, H., May, A., Coates, E., 1992. Use of analgesic agents for invasive medical procedures in pediatric and neonatal intensive care units. *J. Pediatr.* 121, 647–649. [https://doi.org/10.1016/S0022-3476\(05\)81164-3](https://doi.org/10.1016/S0022-3476(05)81164-3)
- Benini, F., Farina, M., Capretta, A., Messeri, A., Cogo, P., 2010. Sedoanalgesia in paediatric intensive care: A survey of 19 Italian units. *Acta Paediatr. Int. J. Paediatr.* 99, 758–762. <https://doi.org/10.1111/j.1651-2227.2010.01705.x>
- Beyer, J.E., Denyes, M.J., Villarruel, A.M., 1992. The creation, validation, and continuing

- development of the Oucher: a measure of pain intensity in children. *J. Pediatr. Nurs.* 7, 335–46. [https://doi.org/0882-5963\(92\)90042-6](https://doi.org/0882-5963(92)90042-6) [pii]
- Brislin, R.P., Rose, J.B., 2005. Pediatric acute pain management. *Anesthesiol. Clin. North America*. <https://doi.org/10.1016/j.atc.2005.07.002>
- Butkovic, D., Kralik, S., Matolic, M., Kralik, M., Toljan, S., Radesic, L., 2007. Postoperative analgesia with intravenous fentanyl PCA vs epidural block after thoracoscopic pectus excavatum repair in children. *Br. J. Anaesth.* 98, 677–681. <https://doi.org/10.1093/bja/aem055>
- Carney, L., Kendrick, J., Carr, R., 2013. Safety and effectiveness of dexmedetomidine in the pediatric intensive care unit (SAD-PICU). *Can. J. Hosp. Pharm.* 66, 21–27.
- Chrysostomou, C., Di Filippo, S., Manrique, A.-M., Schmitt, C.G., Orr, R. a, Casta, A., Suchoza, E., Janosky, J., Davis, P.J., Munoz, R., 2006. Use of dexmedetomidine in children after cardiac and thoracic surgery. *Pediatr. Crit. Care Med.* 7, 126–131. <https://doi.org/10.1097/01.PCC.0000200967.76996.07>
- Chrysostomou, C., Sanchez De Toledo, J., Avolio, T., Motoa, M. V, Berry, D., Morell, V.O., Orr, R., Munoz, R., 2009. Dexmedetomidine use in a pediatric cardiac intensive care unit: can we use it in infants after cardiac surgery? *Pediatr. Crit. Care Med.* 10, 654–660. <https://doi.org/10.1097/PCC.0b013e3181a00b7a>
- Chu, Y.C., Lin, S.M., Hsieh, Y.C., Chan, K.H., Tsou, M.Y., 2006. Intraoperative administration of tramadol for postoperative nurse-controlled analgesia resulted in earlier awakening and less sedation than morphine in children after cardiac surgery. *Anesth. Analg.* 102, 1668–1673. <https://doi.org/10.1213/01.ANE.0000219587.02263.A0>
- Coffman, S., Alvarez, Y., Pyngolil, M., Petit, R., Hall, C., Smyth, M., 1997. Nursing assessment

and management of pain in critically ill children. *Heart Lung* 26, 221–8.

Covidence [WWW Document], 2017. . PICU pain Manag. Interv. URL

<https://www.covidence.org/reviews/9685> (accessed 11.2.17).

DeBerry, B.B., Lynch, J.E., Chernin, J.M., Zwischenberger, J.B., Chung, D.H., 2005. A survey for pain and sedation medications in pediatric patients during extracorporeal membrane oxygenation. *Perfusion* 20, 139–43. <https://doi.org/10.1191/0267659105pf801oa>

Gelinas, C., Fortier, M., Viens, C., Fillion, L., Puntillo, K., 2004. Pain assessment and management in critically ill intubated patients: a retrospective study. *Am. J. Crit. Care* 13, 126.

Grant, M.J., Scoppettuolo, L.A., Wypij, D., Curley, M.A., 2012. Prospective evaluation of sedation-related adverse events in pediatric patients ventilated for acute respiratory failure. *Crit Care Med* 40, 1317–1323. <https://doi.org/10.1097/CCM.0b013e31823c8ae3>

Horvath, R., Halbrooks, E.F., Overman, D.M., Friedrichsdorf, S.J., 2015. Efficacy and safety of postoperative dexmedetomidine administration in infants and children undergoing cardiac surgery: A Retrospective Cohort Study. *J. Pediatr. Infect. Dis.* 1, 138–145.

International Association for Study of Pain, 2015. Declaration of Montreal [WWW Document]. URL <http://www.iasp-pain.org/DeclarationofMontreal?navItemNumber=582> (accessed 9.27.16).

Ismail, A., 2016. The Challenges of providing effective pain management for children in the pediatric intensive care unit. *Pain Manag. Nurs.* 17, 372–383. <https://doi.org/10.1016/j.pmn.2016.08.005>

Keogh, S.J., Long, D. a, Horn, D. V, 2015. Practice guidelines for sedation and analgesia management of critically ill children: a pilot study evaluating guideline impact and

feasibility in the PICU. *BMJ Open* 5, e006428. <https://doi.org/10.1136/bmjopen-2014-006428>

Kline, W.H., Turnbull, A., Labruna, V.E., Haufler, L., Devivio, S., Ciminera, P., 2010.

Enhancing pain management in the PICU by teaching guided mental imagery: A quality-improvement project. *J. Pediatr. Psychol.* 35, 25–31. <https://doi.org/10.1093/jpepsy/jsp030>

LaFond, C.M., Van Hulle Vincent, C., Corte, C., Hershberger, P.E., Johnson, A., Park, C.G.,

Wilkie, D.J., 2014. PICU nurses' pain assessments and intervention choices for virtual human and written vignettes. *J. Pediatr. Nurs.* 30, 580–590.

<https://doi.org/10.1016/j.pedn.2015.01.022>

Larson, G.E., Arnup, S.J., Clifford, M., Evans, J., 2013. How does the introduction of a pain and

sedation management guideline in the paediatric intensive care impact on clinical practice?

A comparison of audits pre and post guideline introduction. *Aust. Crit. Care* 26, 118–123.

<https://doi.org/10.1016/j.aucc.2013.04.001>

Lieh-Lai, M.W., Kauffman, R.E., Uy, H.G., Danjin, M., Simpson, P.M., 1999. A randomized

comparison of ketorolac tromethamine and morphine for postoperative analgesia in

critically ill children. *Crit. Care Med.* 27, 2786–91. [https://doi.org/10.1097/00003246-](https://doi.org/10.1097/00003246-199912000-00030)

[199912000-00030](https://doi.org/10.1097/00003246-199912000-00030)

Lowe, N.K., Walker, S.N., MacCallum, R.C., 1991. Confirming the theoretical structure of the

McGill pain questionnaire in acute clinical pain. *Pain* 46, 53–60.

[https://doi.org/10.1016/0304-3959\(91\)90033-T](https://doi.org/10.1016/0304-3959(91)90033-T)

Maldini, B., Radesic, L., Javorovic, B., Fattorini, I., 1997. Postoperative analgesia with tramadol

in children recovering from major surgery. *Paediatr. Croat.* 41, 29–32.

McGrath, P., Johnson, G., Goodman, J., Dunn, J., Chapman, J., 1985. CHEOPS: a behavioral

- scale for rating postoperative pain in children., in: Fields, H., Dubner, R., Cervero, F. (Eds.), *Advances in Pain Research and Therapy*. Raven Press, New York, pp. 395–402.
- Merkel, S.I., Voepel-Lewis, T., Shayevitz, J.R., Malviya, S., 1997. The FLACC: a behavioral scale for scoring postoperative pain in young children. *Pediatr. Nurs.* 23, 293–297.
- Naguib, A.N., Dewhirst, E., Winch, P.D., Simsic, J., Galantowicz, M., Tobias, J.D., 2012. Pain management after surgery for single-ventricle palliation using the hybrid approach. *Pediatr. Cardiol.* 33, 1104–1108. <https://doi.org/10.1007/s00246-012-0233-8>
- Oakes, L., 2011. *Compact Clinical Guide to Infant and Child Pain Management*. Springer Publishing, New York.
- Payen, J.F., Bru, O., Bosson, J.L., Lagrasta, a, Novel, E., Deschaux, I., Lavagne, P., Jacquot, C., 2001. Assessing pain in critically ill sedated patients by using a behavioral pain scale. *Crit. Care Med.* 29, 2258–2263. <https://doi.org/10.1097/00003246-200112000-00004>
- Playfor, S., Jenkins, I., Boyles, C., Choonara, I., Davies, G., Haywood, T., Hinson, G., Mayer, A., Morton, N., Ralph, T., Wolf, A., 2006. Consensus guidelines on sedation and analgesia in critically ill children. *Intensive Care Med.* <https://doi.org/10.1007/s00134-006-0190-x>
- Prins, S.A., Van Dijk, M., Van Leeuwen, P., Searle, S., Anderson, B.J., Tibboel, D., Mathot, R.A.A., 2008. Pharmacokinetics and analgesic effects of intravenous propacetamol vs rectal paracetamol in children after major craniofacial surgery. *Paediatr. Anaesth.* 18, 582–592. <https://doi.org/10.1111/j.1460-9592.2008.02619.x>
- Registered Nurses Association of Ontario, 2013. Assessment and management of pain [WWW Document]. *Clin. best Pract. Guidel.* URL <http://rnao.ca/sites/rnao-ca/files/AssessAndManagementOfPain2014.pdf> (accessed 3.2.17).
- Reiter, P.D., Ng, J., Dobyys, E.L., 2012. Continuous hydromorphone for pain and sedation in

mechanically ventilated infants and children. *J. Opioid Manag.* 8, 99–104.

<https://doi.org/10.5055/jom.2012.0102>

Renfrow, T., 2009. Pediatric intensive care unit pain management in extubated postoperative infants and children. ProQuest Diss. Theses.

Rennick, J.E., Johnston, C.C., Dougherty, G., Platt, R., Ritchie, J.A., 2002. Children's psychological responses after critical illness and exposure to invasive technology. *J. Dev. Behav. Pediatr.* 23, 133–144. <https://doi.org/10.1097/00004703-200206000-00002>

Rennick, J.E., Morin, I., Kim, D., Johnston, C.C., Dougherty, G., Platt, R., 2004. Identifying children at high risk for psychological sequelae after pediatric intensive care unit hospitalization. *Pediatr. Crit. Care Med.* 5, 358–363.
<https://doi.org/10.1097/01.PCC.0000128603.20501.0D>

Ross, D., Ross, S., 1988. *Childhood Pain: Current Issues, Research, and Management.* Urban and Schwartzberg, Baltimore.

Ross, P. A, Smith, B.M., Tolo, V.T., Khemani, R.G., 2011. Continuous infusion of bupivacaine reduces postoperative morphine use in adolescent idiopathic scoliosis after posterior spine fusion. *Spine (Phila. Pa. 1976).* 36, 1478–83.
<https://doi.org/10.1097/BRS.0b013e3181f352d1>

Rycroft-Malone, J., 2004. The PARIHS framework--a framework for guiding the implementation of evidence-based practice. *J. Nurs. Care Qual.* 19, 297–304.
<https://doi.org/10.1097/00001786-200410000-00002>

Samuels, J.G., Fetzer, S.J., 2009. Evidence-based pain management: Analyzing the practice environment and clinical expertise. *Clin. Nurse Spec.* 23, 245–51.
<https://doi.org/10.1097/NUR.0b013e3181b20745>

- Schaffer, J., Piepenbrock, S., Kertz, J., Schonfield, C., 1986. Naibuphin und tramadol zur postoperativen schmerzbekämpfung bei kindern. *Anaesthesist* 35, 408–413.
- Sharek, P.J., Wayman, K., Lin, E., Strichartz, D., Sentivany-Collins, S., Good, J., Esquivel, C., Brown, M., Cox, K., 2006. Improved pain management in pediatric postoperative liver transplant patients using parental education and non-pharmacologic interventions. *Pediatr. Transplant.* 10, 172–177. <https://doi.org/10.1111/j.1399-3046.2005.00438.x>
- Shayevitz, J.R., Merkel, S., O’Kelly, S.W., Reynolds, P.I., Gutstein, H.B., 1996. Lumbar epidural morphine infusions for children undergoing cardiac surgery. *J. Cardiothorac. Vasc. Anesth.* 10, 217–224. [https://doi.org/10.1016/S1053-0770\(96\)80241-2](https://doi.org/10.1016/S1053-0770(96)80241-2)
- Sheridan, R., Stoddard, F., Querzoli, E., 2001. Management of background pain and anxiety in critically burned children requiring protracted mechanical ventilation. *J. Burn Care Rehabil.* 22, 150–153 4p.
- Srouji, R., Ratnapalan, S., Schneeweiss, S., 2010. Pain in children: Assessment and nonpharmacological management. *Int. J. Pediatr.* 2010, 694–699. <https://doi.org/10.1155/2010/474838>
- Stevens, B., Abbott, L., Yamada, J., Harrison, D., Stinson, J., Taddio, a, Barwick, M., Latimer, M., Scott, S., Rashotte, J., Campbell, F., Finley, a, CIHR Team in Children’s Pain, 2011. Epidemiology and management of painful procedures in hospitalized children across Canada. *C. Can. Med. Assoc. J.* 183, E403–E410. <https://doi.org/10.1503/cmaj.101341>
- Thomas, M., Dhanani, S., Irwin, D., Writer, H., Doherty, D., 2010. Development, dissemination and implementation of a sedation and analgesic guideline in a pediatric intensive care unit...it takes creativity and collaboration. *Dynamics* 21, 16–25.
- Thorp, J., James, S., 2010. Pain Management in the Intensive Care Unit, in: Kopf, A., Patel, N.

- (Eds.), *Guide to Pain Management in Low-Resource Settings*. International Association for the Study of Pain, Seattle, pp. 283–291.
- Turner, H.N., 2005. Complex pain consultations in the pediatric intensive care unit. *AACN Clin. Issues* 16, 388–95.
- Van Der Marel, C.D., Van Lingen, R.A., Pluim, M.A.L., Scoones, G., Van Dijk, M., Vaandrager, J.M., Tibboel, D., 2001. Analgesic efficacy of rectal versus oral acetaminophen in children after major craniofacial surgery. *Clin. Pharmacol. Ther.* 70, 82–90.
<https://doi.org/10.1067/mcp.2001.116794>
- Van Dijk, M., Bouwmeester, N.J., Duivenvoorden, H.J., Koot, H.M., Tibboel, D., Passchier, J., De Boer, J.B., 2002. Efficacy of continuous versus intermittent morphine administration after major surgery in 0-3-year-old infants; a double-blind randomized controlled trial. *Pain* 98, 305–313. [https://doi.org/10.1016/S0304-3959\(02\)00031-3](https://doi.org/10.1016/S0304-3959(02)00031-3)
- Voepel-Lewis, T., Zanutti, J., Dammeyer, J.A., Merkel, S., 2010. Reliability and validity of the face, legs, activity, cry, consolability behavioral tool in assessing acute pain in critically ill patients. *Am. J. Crit. Care* 19, 55–61. <https://doi.org/10.4037/ajcc2010624>
- Voscopoulos, C., Lema, M., 2010. When does acute pain become chronic? *Br. J. Anaesth.* 105, i69–i85. <https://doi.org/10.1093/bja/aeq323>
- Weldon, B.C., Connor, M., White, P.F., 1993. Pediatric PCA: the role of concurrent opioid infusions and nurse-controlled analgesia. *Clin. J. Pain* 9, 26–33.
- Wong, D., Hockenberry-Eaton, M., Wilson, D., Winkelstein, M., Ahmann, E., DiVito-Thomas, P., 1999. *Whaley and Wong's Nursing Care of Infants and Children*. Mosby, St. Louis.
- World Health Organization, 2012. WHO guidelines on the pharmacological treatment of persisting pain in children with medical illnesses [WWW Document]. URL

http://apps.who.int/iris/bitstream/10665/44540/1/9789241548120_Guidelines.pdf (accessed 9.21.16).

Wu, S., Sapru, A., Stewart, M.A., Milet, M.J., Hudes, M., Livermore, L.F., Flori, H.R., 2009.

Using acupuncture for acute pain in hospitalized children. *Pediatr. Crit. Care Med.* 10, 291–6. <https://doi.org/10.1097/PCC.0b013e318198afd6>

Zalieckas, J., Weldon, C., 2015. Sedation and analgesia in the ICU. *Semin. Pediatr. Surg.* 24, 37–

46. <https://doi.org/10.1053/j.sempedsurg.2014.11.011>

Chapter Three

Pain Management Practice and Guidelines in Jordanian Pediatric Intensive Care Units

This chapter is based upon a published manuscript in *Pain Management Nursing*, and it was written based on the journal's format.

Ismail, A., Forgeron, P., Polomeno, V., Gharaibeh, H., & Harrison, D. (2018). Pain management practice and guidelines in Jordanian Pediatric Intensive Care Units. *Pain Management Nursing : Official Journal of the American Society of Pain Management Nurses*, 19 (2), 195–203.e4.

Appendix D. Elsevier Guidelines for Using Published Articles in Dissertation for Non-Commercial Purposes

Abstract

Limited knowledge exists of current pain management practices and supporting guidelines in Jordanian pediatric intensive care units. To determine the current pain management practices and the availability and content of practice guidelines in Jordanian pediatric intensive care units, we conducted a cross-sectional and multisite survey of four pediatric intensive care units in Jordan. A questionnaire was developed and orally administered over the phone or in person to head nurses or their nominees to capture pain management practices and the existence and content of guidelines. All units had written pain management guidelines that included pain assessment, documentation, and management. All four units used one or more pain assessment tools. In three units, pain management was considered multidisciplinary and routinely discussed on unit rounds. In two units, continuous infusion of intravenous opioids was used as well as sedatives and neuromuscular blockers for most ventilated patients. In the two other units, continuous intravenous infusion of opioids was not used and only sedatives were administered for patients on mechanical ventilation. In two units, there were no specific guidelines on the use of non-opioid analgesics, patient-controlled anesthesia, or the management of postoperative pain. No unit used an opioid or sedative withdrawal assessment tool or had pain management guidelines on the use of topical anesthetic agents or sucrose. Pain management practices and guidelines varied across the four units, suggesting that there is an opportunity for improvement in pain management in pediatric intensive care units in Jordan.

BACKGROUND

In most parts of the world, pain in children is considered a public health concern (WHO, 2012). In 2010, the Declaration of Montreal stated that people, including children, have the right to access appropriate assessment and treatment of pain by adequately trained HCPs (International Association for Study of Pain [IASP], 2015). However, five billion people have no or insufficient access to treatment for moderate to severe pain (IASP, 2015). Pain, including children's pain in pediatric intensive care units (PICUs), should be considered a high priority issue requiring vigilance on the part of professional organizations and HCPs to ensure that optimal pain management is delivered to all patients (Registered Nurses Association of Ontario [RNAO], 2013).

The IASP (2015) has reported that pain management is sub-optimal in most parts of the world. Access to treatment for acute pain caused by trauma, disease, and terminal illness is inadequate (IASP, 2015). The availability of analgesics, particularly opioid analgesics, may be restricted, especially in low to middle income countries. In many countries, HCPs receive little education and training about pain, and their knowledge about the mechanisms and management of pain is limited. Pain management in the PICU is no exception to these concerns as addressed by the IASP.

In PICU, pain management can provide unique challenges. Patients in the PICU are not only critically ill with complex conditions (Gélinas, Fortier, Viens, Fillion & Puntillo, 2004; Johansson & Kokinsky, 2009; Oakes, 2011; Turner, 2005), they are children, which makes pain management more challenging than in adults due to differences in cognitive, psychosocial, and physical development (Srouji, Rantapalan & Schneeweiss, 2010). Self-report of pain which is widely considered the gold standard for pain assessment and management (American

Association of Critical-Care Nurses [AACN], 2014) is compromised by the administration of sedative agents, neuromuscular blocking agents, mechanical ventilation, and often, altered and changing levels of consciousness (Gélinas et al., 2004; Johansson & Kokinsky, 2009; Oakes, 2011; Turner, 2005). However, regardless of all of these challenges, provision of appropriate and adequate analgesia is essential for all critically ill children (Playfor et al., 2006).

Untreated or poorly managed pain can negatively affect critically ill children, physiologically and psychologically (Oakes, 2011; Rennick et al., 2004; Turner, 2005). Post-operative pain can lead to pulmonary complications due to reduced chest and abdominal wall movement, leading to delays in weaning from mechanical ventilation (Thorp & James, 2010). Sympathetic nervous system responses can be increased, resulting in an increased cardiac effort and oxygen consumption, elevation of stress hormones, immunosuppression, and delays in wound healing (Thorp & James, 2010). These consequences can delay discharge from the PICU. Pain can also result in negative psychological outcomes after discharge from the PICU. Exposure to high numbers of invasive procedures was reported as the most important predictor of negative psychological outcomes following discharge from the PICU (Rennick et al., 2004). Pediatric patients in intensive care units are exposed to large numbers of painful procedures (an average of 13 procedures/day), (Stevens et al., 2011), highlighting the need to ensure effective pain management during these multiple procedures.

The use of pain management research evidence is essential in the provision of effective pain management (Samuels & Fetzer, 2009). Yet, in critical care settings, such as the PICU, there is a wide gap between pain management evidence and practice (Samuels & Fetzer, 2009). Clinical practice guidelines (CPGs), based on best available research evidence and practice experience, are helpful tools for closing the gap between evidence and practice (Woolf, Grol,

Hutchinson, Eccles, & Grimshaw, 1999). CPGs can be defined as “recommendations for clinicians about the care of patients with specific conditions” (Shekelle, 2016, para. 1). CPGs can support more consistent and efficient care practices (Graham & Harrison, 2005; Woolf et al., 1999). Policies provide clinicians with actions that must be taken in a particular situation (University of Wisconsin, 2017). Although both policies and CPGs are considered supporting resources that provide clinicians with practice guidelines that can be followed, policies are considered mandatory to follow.

Although CPGs are a strategy to improve pain care, there is a need to establish a baseline understanding if this is one of the barriers to improved pain management in a given context, as well as determine current practices and availability and content of CPGs that are in use. While there are several studies that have been conducted relating to pain management in Jordanian hospitals (Abdalahim, Majali, Stomberg & Bergbom 2011; Al Qadire & Al Khalailah, 2014; Ayasrah, O'Neill, Abdalahim, Sutary, & Kharabsheh, 2014) including pediatric pain management (Batiha, 2014; Finley, Forgeron & Arnaout, 2008; Forgeron, Finley & Arnaout, 2005), no previous research to our knowledge has assessed pain management practices and availability and content of CPGs guiding pain management in Jordanian PICUs. Nevertheless, Jordanian nurses have identified that policies and guidelines are necessary to improve pediatric pain management (Finley et al., 2008). Therefore, the aim of this study is to assess pain management practices as well as the existence and content of pain management guidelines currently being used in Jordanian PICUs.

MATERIALS AND METHODS

Design

A quantitative, multisite, descriptive survey study was conducted to explore pain management practices and the use and content of CPGs in Jordanian PICUs.

Ethics

There are six hospitals in Jordan that have dedicated PICUs. Ethics approval was obtained from the principle investigator's affiliated University and from four hospitals. Two hospitals did not respond to the ethics application.

Setting and Participants

Six hospitals with PICUs in Jordan were eligible to participate in the study. Two of these hospitals were pediatric, one was specialized for cancer including adults and pediatrics, and the other three were general (for any case and any age). All of the six hospitals were invited to participate in this study. Four hospitals participated and the other two did not respond to our invitation and ethics application.

The head registered nurse of PICUs in Jordan, or his/her nominee was invited to complete a phone questionnaire. The inclusion criteria were: (1) working in the PICU in Jordan, and (2) as the questionnaire was in English, be able to read, speak, and understand English.

Data Collection Instrument

A questionnaire was developed by the investigators for the purpose of this survey study (See Appendix E). The questionnaire included 50 items designed to capture: Demographic characteristics of the PICU (e.g. number of beds, number of staff nurses, number of physicians, and number of other healthcare workers involved in patient care), pain assessment and management practices (e.g. frequency of pain assessment, availability of pain-related clinical guidelines, pain assessment tools and/or sedation assessment tools used, use of opioids and/or sedatives) as well as questions on documentation of pain assessment and management. We

included items on sedatives because of their role in management of pain and discomfort (Zaliecckas & Weldon, 2015). We asked an open ended question at the end of the survey requesting any additional comments regarding pain management or about the influence of other factors on pain management not otherwise addressed in the survey.

The questionnaire was reviewed by a panel of nine experts in the fields of research, pain, and child health and included three nursing professors working at the PI's university, a nursing professor at a university in Jordan, a pediatric anesthesiologist working at a Canadian hospital, a nurse research consultant working at a children's hospital in Australia, a clinical nurse specialist working at a Canadian PICU, a PICU head nurse and PICU charge nurse working at a hospital in Saudi Arabia. Following experts' review, the questionnaire was modified to improve clarity and reduce redundant items and reviewed by the panel again which resulted in no further modifications.

Data Collection Procedure

Telephone survey methods have been identified as appropriate to facilitate access in a geographically dispersed sample (Boland, Sweeney, Scallan, Harrington & Staines, 2006). In addition, the telephone survey provides some degree of personal interaction between the investigator and the participants (Szolnoki & Hoffmann, 2013) and the response rate is higher using the telephone to capture data than Web based surveys (Fricker, Galesic, Tourangeau & Yan, 2005; Szolnoki & Hoffmann, 2013). After obtaining ethics approval, the principal investigator (PI) contacted the PICUs in Jordan by telephone, and asked to speak to the head nurse or his/her nursing nominee. The study and its significance were explained, along with the time commitment for the telephone survey which was between 20 to 25 minutes, and then the head nurse determined who had the best knowledge to complete the questionnaire. A suitable

appointment time was made with the participant who would be answering the survey. A copy of the questionnaire was emailed to the participants one week prior to the scheduled telephone survey date. Data collection occurred in August and September 2015.

Statistical Analysis

The purpose of the study was to understand the existence of current CPGs that support nursing practice in Jordanian PICUs thus the data were analyzed using descriptive statistics to summarize the categorical, nominal, and continuous data points. The data were analyzed using the Statistical Package for Social Sciences (SPSS) version 23. Examples of categorical and nominal variables included: type of hospital, having a pain assessment policy, having a pain documentation policy, and having a pain management policy. Examples of continuous variables included: number of beds, number of staff nurses, and number of physicians. Responses to the open ended survey question were described and summarized.

RESULTS

Four of six hospitals in Jordan with PICUs (two governmental, one university, and one none-profit hospital) gave consent to participate in this study. Hospitals in Jordan can be categorized by the ownership into five types: Ministry of Health (governmental), Royal Medical Services (military services), private, non-profit non-governmental, and university hospitals. Ministry of health hospitals are owned and supported by the Jordanian Ministry of Health, Royal Medical Services hospitals by the Jordanian Armed Forces, private hospitals by the private sector, non-profit non-governmental hospitals by the community and governed by a board of trustees, and university hospitals by the universities. Jordan Ministry of Health is responsible for supervising health services offered by all sectors (Jordan Ministry of Health, 2013). In one of the participating sites, a face to face interview was requested instead of a phone interview which was

granted. As nominated by the head nurses, a charge nurse from each unit completed the survey. Demographic characteristics of the participating PICUs are summarized in Table 3.1. The mean number of beds per unit was eight; on average 27 registered nurses worked in each of the units, with five registered nurses on duty per shift, including a charge nurse. The mean number of charge nurses (all of whom were registered nurses) was four, with one charge nurse working per shift. The average number of practical nurses was two, and each unit had one registered nurse educator. All the units had several physicians with the average being six in each PICU (Table 3.1).

Table 3.1. Demographic Characteristics of the Participating PICUs

Characteristics	Freq.	Mean (SD)
Type of Hospital:		
Government	2	
University	1	
Non-Profit	1	
Number of Beds		8 (1.9)
Number Charge Nurses		4 (2.6)
Number of Charge Nurses /Shift		1 (0)
Number of Registered Nurses		27 (15)
Number of Registered Nurses /Shift		5 (1)
Number of Practical Nurses		2 (1.7)
Number of Nurses in Education		1 (1)
Number of Physicians		6 (3.3)

Pain management practices and guidelines/policies in Jordanian PICUs varied between the four hospitals (Table 3.2). All four participating PICUs had documented pain management guidelines/policies to guide routine pain assessment, documentation and pain management. All four units used one or more pain assessment tools; for example, all four units used the Face, Legs, Activity, Cry, and Consolability Scale (FLACC). Three units considered pain management multi-disciplinary, routinely discussed pain assessment and management on unit rounds. These three units relied on a direct communication process for nurses to report their pain assessment

and concerns to the medical staff (by phone or face to face at the time of their assessment or concern). Two units (A and D) had specific guidelines/policies on pain management for post-operative patients and for analgesic agents. Two units (B and C) did not use continuous intravenous (IV) infusions for opioids and only used sedatives for patients on mechanical ventilation. One PICU (A) had more pain management guidelines/policies to support care than the other three. This PICU used a sedation level assessment tool, specific evidenced based pain assessment tools and had the following pain management guidelines/policies: intravenous opioids administration, opioid antagonists, intravenous sedatives, sedative antagonists, epidural analgesia, and procedural pain management. No unit used an opioid or sedative withdrawal assessment tool. None of the four units had pain management guidelines/policies on the use of topical anesthetic agents or sucrose.

Table 3.2. Pain Management Practice and Policies/Guidelines in Jordanian PICUs

Item/Unit	A	B	C	D
Pain Assessment Guideline/Policy	√	√	√	√
Routine Assessment of Pain	√	√	√	√
Frequency of Routine Pain Assessment/hour	2-3	24	2	12
Common Assessment Tools				
FLACC	√	√	√	√
NPRS	√	√		√
COMFORT	√			
Faces Pain Scale (Wong Baker)	√		√	
VAS	√		√	
CRIES			√	
NIPS				√
Pain Documentation Guideline/Policy	√	√	√	√
Routine Documentation of Pain Assessment	√	√	√	√
Pain Management Guideline/Policy	√	√	√	√
Considering Pain Management as Multidisciplinary	√	√	√	
Participants in Pain Management				
Physicians	√	√	√	
Nurses	√	√	√	
Pharmacist			√	
Family		√		
Pain Management for Patients on Mechanical Ventilator Guideline/Policy		√		

Common Strategies for Management of Patients on Mechanical Ventilator				
Sedatives Only		√	√	
Opioids, Sedatives, and Neuromuscular blockers	√			√
Intravenous Opioids Guideline/Policy	√			
Common IV Opioids for Continuous Infusion (Fentanyl)	√			√
Common IV Opioids for Non-continuous Infusion				
Pethidine		√	√	√
Morphine	√			
Tramadol	√			
Opioids' Antagonists Guideline/Policy	√			
Intravenous Sedatives Guideline/Policy	√			
Common IV Sedatives for Continuous and Non-continuous Infusion (Midazolam)	√	√	√	√
Sedatives' Antagonists Guideline/Policy	√			
Sedation Assessment Tool (COMFORT)	√			
Opioids or Sedatives Withdrawal Assessment Tool				
Non Opioids Analgesics Guideline/Policy	√			√
Epidural Analgesia (or Other Types of Regional Anaesthesia) Guideline/Policy	√			
Topical Anaesthetic Agents Guideline/Policy				
Sucrose Guideline/Policy				
Non-pharmacological Strategies for Pain Management Guideline/Policy				√
Common Non- pharmacological Techniques				
Touch				√
Distraction				√
Pain Management during Common Procedures Guideline/Policy	√			
Pain Management for Post-Operative Patients Guideline/Policy	√			√
Common Pain Management Strategies for Post-op Patients (Opioids and Non-steroidal Anti- inflammatory Drugs)	√			√
PCA Guideline/Policy	√			
Pain Management Discussed on Unit Round	√	√	√	√
Pain Management Discussed on Nursing Hand Over	√	√	√	
Process to Inform Medical Staff about Child's Pain				
- Immediately and Directly by Phone or Face to Face	√	√	√	√
- Reporting to the CN Who Informs the Medical Staff		√		
Involving Family in Pain Management Guideline/Policy				

A = Hospital A

B = Hospital B

C = Hospital C

D = Hospital D

IV = Intravenous

FLACC = Face, Legs, Activity, Cry, Consolability Scale

NPRS = Numeric Pain Rating Scale

VAS = Visual Analog Scale

CRIS = Crying Requires Increased Vital Signs Expression Sleeplessness

NIPS = Neonatal Infant Pain Scale

Responses to the open ended question included: a belief that pain management depended on HCP's expertise rather than on policies or CPGs (two units); having no specific pain management nurse or team (one unit) made it more challenging to provide quality pain management to children; nurses had a key role in pain assessment in the PICU, and pharmacological treatment approaches depended on the physician's judgement (one unit).

DISCUSSION

This study has provided information on current pain management practices, and existence and content of pain management guidelines in over 65% of the PICUs in the country of Jordan. Pain management practices in Jordanian PICUs are supported by guidelines/policies. However, these practices guidelines/policies varied between the four participating hospitals. Availability of written pain management guidelines has the potential to reduce children's pain, provide consistent pain care, and bridge the gap between pain management evidence and practice. However, their potential benefits are conditional of their successful implementation (Woolf et al., 1999). Five factors have been reported to influence the implementation of CPGs (Francke, Smit, de Veer, & Mistiaen, 2008). The first factor is related to the complexity of the guidelines. Guidelines, easy to understand and able to be tried out, are more likely to be utilized. The implementation strategy to be used is the second factor, including staff education, integration with the delivery of health care, and evaluation of compliance with CPGs. The use of multiple strategies, and strategies that are closer to the user of the CPGs and more integrated into health care delivery process are more effective. The third factor is related to the HCPs' characteristics, such as awareness and familiarity with the CPGs. The process of developing evidence-based CPGs can be an intensive and time-consuming process, and the resulting CPG is still only a

document that can be utilized or ignored depending on staff practices. The fourth factor is the environmental or the contextual characteristics such as support from leaders and sufficient staff and time. The last factor is related to the patient characteristics. CPGs are less likely to be followed when patients have complex conditions with co-morbidities (Francke et al., 2008). Given the co-morbidity and complexity of conditions in the PICU, CPGs don't always provide an optimal solution to each patient in terms of pain management in the PICU. Research is needed to gain more understanding about the relationship between the existence of CPGs for pain management within the PICUs and actual pain care.

The variability in pain management practice in PICU, as reported in this study, is consistent with the variability reported internationally. For example, in a study of pain and sedation practices in PICUs in Italy, the majority of Italian PICUs (58%) followed written protocols for analgesia and sedation (Amigoni, Catalano, Vettore, Brugnaro, & Pettenazzo, 2012). As in this study, the most commonly used IV opioids for continuous infusion in Italian PICUs was fentanyl, and midazolam was commonly used for sedation (Amigoni et al., 2012). Pain and/or sedation scales were used to monitor analgesia and sedation in the majority of Italian PICUs (75%). For example, the COMFORT scale was used in nine units (38%), and the FLACC scale was used in two units. In this study, all four participating PICUs reported having a pain specific tool (FLACC scale), and one PICU used COMFORT Scale for sedation assessment. Majority of Italian PICUs (54%) monitored for withdrawal symptoms, whereas in this study, no units reported use of tools to monitor withdrawal symptoms, highlighting the need for amendment of the pain management guidelines in Jordanian PICU to include the monitoring of withdrawal symptoms.

Guidelines for pain management in PICUs exist internationally, but they are varied. These guidelines include recommendations for pain assessment and pain treatment. For pain assessment, the use of appropriate and valid pain scale is recommended, but there is no agreement on a specific scale (Keogh, Long, & Horn, 2015; Playfor et al., 2006; Thomas, Dhanani, Irwin, Writer, & Doherty, 2010). Playfor et al. (2006) recommended to assess pain regularly and to routinely document pain assessment. For children unable to communicate, they recommended assessing for the presence of behavioural and physiological indicators of pain. These authors support the use of behavioural observational scales for children under 3 years of age, self-reporting techniques such as faces scales (photographs or drawings) for children three to eight years, and uni-dimensional tools for children above eight, such as the numeric rating scale (NRS). In Canada, Thomas et al. (2010) recommended to use the Modified COMFORT Scale (Carnevale & Razack, 2002) to assess pain, and the SBS (Curley, Harris, Fraser, Johnson, & Arnold, 2006) to assess sedation for intubated and ventilated children. More recently in Australia, Keogh, Long and Horn (2015) recommended to use the Multidisciplinary Assessment of Pain Scale (MAPS) (Ramelet, Rees, McDonald, Bulsara, & Abu-Saad, 2007). The variability in guideline use and content as it relates to pain assessment is not surprising as there is no one definitive pain assessment tool for children and adolescents in the PICU. However, it is noteworthy that only one PICU in Jordan used the COMFORT tool, which is validated for a wide range of critically ill children in the PICU, ventilated and non-ventilated, and from 0 to 18 years (Ista, Van Dijk, Tibboel, & de Hoog, 2005). Clearly more research is needed to understand the relationship between pain assessment using various tools and pain treatment in the PICU.

Pain treatment interventions include non-pharmacological and/or pharmacological measures. Implementing non-pharmacological (physical and psychological) strategies as

appropriate to reduce discomfort for children in the PICU, such as noise reduction, massage, relaxation techniques, distraction, music, positioning, application of heat, presence of parents and relatives at the bedside, and normalization of sleep pattern, are recommended (Keogh, Long, & Horn, 2015; Playfor et al., 2006; Thomas et al., 2010). In our study, only one PICU reported using non-pharmacological techniques to manage pain including touch and distraction. It is unclear exactly what activities RNs provided when they describe distraction and touch. A previous study in Jordan noted that although nurses stated that they used distraction for pediatric pain relief, when probed, the forms of distraction were relatively simplistic (Finley et al., 2008). There is an opportunity to improve the non-pharmacological approaches that nurses use in these Jordanian PICUs given that these techniques are within the scope of practice of nurses and readily modifiable (Thomas et al., 2010).

Pharmacological pain treatment includes administration of opioids, non-opioids, systemic, regional, and local analgesics. Regardless of the need for sedation, appropriate and sufficient analgesia to effectively reduce pain should be provided to all critically ill children (Playfor et al., 2006). Opioids are recommended for severe pain, non-steroidal anti-inflammatory drugs (NSAIDs) for moderately severe pain, and acetaminophen for mild to moderate pain (Playfor et al., 2006). Playfor et al. (2006) recommend: 1) morphine or fentanyl by continuous IV infusion for severe pain; and 2) NSAIDs or paracetamol as adjuncts to opioids for first line treatment of mild to moderate pain. The WHO recommends paracetamol and ibuprofen for children in mild pain and opioid for moderate to severe pain (WHO, 2012). However, in our study, only two PICUs routinely used IV opioids for continuous infusion (fentanyl). Opioids infusion using PCA is recommended for non-ventilated alert children as this mode of delivery may allow the child to individualize their pain control to receive adequate pain control with

fewer side effects (Playfor et al., 2006). In our study, only one unit had a guideline related to the use of PCA. Local (subcutaneous or topical) and regional anesthetic techniques should be considered in some situations e.g., painful procedures (Playfor et al., 2006). Regional anesthetic techniques can provide pain relief with minimal side effects compared to systemic opioids (Guedes, Rebelo, Oliveira, & Neves, 2012). Local anesthetics can be used to manage pain during painful procedures. In our study, one unit had a guideline related to pain management during painful procedures. The same unit had a guideline related to epidural analgesia or other types of regional anesthesia. However, no unit had policies or clinical guidelines on the application of topical anesthetic agents or sucrose for neonates. Pain management for painful procedures appear to be left to the individual physician discretion. It is difficult to be prescriptive in the PICU as type and severity of illnesses vary widely. One-size fits-all approach for treatment is therefore not possible.

Recommendations for sedation management in PICUs are even more variable. For example, Playfor et al. (2006) recommend to assess and document the level of sedation regularly using a sedation assessment scale such as the COMFORT scale, and to use continuous midazolam infusion for the majority of critically ill children requiring IV sedation. Yet Thomas et al. (2010) recommend starting with intermittent lorazepam, followed by continuous infusion of midazolam, if required. Keogh et al. (2015) recommend administering a loading dose of IV midazolam to achieve the desired level of sedation, then to convert IV to long-acting enteral agents such as diazepam when reaching the plateau phase, and to use a dedicated assessment tool and tapering regime in the weaning phase. In our study, majority of the units had no guidelines on sedation management, and did not use a sedation assessment scale. Midazolam was the most common sedative used for continuous and non-continuous infusion in the four units. Of note,

regardless of how patients in the PICU are managed, it is widely acknowledged that after about seven days of continuous use of opioid or benzodiazepine withdrawal syndrome can develop, and in our study none of the PICUs used an opioid or sedative withdrawal assessment tool. One strategy to improve potential negative effects from abrupt discontinuation of analgesia for pain management within the PICUs in Jordan may be education on withdrawal syndrome, use of a withdrawal scale and use of CPGs to guide such practices.

This study provided useful information on pain management practices and use of pain related guidelines in Jordanian PICUs. This baseline knowledge has the potential to be used to improve pain management for children in PICUs in Jordan. The findings of this study can support the healthcare leaders to review and improve their policies and guidelines for pain management in Jordanian PICUs. The findings of this study can also support clinical and academic educators to design specific educational programs for practitioners as well as undergraduate and graduate students working in PICUs. Nurses and nursing leaders in Jordan can use the findings of this study to support their pain management practices and to amend the guidelines/policies they have. Pediatric critical care nurses beyond Jordan especially in the low to middle income countries can benefit from this study by comparing their pain management practice with the ones in Jordan. They can also identify the internationally developed guidelines and use them to develop or modify the guidelines they have. Further research aimed at understanding contextual factors that influence the uptake and use of pain management evidence in Jordanian PICUs is warranted.

CONCLUSION

In conclusion, pain management guidelines/policies are formal organizational resources to support clinicians' practice. There are similarities as well as differences between the four

participating Jordanian PICUs in this study, as well as other PICUs in Australia, Canada and Italy, in terms of pain management practices and availability of guidelines/policies. These variabilities in practices and policies suggest that there is an opportunity for improvement, promoting more consistent use of best practices, and reducing variability in care. Knowledge translation activities must include best evidence, which CPGs are one organizational form. Organizational resources in the form of pain management guidelines/policies may benefit from sharing and standardization in Jordanian PICUs and beyond.

ACKNOWLEDGEMENTS

We thank : (1) Allen Finley, MD, FRCPC, FAAP, Centre for Pediatric Pain Research, IWK Health Centre; (2) Sharon Kinney, Nurse Consultant Research, The Royal Children's Hospital Melbourne, Australia; (3) Margot Thomas, R.N., Children's Hospital of Eastern Ontario Research Institute Inc.; (4) Mahmoud Alshalabi, R.N., King Fahad Medical City, Riyadh, Saudi Arabia; and (5) Ghalib Hashim, R.N., King Fahad Medical City, Riyadh, Saudi Arabia for their help in development and validation of the survey for this study. We also thank Amer Aridah, R.N., King Hussein Cancer Centre, Jordan for his support in the data collection procedure in King Hussein Cancer Centre. Finally, we acknowledge Canadian Pain Society for their financial support that enabled the PI to present the findings of this study at the Canadian Pain Society Scientific Meeting in Vancouver May 2016.

REFERENCES

- Abdalahim, M. S., Majali, S. a, Stomberg, M. W., & Bergbom, I. (2011). The effect of postoperative pain management program on improving nurses' knowledge and attitudes toward pain. *Nurse Education in Practice*, *11*(4), 250–255.
<http://doi.org/10.1016/j.nepr.2010.11.016>
- Al Qadire, M., & Al Khalaileh, M. (2014). Jordanian nurses knowledge and attitude regarding pain management. *Pain Management Nursing*, *15*(1), 220–228.
<http://doi.org/10.1016/j.pmn.2012.08.006>
- American Association of Critical-Care Nurses. (2014). Assessing pain in the critically ill adult. Retrieved September 21, 2016, from
<http://www.aacn.org/wd/practice/content/practicealerts/assessing-pain-critically-ill-adult.pcms?menu=practice>
- Amigoni, A., Catalano, I., Vettore, E., Brugnaro, L., & Pettenazzo, A. (2012). Practice of analgesia and sedation in Italian pediatric intensive care units: Did we progress? *Minerva Anestesiologica*, *78*(12), 1365–1371.
- Ayasrah S, O'Neill T, Abdalahim M, Sutary M, & Kharabsheh M. (2014). Pain assessment and management in critically ill intubated patients in Jordan: a prospective study. *Int J Health Sci (Qassim)*, *8*, 287-98.
- Batiha, A., M. (2014). Pain management barriers in critical care units: A qualitative study. *International Journal of Advanced Nursing Studies*, *3*(1), 1–5. Retrieved from
<http://search.proquest.com/docview/1637583983?accountid=14477>
[https://nevada.ual.es/biblioteca/gtb/sod/poa_login.php?centro=\\$UALMG&sid=\\$UALMG&title=International+Journal+of+Advanced+Nursing+Studies&atitle=Pain+management+barriers+in+critical+care+](https://nevada.ual.es/biblioteca/gtb/sod/poa_login.php?centro=$UALMG&sid=$UALMG&title=International+Journal+of+Advanced+Nursing+Studies&atitle=Pain+management+barriers+in+critical+care+)

units%3A

- Boland, M., Sweeney, M. R., Scallan, E., Harrington, M., & Staines, a. (2006). Emerging advantages and drawbacks of telephone surveying in public health research in Ireland and the U.K. *BMC Public Health*, 6, 208. <http://doi.org/10.1186/1471-2458-6-208>
- Carnavale, F. A., & Razack, S. (2002). An item analysis of the COMFORT scale in a pediatric intensive care unit. *Pediatric Critical Care Medicine*, 3(2), 177–180 4p.
- Curley, M. a Q., Harris, S. K., Fraser, K. a, Johnson, R. a, & Arnold, J. H. (2006). State Behavioral Scale: a sedation assessment instrument for infants and young children supported on mechanical ventilation. *Pediatric Critical Care Medicine : A Journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies*, 7(2), 107–14. <http://doi.org/10.1097/01.PCC.0000200955.40962.38>
- Finley, G., Forgeron, P., & Arnaout, M. (2008). Action research: developing a pediatric cancer pain program in Jordan. *Journal of Pain and Symptom Management*, 35, 447-454.
- Forgeron, P., Finley, A., & Arnaout, M. (2005). Pediatric pain prevalence and parents' attitudes at a cancer hospital in Jordan. *Journal of Pain and Symptom Management*, 31, 440-448.
- Francke, A. L., Smit, M. C., de Veer, A. J. E., & Mistiaen, P. (2008). Factors influencing the implementation of clinical guidelines for health care professionals: a systematic meta-review. *BMC Medical Informatics and Decision Making*, 8, 38. <http://doi.org/10.1186/1472-6947-8-38>
- Fricke, S., Galesic, M., Tourangeau, R., & Yan, T. (2005). An experimental comparison of web and telephone surveys. In *Public Opinion Quarterly* (Vol. 69, pp. 370–392). <http://doi.org/10.1093/poq/nfi027>

- Gélinas, C., Fortier, M., Viens, C., Fillion, L., & Puntillo, K. (2004). Pain assessment and management in critically ill intubated patients: a retrospective study. *American Journal of Critical Care, 13*, 126-136.
- Graham, I., & Harrison, M. (2005). Evaluation and adaptation of clinical practice guidelines. *Evid Based Nurs, 8*, 68–72.
- Guedes, L., Rebelo, H., Oliveira, R., & Neves, A. (2012). Regional analgesia in intensive care. *Revista Brasileira de Anestesiologia, 62*(5), 719–730.
- International Association for Study of Pain. (2015). Declaration of Montréal. Retrieved September 21, 2016, from <http://www.iasp-pain.org/DeclarationofMontreal?navItemNumber=582>
- Ista, E., M, van D., Tibboel, D., M, de H., & Aneja, R. (2005). Assessment of sedation levels in pediatric intensive care patients can be improved by using the COMFORT “behavior” scale. *Pediatric Critical Care Medicine, 6*(1), 58–92 8p.
<http://doi.org/10.1097/01.PCC.0000149318.40279.1A>
- Johansson M, Kokinsky E. The COMFORT behavioural scale and the modified FLACC scale in paediatric intensive care. *Nurs Crit Care. 2009;14*(3):122-130. doi:10.1111/j.1478-5153.2009.00323.x.
- Jordan Ministry of Health. (2013). About Ministry of Health. Retrieved October 3, 2016, from <http://www.moh.gov.jo/EN/AbouttheMinistryofHealth/Pages/About-MinistryOf-Health.aspx>
- Keogh, S. J., Long, D. a, & Horn, D. V. (2015). Practice guidelines for sedation and analgesia management of critically ill children: a pilot study evaluating guideline impact and feasibility in the PICU. *BMJ Open, 5*(3), e006428. <http://doi.org/10.1136/bmjopen-2014->

006428

Oakes, L. (2011). *Compact clinical guide to infant and child pain management*. New York, NY: Springer Publishing.

Playfor, S., Jenkins, I., Boyles, C., Choonara, I., Davies, G., Haywood, T., ... Wolf, A. (2006). Consensus guidelines on sedation and analgesia in critically ill children. *Intensive Care Medicine*. <http://doi.org/10.1007/s00134-006-0190-x>

Ramelet, A.-S., Rees, N., McDonald, S., Bulsara, M., & Abu-Saad, H. H. (2007). Development and preliminary psychometric testing of the Multidimensional Assessment of Pain Scale: MAPS. *Paediatric Anaesthesia*, *17*, 333–340. <http://doi.org/10.1111/j.1460-9592.2006.02115.x>

Registered Nurses Association of Ontario (2013). Assessment and management of pain. Retrieved September 21, 2016, from <http://rnao.ca/sites/rnao-ca/files/AssessAndManagementOfPain2014.pdf>

Rennick, J., Morin, I., Kim, D., Johnston, C., Dougherty, G., & Platt, R. (2004). Identifying children at high risk for psychological sequelae after pediatric intensive care unit hospitalization. *Pediatric Critical Care Medicine*, *5*, 358-63.

Samuels, J., & Fetzer, S. (2009). Evidence-based pain management: analyzing the practice environment and clinical expertise. *The Journal for Advanced Nursing Practice*, *23*, 245-251.

Shekelle, P. (2016). Overview of clinical practice guidelines. Retrieved August 17, 2016, from <http://www.uptodate.com/contents/overview-of-clinical-practice-guidelines#H1>

- Srouji, R., Rantapalan, S., & Schneeweiss, S. (2010). Pain in children: assessment and nonpharmacological management. *International Journal of Pediatrics*, 2010, 1-11, <http://dx.doi.org/10.1155/2010/474838>
- Stevens, B., Abbott, L., Yamada, J., Harrison, D., Stinson, J., Taddio, a, ... CIHR Team in Children's Pain. (2011). Epidemiology and management of painful procedures in hospitalized children across Canada. *CMAJ Canadian Medical Association Journal*, 183(7), E403–E410. <http://doi.org/10.1503/cmaj.101341>
- Stevens, B., McGrath, P., Dupuis, A., Gibbins, S., Beyene, J., Breau, L., ... Yamada, J. (2009). Indicators of pain in neonates at risk for neurological impairment. *Journal of Advanced Nursing*, 65, 285–296.
- Szolnoki, G., & Hoffmann, D. (2013). Online, face-to-face and telephone surveys—Comparing different sampling methods in wine consumer research. *Wine Economics and Policy*, 2(2), 57–66. <http://doi.org/10.1016/j.wep.2013.10.001>
- Thomas, M., Dhanani, S., Irwin, D., Writer, H., & Doherty, D. (2010). Development, dissemination and implementation of a sedation and analgesic guideline in a pediatric intensive care unit...it takes creativity and collaboration. *Dynamics (Official Journal of the CACCN)*, 21(4), 16–25.
- Thorp, J., & James, S. (2010). Pain management in the intensive care unit. In Kopf, A., & Patel, N. (Eds), *Guide to pain management in low-resource settings* (pp. 283-291). IASP: Seattle.
- Turner, H. N. (2005). Complex pain consultations in the pediatric intensive care unit. *AACN Clinical Issues*, 16(3), 388–95. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/16082240>

University of Wisconsin. (2017). Nursing resources: Standard, guideline, protocol, policy.

Retrieved June 7, 2017, from

<http://researchguides.ebling.library.wisc.edu/c.php?g=293229&p=1953402>

Woolf, S. H., Grol, R., Hutchinson, A., Eccles, M., & Grimshaw, J. (1999). Clinical guidelines:

Potential benefits, limitations, and harms of clinical guidelines. *Bmj*, *318*(7182), 527–530.

<http://doi.org/10.1136/bmj.318.7182.527>

World Health Organization. (2012). WHO guidelines on the pharmacological treatment of

persisting pain in children with medical illnesses. Retrieved September 21, 2016, from

http://apps.who.int/iris/bitstream/10665/44540/1/9789241548120_Guidelines.pdf

Zalieckas, J., & Weldon, C. (2015). Sedation and analgesia in the ICU. *Seminars in Pediatric*

Surgery, *24*(1), 37–46. <http://doi.org/10.1053/j.sempedsurg.2014.11.011>

Chapter Four

The Influence of Context on Utilizing Research Evidence for Pain Management in Jordanian Pediatric Intensive Care Units

This chapter is based upon a published manuscript in the *Journal of Pediatric Nursing*, and it was written based on its format.

Ismail, A., Squires, J., Forgeron, P., Polomeno, V., Gharaibeh, H., & Harrison, D. (2018). The Influence of Context on Utilizing Research Evidence for Pain Management in Jordanian Pediatric Intensive Care Units (PICU). *Journal of Pediatric Nursing*, 38.

<http://doi.org/10.1016/j.pedn.2017.10.012>

Abstract

Purpose: The purpose of this study was to gain a beginning understanding of the contextual factors that influence the use of research for pain management in Jordanian Pediatric Intensive Care Units (PICUs).

Design and Methods: A paper or online questionnaire was used to collect data on instrumental research use (IRU) and conceptual research use (CRU) and ten contextual variables from 73 registered nurses working in four Jordanian PICUs. The Pearson product-moment correlation coefficient was used to test the relationship between continuous (demographic characteristics and contextual factors) and IRU and CRU. One way ANOVA and independent t test were used to examine the differences between sociodemographic variables and IRU and CRU. Generalized Estimating Equations (GEE) was used to determine the demographic and contextual factors that influenced research use. We modeled the significant variables identified by bivariate correlation, t test, and ANOVA at ($p \leq 0.10$).

Results: Nine of the contextual factors significantly and positively correlated with the IRU for pain assessment, eight with the IRU for pain treatment, and six with the CRU for pain management (including assessment and treatment). Hospital type (public/governmental) predicted the IRU for pain assessment. Social capital and structural and electronic resources predicted the IRU for pain treatment. Social capital predicted the CRU for pain management.

Conclusion: Context influences Jordanian PICU nurses' use of research for pain management.

Practice Implications: Concentrating on modifiable contextual factors may positively influence Jordanian PICU nurses' use of research for pain management. This influence may extend to reduce children's pain in Jordanian PICUs.

Introduction

Children have the right to access appropriate pain management provided by adequately-trained HCPs (International Association for Study of Pain [IASP], 2015). However, pain management in the Pediatric Intensive Care Unit (PICU) has been reported to be suboptimal (Agarwal et al., 2010; Grant, Scoppettuolo, Wypij, & Curley, 2012). In a study of adverse events in PICUs in the United States of America, uncontrolled pain was one of the most common major adverse events reported, with 82 % of these pain events considered to be preventable (Agarwal et al., 2010).

Pain management in children in the PICU may be more challenging than in other populations. Many factors can challenge HCPs to effectively assess and treat children's pain in the PICU such as children's physical and cognitive development, the nature of the child's critical condition, and the complexity and severity of illness in the critical care setting. In addition, the self-report of pain in the PICU (widely considered the gold standard for pain assessment and treatment) is complicated by the administration of sedative agents, paralytic agents, mechanical ventilation, and, often, altered and changing levels of consciousness (Gelin, Fortier, Viens, Fillion, & Puntillo, 2004; Ismail, 2016; Oakes, 2011; Srouji, Ratnapalan, & Schneeweiss, 2010; Turner, 2005).

The use of research evidence is a critical factor in providing appropriate pain management (Samuels & Fetzer, 2009). However, there is a gap between knowledge and practice (Hanberg & Brown, 2006; Samuels & Fetzer, 2009). To design successful interventions aimed at improving the use of research evidence for pain management, there should be a clear understanding about the nature of the research evidence being used, the quality of the context, and the type of facilitation needed to ensure a successful change process (Rycroft-Malone et al.,

2002). Context (the environment in which a HCP works) is widely considered a significant factor that can influence the successful implementation of research evidence in healthcare settings (Dopson, FitzGerald, Ferlie, Gabbay, & Locock, 2002; Meijers et al., 2006; Rycroft-Malone, 2004; Wallin, Estabrooks, Midodzi, & Cummings, 2006). However, little is understood about the organizational factors (embedded in context) that may influence HCPs' use of research to guide the practice (Stevens et al., 2011). What is known is primarily from a Western context, where human and financial resources are less challenging than in low to middle income countries such as Jordan (Finley, Forgeron, & Arnaout, 2008). Based on ownership and governance, hospitals in Jordan can be categorized into five types: Ministry of Health (public funded by the government), Royal Medical Services (military hospitals), private (private funded and work for profit), non-profit non-governmental (self-operated and mainly funded by money donated by people), and university hospitals. Jordan Ministry of Health supervises health services offered by all sectors (Jordan Ministry of Health, 2013a). These five types have different organizational contexts affecting the way of delivering patient's care. In Canada for example, the health care system is publicly funded. Without paying out-of-pocket, all residents have access to hospital services. The standards for health care are set and administered by the federal government (Government of Canada, 2016). Therefore, organizational contexts of the hospitals can be less different.

Review of Literature

Several studies have been conducted in Western countries demonstrated the importance of context for research utilization. In Canada, Cummings, Hutchinson, Scott, Norton, and Estabrooks (2010) found that pediatric nurses who reported more positive perceptions of their context, including culture, leadership, and evaluation, reported higher instrumental research use (IRU) and higher conceptual research use (CRU). Instrumental research use (IRU) is the direct

application of research findings, and the conceptual research use (CRU) is being aware of research findings that could alter the way of thinking and/or practicing (Cummings et al., 2010). In a subsequent study conducted in Canadian pediatric hospitals which included medical, surgical and critical care units, Squires et al. (2013) found that organizational culture and the proportion of nurses having a baccalaureate degree or higher were predictors of IRU and leadership, culture, evaluation, formal interactions, informal interactions, and organizational slack-space were predictors of CRU. Organizational slack is described as the unit cushion of resources (actual or potential) that helps the unit to adapt to internal and external pressures e.g., staffing (Estabrooks, Squires, Cummings, Birdsell, & Norton, 2009). From responses of 2361 nurses working across different care settings in Canada and Australia, Squires et al. (2015) found that contextual factors such as leadership, culture, evaluation, formal interactions, informal interactions, structural and electronic resources, social capital, organizational slack-time, organizational slack-staffing, and organizational slack-space correlated positively with both IRU and CRU. These studies focused on the general research use for any condition. This study only focused on the research use for pain management in Jordanian PICUs.

Several studies have been conducted investigating pain management in Jordanian hospitals (Abdalahim, Majali, Stomberg, & Bergbom, 2011; Abdel Razeq, Akuma, & Jordan, 2016; Al Qadire & Al Khalaileh, 2014; Ayasrah, O'Neill, Abdalahim, Sutary, & Kharabsheh, 2014; Batiha, 2014; Finley et al., 2008; Forgeron, Finley, & Arnaout, 2006). Yet, no studies have evaluated the influence of context on research utilization for pain management in Jordanian PICUs.

Purpose

The purpose of this study was to gain a beginning understanding of the contextual factors that influence research utilization by nurses to guide pain management in Jordanian PICUs. The specific aims were to:

- 1) Examine the relationship between each of the contextual factors and each kind of research utilization for pain management;
- 2) Identify the significant predictors for research use.

Methods

The Promoting Action on Research Implementation in Health Services (PARiHS) model (Kitson, Harvey, & McCormack, 1998) guided the planning and conduct of this study. The PARiHS model consists of three main constructs: (1) evidence, (2) context, and (3) facilitation. These three elements are interrelated, and each is positioned on a “high” to “low” continuum (Kitson et al., 1998; Rycroft-Malone et al., 2002). Successful implementation of research evidence is purported to be a result of interplay between the three constructs. In order to successfully translate pain management evidence into practice, there is a need to clearly understand the quality of the context where the evidence being implemented, the type and nature of the evidence, and the type of facilitation being provided (Kitson et al., 1998; Rycroft-Malone et al., 2002; Rycroft-Malone, 2004). Contextual factors can play an important role in facilitating or inhibiting the research use (Rycroft-Malone, 2004). Pain management research use in Jordanian PICUs is no exception. The focus in this study was to assess the contextual factors of the PICU setting in Jordan. Another focus was to examine the relationship between these factors and research use for pain management.

Design

A cross-sectional survey design was used to capture Jordanian PICU nurses' perceptions about aspects of the context in which they work and the extent to which they use research evidence for pain management.

Sample

Registered nurses working in PICUs in Jordan, including charge nurses and staff nurses, were invited to participate in this study. The inclusion criteria were: (1) working in the PICU in Jordan for six months or more, so they had adequate experience to answer the survey items, and (2) able to read, write, and understand English. Exclusion criteria were: (1) nurse managers, (2) head nurses, and (3) practical nurses. The expected sample size was small (the expected population of PICU nurses in Jordan was 120 nurses (H. Gharaibeh, personal communication, April 4, 2013), so the sample size was calculated based on bivariate correlation. Using GPower 3 software (Faul, Erdfelder, Buchner, & Lang, 2009), the number of participants to establish a significant association between each contextual factor and each kind of research use for pain management using Pearson's correlation was approximately 67 PICU nurses. There were no similar studies conducted in a Jordanian context to calculate the effect size, so a moderate effect size (0.30) was used. The number of participants required for 80% power at the 5% alpha level, and a moderate effect size (0.30) between the two variables is 67.

Nurses were invited to complete a paper-based or web-based questionnaire based on their preference. Having both options available for survey completion may enhance the response rate. The online questionnaire was hosted on FluidSurveys (FluidSurveys, 2015), which is a Canadian company that has security measures in place in order to keep the data confidential such as: 1) secured server for the data; 2) data encryption using Secured Socket Layer (SSL); and 3) de-identified responses. The recruitment procedure was initiated two months before the

commencement of data collection. The principal investigator (PI) visited the research sites and met with the nurse leaders and with the PICU nurses to introduce the study and explain its significance, and to answer any questions about the study. The PI provided a series of informal interactions with the PICU nurses to familiarize them with the study aims and processes of data collection. Each eligible PICU nurse was invited to choose one of the two survey packages. The first package was the online questionnaire package which contained a letter introducing the study and a card providing access to the website address (URL) of the questionnaire. The second package was the paper questionnaire package which contained a letter introducing the study, the paper questionnaire, and a sealable stamped self-addressed envelope. The PI distributed the packages personally to the participants, so the people in authority e.g., the head nurse did not know who participated in the survey or who did not. One hundred and five survey packages were distributed. Seventy three were completed (58 paper and 15 online), representing a response rate of 70%. Nurses who chose to complete the online questionnaire provided the PI with their personal email addresses in order to send future reminders. The email list was confidential and not shared with employers. Email reminders were sent to the email list (all those who chose the online option) two weeks and four weeks after commencement of the data collection thanking those who had completed the survey and reminding others to complete the survey. In addition, the PI visited the sites two weeks and four weeks after commencement of the data collection to remind the nurses to complete the surveys and answer any questions. Nurses who chose the paper mode had two options to return the completed questionnaires: (1) to drop it in the provided locked box, or (2) to mail it. All of the completed paper questionnaires were found in the locked boxes.

Setting

There are six hospitals in Jordan that have dedicated PICUs (Jordan Ministry of Health, 2013b). All six hospitals were invited to participate in this study. Four hospitals (two governmental, one university, and one non-profit hospital) were included in this study because of an inability to get ethics approval from two hospitals. Total number of beds in the first governmental hospital was 112 including 6 PICU beds, 951 beds in the second governmental hospital including 8 PICU beds, 526 beds in the university hospital including 10 PICU beds, and 180 beds in the non-profit hospital including 6 PICU beds.

Distinct PICUs were found in governmental, military, university, and non-profit hospitals in Jordan (Jordan Ministry of Health, 2013b). Private hospitals can receive and treat critically ill children but in the intensive care unit (ICU) with adults, therefore these institutions were not invited to take part as the challenges and reasons for using pediatric evidenced based practices may differ from hospitals with dedicated PICUs.

Instruments

Four instruments were used to collect the data, all of which were administered in English. Nursing education in Jordanian universities is in English and clinical documentation in Jordanian hospitals is in English, thus all registered nurses have a working comprehension of English. The instruments were: 1) Demographic Data Sheet; 2) Alberta Context Tool (ACT) (Estabrooks et al., 2009); 3) IRU; and 4) a modified version of the CRU Scale (Squires, Estabrooks, Newburn-Cook, & Gierl, 2011) (Appendix F).

Demographic Data Sheet

The Demographic Data Sheet (six items) was developed by the investigators for the purpose of this study. It included items such as age, gender, education (e.g., diploma,

baccalaureate or graduate degree), years of experience, position (e.g., staff nurse, charge nurse, educator), and hospital type (e.g., government, private, military).

Alberta Context Tool

The Alberta Context Tool (Acute Pediatric Care Version) (Estabrooks et al., 2009), developed based on the PARiHS model, is a standardized measure consisting of 57 items capturing data on 10 factors of the element of context: (1) leadership, (2) culture, (3) evaluation, (4) social capital, (5) informal interactions, (6) formal interactions, (7) structural and electronic resources, (8) organizational slack – staffing, (9) organizational slack – space, and (10) organizational slack – time (Estabrooks et al., 2009). Permission to use the ACT was obtained from the original author (C. Estabrooks, personal communication, April 25, 2013) (Appendix G). Each factor and its related concepts were scored on a 5-point Likert agreement scale (1 “Strongly Disagree” to 5 “Strongly Agree”) or a 5-point Likert frequency scale (1 “Never” to 5 “Almost Always”) (Table 4.1).

Table 4.1. Alberta Context Tool Concepts and Scoring

Factor	Concepts	Scoring
Leadership	Openness, optimism, self-control, empathic, developing others, and conflict management	5-point Likert agreement scale
Culture	Recognition, autonomy, work-life balance, development opportunity, focus on service mission, and support	5-point Likert agreement scale
Evaluation	Data access, informal data review, formal data review, action planning, performance monitoring, and benchmarking	5-point Likert agreement scale
Social capital	Bonding, bridging, and linking	5-point Likert agreement scale
Informal interactions	Interactions with others through engagement in informal unit activities	5-point Likert frequency scale
Formal interactions	Interactions with others through engagement in formal unit activities	5-point Likert frequency scale
Structural and electronic resources	Availability/use of structural and electronic resources	5-point Likert frequency scale including a “not available” option
Organizational slack-staffing	Availability of adequate staffing resources	5-point Likert agreement scale
Organizational slack-space	Availability and use of space	5-point Likert agreement scale and one item on 5-point Likert frequency scale
Organizational slack-time	Availability and use of time	5-point Likert frequency scale

The ACT has previously been shown to be a valid and reliable tool. All of the ACT factors significantly associated with IRU and CRU (Estabrooks et al., 2009; Squires et al., 2015), and the internal consistency reliability ranged from 0.60 for to 0.91 for each of the 10 ACT factors (Estabrooks et al., 2009).

Conceptual Research Use

Conceptual research use for pain management in Jordanian PICUs was examined using a modified version of the CRU scale (Squires et al., 2011). It included five items scored on a 5-point Likert frequency scale (1 “Never” to 5 “Almost Always”). Permission to use the CRU scale was obtained from the author of the scale (J. Squires, personal communication, September 12, 2014) (Appendix H). The modification including wordings to reflect pain management within the Jordanian PICU was agreed with by Squires (J. Squires, personal communication, September 12, 2014). The original CRU scale has previously been shown to be a valid and reliable tool. Content validity index scores ranged from 0.55 to 1.00. The principal components analysis predicted a one factor model of the five items. Pearson’s correlation coefficient between CRU and IRU was 0.29 ($p < 0.01$). Cronbach's alpha for the 5-item CRU scale was 0.89 (Squires et al., 2011).

Instrumental Research Use

Two questions developed by the authors were used to measure IRU in Jordanian PICUs. The two questions also used a 5-point Likert frequency scale (1 “Never” to 5 “Almost Always”) and asked about the frequency of using research-based policies or guidelines for pain assessment and pain treatment on the last typical workday. Pain management in PICU is operationalized to include both pain assessment and pain treatment (Ismail, 2016).

Data Analysis

The IBM-SPSS version 24 was used to analyze the data. Data were analyzed for descriptive statistics, bivariate correlation, and multivariate analysis. Pearson's correlation coefficient was used to examine the relationship between each one of the continuous (demographic and contextual) factors and the IRU for pain assessment and pain treatment, and CRU for pain management. Independent t test and one-way analysis of variance (ANOVA) were used to examine the differences among the independent groups of the categorical demographic factors on IRU for pain assessment, IRU for pain treatment, and CRU for pain management. Levene's statistic was used to assess the equality of variances between the independent groups of the categorical demographic factors e.g., hospital type. Means and standard deviations were computed on each of the ACT context factors, the IRU for pain assessment, IRU for pain treatment, and CRU for pain management items.

Data were expected to cluster at the unit level. Nurses who completed the survey were nested within the participating PICUs. Each unit has a unique work context (e.g., different leader and work culture) that could be shared by the nurses within that unit, and therefore PICU nurses' responses to the survey items may be correlated. The generalized estimating equation (GEE) was used to model the significant contextual and demographic variables on IRU and CRU correcting for the unit. A ($p < 0.10$) was chosen to identify all possible important predictors from bivariate analysis. Choosing $p \leq 0.05$ may lead to an inability to identifying variables that could be important (Bursac, Gauss, Williams, & Hosmer, 2008). The GEE is suitable for the analysis of correlated observations, such as clustered data (IBM Knowledge Center, 2016). Correlated data could be correlated in many ways but all represent the within-subject dependencies. There are many options for the working correlation matrix. For example, the independent correlation matrix assumes the measurements are uncorrelated, the unstructured

correlation matrix has no assumptions about the correlation between observations, and the exchangeable matrix assumes homogenous correlations between observations. We considered independent (default in SPSS) and exchangeable working correlation structures because they are the reasonable alternatives for non-longitudinal clustered data (Squires et al., 2013). GEE is robust to misspecification (IBM Knowledge Center, 2016). We also reported values for Quasi Likelihood under Independence Model Criterion (QIC), which indicates the better working correlation structure to be selected; the smaller QIC value indicates the better working correlation structure to choose (IBM Knowledge Center, 2016). We also reported the Corrected Quasi Likelihood under Independence Model Criterion (QICC) regarding model fit. The smaller QICC value indicates better model fit (IBM Knowledge Center, 2016). We reported the QICC value for the model including all independent variables as well as for the models (chosen for this study), which included the selected variables (significant bivariate correlation with either type of IRU or CUR) to show the improvement in the QICC values for the model we chose. The full model consisted of 16 independent variables (gender, age, education, and experience in PICU, position, hospital type, leadership, culture, evaluation, formal interactions, informal interactions, social capital, structural and electronic resources, organizational slack-staffing, organizational slack-space, and organizational slack- time). Our 12 selected factors for predicting the IRU for pain assessment were hospital type, age, leadership, culture, evaluation, formal interactions, informal interactions, social capital, structural and electronic resources, organizational slack-staffing, organizational slack-space, and organizational slack-time. Our 13 selected factors for predicting the IRU for pain treatment were hospital type, age, experience, leadership, culture, evaluation, formal interactions, informal interactions, social capital, structural and electronic resources, organizational slack-staffing, organizational slack-space, and organizational slack-

time. Our 8 selected factors for predicting the CRU for pain management were gender, hospital type, culture, evaluation, social capital, structural and electronic resources, organizational slack-space, and organizational slack-time.

Ethics

Ethics approval was obtained from the PI's affiliated University and from four of the six hospitals in Jordan with PICUs. The other two hospitals did not respond to the ethics application. Participants were assured that their participation was voluntary and anonymous. In addition, they have been assured that their responses will be treated confidentially. Data storage and destruction following the required period of time following analysis of the data comply with the ethical requirements.

Results

Data collection took place between August 2015 and October 2015 in the four participating Jordanian PICUs. Missing data were minimal; all nurse cases had more than 90% completed data. If there were missing data, it was declared as missing. Missing data on any variable were treated by pairwise deletion that maximized the data available analyses by analysis. Any nurse case with missing values was used in all analysis except the GEE. In the GEE analysis, cases with missing values on dependent variables or covariates were excluded (IBM Knowledge Center, 2016).

Participant Demographics

As summarized in Table 4.2, the mean age of the participants was 31 years, and the mean years of experience in the PICU was five years. The majority of participants were staff nurses, females, and held bachelor degrees in nursing. Forty-two participants were working in one of the two governmental hospitals.

Table 4.2. Nurse demographics (N=73)

Demographic Variable	Mean (SD)	N (%)
Age (years)	31 (6.6)	
Years of experience in PICU	5 (4.7)	
Gender		
Male		14 (19)
Female		59 (81)
Education		
Diploma in Nursing		8 (11)
Bachelor Degree in Nursing		58 (79)
Master's Degree or More		7 (10)
Position		
Charge Nurse		12 (16)
Staff Nurse		61 (84)
Hospital Type		
Government		42 (58)
University		14 (19)
Non-Profit		17 (23)

The age of participants had a small negative correlation with IRU for pain treatment ($r = -0.25, p = 0.04$). Experience in PICU in years had a moderate significant negative correlation with IRU for pain treatment ($r = -0.30, p = 0.01$) (Table 4.3).

Table 4.3. Pearson moment correlation-continuous demographics and research utilization

Demographic Variable	IRU- Pain Assessment		IRU- Pain Treatment		CRU- Pain Management	
	r	(P)	r	(P)	r	(P)

Age in years	- 0.21 (0.08)	- 0.25 (0.04)	- 0.02 (0.87)
Experience in PICU/ years	- 0.15 (0.23)	- 0.30 (0.01)	- 0.18 (0.13)

IRU: Instrumental Research Utilization
CRU: Conceptual Research Utilization

There was a significant difference in IRU for pain assessment in terms of hospital type (governmental, university, and non-profit) ($p \leq 0.05$). Levene's statistic was insignificant ($p = 0.22$). Using post hoc Bonferroni, the difference was between the governmental and non-profit hospitals ($p = 0.05$) (Table 4.4).

Table 4.4. Independent t test and one way analysis of variance (ANOVA) for categorical demographics and research utilization

Demographic Variable	IRU- Pain Assessment		IRU- Pain Treatment		CRU- Pain Management	
	Mean (SD)	(P)	Mean (SD)	(P)	Mean (SD)	(P)
Gender		(0.90)		(0.62)		(0.06)
Male	3.50		3.5 (1.16)		2.97 (0.90)	
Female	(1.16)		3.32 (1.24)		3.43 (0.77)	
	3.47					
	(1.20)					
Position		(0.93)		(0.84)		(0.18)
Charge nurse	3.50		3.42 (1.24)		3.05 (1.01)	
Staff nurse	(1.17)		3.34 (1.23)		3.40 (0.76)	
	3.47					
	(1.20)					
Education		(0.77)		(0.97)		(0.79)
Diploma	3.63		3.25 (1.58)		3.50 (1.45)	
Bachelor	(1.30)		3.37 (1.21)		3.33 (0.79)	
≥ Master	3.48		3.33 (1.03)		3.20 (0.64)	
	(1.20)					

	3.17 (0.98)			
Hospital Type	(0.05)		(0.07)	(0.10)
Governmental	3.24 (1.25)	3.07 (1.29)		3.41 (0.85)
University		3.62 (1.04)		2.91 (0.69)
Non-profit	3.46 (0.88)	3.82 (1.02)		3.48 (0.74)
	4.06 (1.09)			

IRU: Instrumental Research Utilization
CRU: Conceptual Research Utilization

Further analysis found significant differences in five of the 10 factors captured by the ACT based on hospital type. Evaluation, formal interactions, structural and electronic resources, organizational slack-staffing, and organizational slack-space were lower in governmental hospitals than in university and non-profit hospitals ($p \leq 0.05$) (Table 4.5).

Table 4.5. Hospital type and contextual factors

Factor	Governmental Mean (SD)	University Mean (SD)	Non-profit Mean (SD)	(P)
Leadership	3.50 (0.78)	4.0 (0.38)	3.70 (0.67)	0.07
Culture	3.50 (0.84)	3.94 (0.50)	3.89 (0.48)	0.13
Evaluation	3.46 (0.95)	3.60 (0.49)	3.61 (0.78)	0.05
Formal Interactions	2.01 (1.50)	3.11 (0.84)	2.74 (1.08)	0.015
Informal Interactions	4.41 (3.05)	4.77 (3.05)	6.33 (2.23)	0.098
Connection Among People	3.43 (0.84)	3.65 (0.70)	3.66 (0.84)	0.53
Structural and Electronic	3.94 (3.85)	7.04 (2.73)	6.41 (2.77)	0.001

Resources				
Organizational				
Slack:				
Staffing	2.27 (1.25)	2.93 (1.14)	3.24 (1.38)	0.02
Space	2.75 (1.31)	2.73 (0.72)	3.78 (0.83)	0.01
Time	2.84 (0.99)	3.31 (0.75)	2.96 (0.92)	0.28

Means of leadership, culture, evaluation, connection among people, staffing, space, time out of 5
Means of formal interactions out of 4
Means of informal interactions out of 9
Means of structural and electronic resources out of 10

Bivariate Relationship between Contextual Factors and Research Utilization

Culture, evaluation, formal interactions, social capital, structural and electronic resources, organizational slack-space, and organizational slack-time had a moderate significant positive correlation with IRU for pain assessment ($r = 0.42, 0.38, 0.33, 0.37, 0.42, 0.46,$ and 0.33 respectively, $p \leq 0.01$). Leadership and organizational slack-staffing had a small significant positive correlation with the IRU for pain assessment ($r = 0.28$ and 0.25 respectively, $p \leq 0.05$) (Table 4.6). Structural and electronic resources had a strong significant positive correlation with IRU for pain treatment ($r = 0.52, p \leq 0.01$). Leadership, culture, formal interactions and social capital had a moderate significant positive correlation with instrumental research utilization for pain treatment ($r = 0.30, 0.37, 0.30,$ and 0.48 respectively, $p \leq 0.01$). Evaluation, organizational slack-staffing, and organizational slack-space had a small significant positive correlation with IRU for pain treatment ($r = 0.25, 0.27,$ and 0.24 respectively, $p \leq 0.05$) (Table 4.6).

Social capital had a strong significant positive correlation with CRU for pain management ($r = 0.58, p \leq 0.001$). Culture, evaluation, and organizational slack-space had a moderate significant positive correlation with CRU for pain management ($r = 0.33, 0.30,$ and 0.36 respectively, $p \leq 0.01$). Structural and electronic resources and organizational slack-time

had a small significant positive correlation with CRU for pain management ($r = 0.25$ and 0.27 respectively, $p \leq 0.05$) (Table 4.6).

Table 4.6. Pearson moment correlation between contextual factors and research utilization

Contextual Factor	IRU- Pain Assessment r and (P)	IRU- Pain Treatment r and (P)	CRU- Pain Management r and (P)
Leadership	0.28 (0.02)	0.30 (0.01)	0.15 (0.225)
Culture	0.42 (0.000)	0.37 (0.002)	0.33 (0.006)
Evaluation (Feedback)	0.38 (0.001)	0.25 (0.04)	0.30 (0.011)
Formal Interactions	0.33 (0.005)	0.30 (0.01)	0.13 (0.284)
Informal Interactions	0.22 (0.07)	0.24 (0.057)	0.15 (0.25)
Social Capital (Connection Among People)	0.37 (0.002)	0.48 (0.000)	0.58 (0.000)
Structural and Electronic Resources Organizational Slack	0.42 (0.000)	0.52 (0.000)	0.25 (0.044)
Staffing	0.25 (0.04)	0.27 (0.02)	0.17 (0.17)
Space	0.46 (0.000)	0.24 (0.049)	0.36 (0.003)
Time	0.33 (0.006)	0.23 (0.06)	0.27 (0.026)

IRU: Instrumental Research Utilization

CRU: Conceptual Research Utilization

Relationship between Significant Variables on ($p \leq 0.10$) as a Set and Research Utilization

Fifty-three cases had no missing values on IRU-pain assessment and IRU-pain treatment, and fifty-two cases had no missing values on the CRU-pain management. Thus, these were the sample sizes used in the GEE analysis. Results of the GEE analysis showed that working in a government hospital was a significant predictor for IRU-pain assessment (estimate: -0.788 , $p \leq 0.05$). Social capital and structural and electronic resources were significant predictors for the IRU-pain treatment (estimate: 0.447 and 0.187 respectively, $p \leq 0.05$). Social capital was a significant predictor for the CRU-pain management (estimate: 0.609 , $p \leq 0.05$). The Quasi

Likelihood under Independence Model Criterion (QIC) for two correlation structures (independent and exchangeable) resulted in the same values: 79.05 for the IRU for pain assessment, 72.49 for the IRU for pain treatment, and 35.01 for the CRU for pain management, meaning that either of them can be used. The Corrected Quasi Likelihood under Independence Model Criterion (QICC) values of the study models of selected significant factors were less than the model of all factors, indicating a better model fit with fewer variables. The QICC values for the study models were 77.62 for the IRU for pain assessment, 73.12 for the IRU for pain treatment, and 37.0 for the CRU for pain management compared to 84.1 IRU for pain assessment, 80.2 for the IRU for pain treatment, and 50 for the CRU for pain management for the full model including all factors (Table 4.7).

Table 4.7. GEE Results for Instrumental Research Use (IRU) and Conceptual Research Use (CRU) (Independent Working Correlation Structure)

Predictor	IRU- Pain		IRU- Pain		CRU- Pain	
	Assessment		Treatment		Management	
	N= 53		N= 53		N= 52	
	Estimate	P	Estimate	P	Estimate	P
Gender (Male) ¹					-0.307	0.080
Hospital Type ²						
Governmental	-0.788	0.035	-0.196	0.598	0.230	0.265
University	-0.707	0.268	-0.032	0.963	0.054	0.852
Age	0.001	0.955	-0.002	0.919		
Experience			-0.035	0.390		
Leadership	0.303	0.203	-0.224	0.257		
Culture	0.015	0.962	-0.015	0.954	-0.162	0.399
Evaluation	0.392	0.248	0.200	0.553	0.108	0.581
Formal Interactions	-0.135	0.381	-0.141	0.311		
Informal Interactions	-0.130	0.094	-0.057	0.413		

Connection Among People (Social Capital)	0.175	0.431	0.447	0.030	0.609	.000
Structural and Electronic Resources	0.095	0.290	0.187	0.023	-0.061	.110
Organizational Slack						
Staffing	-0.022	0.897	0.094	0.629		
Space	-0.037	0.849	-0.255	0.143	0.126	0.211
Time	0.548	0.105	0.189	0.520	0.099	0.447
Working correlation						
QIC -Independent	79.05		72.49		35.01	
QIC –Exchangeable	79.05		72.49		35.01	
QICC all (independent variables)	84.1		80.2		50	
QICC (significant variables)	77.62		73.12		37.00	

IRU: Instrumental Research Utilization

CRU: Conceptual Research Utilization

QIC: Quasi Likelihood under Independence Model Criterion

QICC: Corrected Quasi Likelihood under Independence Model Criterion

Bold statistically significant ($p < 0.05$)

¹Reference group = Female

²Reference group = Non-profit

Discussion

Results of this study showed that the majority of contextual factors on the ACT tool were correlated with research use (IRU and CRU) for pain management, and two contextual factors (social capital and structural and electronic resources) were significant predictors of research use by nurses working in Jordanian PICUs. Results of the study are consistent with those found in the literature (Estabrooks et al., 2009; Squires et al., 2015). From responses of 752 nurses working in seven Canadian pediatric hospitals, Estabrooks et al. (2009) found that 9 of 10 contextual factors (leadership, culture, evaluation, social capital, formal interactions, informal interactions, structural and electronic resources, organizational slack-space, and organizational

slack-time) had a significant positive small correlation with the IRU. In this study 9 of 10 contextual factors significantly and positively correlated with the IRU for pain assessment. Seven of which had a moderate correlation with the IRU for pain assessment including culture, evaluation, formal interactions, social capital, structural and electronic resources, organizational slack-space, and organizational slack-time, and two factors had a small correlation including leadership and organizational slack-staffing. In addition, 8 factors correlated (small to large) with the IRU for pain treatment including structural and electronic resources, leadership, culture, formal interactions, social capital, evaluation, organizational slack-staffing, and organizational slack-space. Organizational slack-staffing, which did not significantly correlate with the IRU in Estabrooks et al. (2009) study significantly correlated with the IRU for pain assessment and pain treatment in this study. From responses of 2361 nurses working across different care settings in Canada and Australia, Squires et al. (2015) found that all of the 10 ACT factors correlated positively with both the IRU and the CRU. In this study, six factors significantly correlated (small to large) with the CRU for pain management including social capital, culture, evaluation, organizational slack-space and time, and structural and electronic resources. In this study, the magnitude of the associations are stronger than Estabrooks et al. (2009) and Squires et al. (2015) except for the informal interactions, suggesting that although contextual factors may influence Western nurses' use of IRU and CRU, contextual factors may play a more significant role in nurses' use of both IRU and CRU for pain management in low to middle income countries such as Jordan.

Bivariate analyses assessed the existence and the strength of the relationship between each contextual factor and the research use and the multivariate analysis determined how well independent variables, taken together, predicted research utilization and which factor best

predicted this. At the multivariate level, working at a governmental hospital was a significant predictor for the IRU-pain assessment. Social capital and structural and electronic resources were significant predictors for the IRU-pain treatment, and social capital was a significant predictor for the CRU- pain management.

Nurses who worked in government (public) run hospitals were less likely to use research when assessing pain in PICU patients compared to nurses working in university and non-profit hospitals. This finding is consistent with a recent study conducted by Abdel Razeq et al. (2016) who assessed the status of pain management in Jordanian neonatal intensive care units (NICU). They found that the use of pain assessment tools by NICU nurses was low (20%) in governmental hospitals. One important indicator for IRU is the utilization of research-based appropriate assessment tools e.g., pain assessment tool (Estabrooks et al., 2011). Abdel Razeq et al. (2016) indicated that public/government hospitals have a higher patient turnover and may be less equipped than other hospitals, and these organizational factors may explain why using pain assessment tools is low in governmental hospitals. Furthermore, there may be a need to improve continuing education in government hospitals as they have fewer resources. This study demonstrated that scores on all 10 contextual factors were also lower amongst the PICU nurses working for governmental hospitals compared to university and non-profit hospitals and that five of these factors were statistically significant (structural and electronic resources, evaluation, formal interactions, organizational slack-staffing, and organizational slack-space). Contextual factors do influence evidenced based pain management in a multitude of settings including PICU (Dopson et al., 2002; Meijers et al., 2006; Rycroft-Malone, 2004; Wallin et al., 2006). More research is needed to understand the underlying challenges faced by Jordanian government

hospitals that negatively affect their contextual factors scores and which of these are amendable to intervention.

The greater the connection among Jordanian PICU nurses in their groups and with others, the higher the reported IRU for pain treatment and CRU for pain management. This feeling of belonging demonstrated the importance of social capital on both types of research utilization for pain management: sharing information about pain management, being comfortable talking about the patient's pain with people of authority, group exchanges aimed at helping others do their job in terms of pain management, the value of the group members who participate in the group activities, and the feeling that people of authority take PICU nurses' observations about patients seriously. It was noted that the four Jordanian PICUs in this study share an open PICU design with no barriers; the majority of patients' beds are in one open room except for isolation rooms. This enhances the interaction between PICU nurses. Relationships and social interaction are important factors that impact research use (Estabrooks, Floyd, Scott-Findlay, O'Leary, & Gushta, 2003; Fleuren, Wiefferink, & Paulussen, 2004; Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004). Receptive context is highly dependent on having good quality social interactions (Dopson et al., 2002). Research use by different HCPs for pain management in Jordanian PICUs may be increased by encouraging and fostering interaction amongst them.

The greater availability and use of structural and electronic resources, the higher the reported IRU for pain treatment by using the library, text books, journals, notice boards, policies and procedures, clinical practice guidelines, computerized decision supports, reminder systems, and websites on the internet. A previous study conducted in critical care units including PICUs in Jordan noted that the inadequacy in some structural and electronic resources, e.g. clinical practice guidelines and policies was viewed by nurses as a barrier for providing effective pain

management (Batiha, 2014). There is an opportunity to positively modify the availability and the use of structural and electronic resources that support pain management provided by nurses and other HCPs in Jordanian PICUs.

The results of this study build on a previous work showing the importance of context on research utilization in different settings. Cummings, Estabrooks, Midodzi, Wallin, and Hayduk (2007) found that registered nurses working in context with more positive culture, leadership, and evaluation reported significantly more research utilization in clinical practice (IRU) than nurses working in less positive contexts. In addition, they found that responsive administration (administration that listens and responds to staff concerns e.g., providing resources), relational capital (social capital), and hospital size (number of beds) positively, but indirectly, influenced nurses' research utilization by acting through staff development, opportunities for nurse-to nurse collaboration, and staffing and support services. However, in this study, social capital had a direct influence on research utilization. In a subsequent study, Cummings et al. (2010) found that the higher self-reported IRU and CRU were associated with more positive perceptions of context by pediatric nurses. Squires et al. (2013) found that culture was a significant predictor of IRU in Canadian pediatric hospitals (including medical, surgical and critical care units), and leadership, culture, evaluation, formal interactions, informal interactions, and organizational slack-space were significant predictors of CRU in Canadian pediatric hospitals. These previous studies demonstrated the importance of context on research utilization in different settings. In this study, data were collected exclusively from PICU nurses in Jordan where resources are more limited than in Canada. In addition, research utilization items in this study were exclusively asking about pain and not on the general use of research. This demonstrated the importance of research use for

pain management specifically compared to general research use as well as in the pediatric intensive care population.

This study focused on the second construct of the PARIHS framework (context). Given the influence of context on research use for pain management, multifaceted knowledge translation strategies that take context into consideration are needed to move pain management evidence into practice. This study provided useful information on the influence of context on research use by nurses for pain management in Jordanian PICUs. This baseline knowledge has the potential to be used to improve pain management for children in PICUs in Jordan. The findings of this study illustrate the importance of having the support of administrators as well as clinicians in improving evidenced informed pain practice as many of the contextual factors require administrator support to amend.

Limitations

This study has three limitations. First, the sample was drawn from three of the four health sectors in Jordan: governmental, university, and non-profit hospitals. No data were collected from military hospitals, which may have different contexts. The second limitation was that the data included only registered nurses from PICUs. Other HCPs may perceive the same contexts in different ways. The third limitation concerned using self-reported questionnaires. Participants may over or underestimate the perception of their context as well as their reported IRU and CRU. Results of this study may therefore not be generalizable beyond research use for pain management in participating PICUs as perceived by Jordanian PICU nurses.

Direction for Future Action

This study offers empirical evidence for the importance of context to research use by identifying the contextual factors that correlate with the IRU and CRU for pain management.

Future research to tailor interventions to the local context by modifying these contextual factors with the aim of improving research use by nurses to achieve better pain management in Jordanian PICUs is needed.

Conclusion

Context plays an important role in Jordanian PICU nurses' use of research for pain management. A majority of the contextual factors correlate with the IRU and CRU for pain management. Social capital was the contextual factor that significantly predicted both instrumental research use and conceptual research use by Jordanian PICU nurses. Contextual factors described as structural and electronic resources also significantly predicted instrumental research use for both pain assessment and pain treatment in Jordanian PICUs. Concentrating on modifiable contextual factors may positively influence Jordanian PICU nurses' use of research for pain management. This influence may extend to reduce children's pain in Jordanian PICUs and their parents' reactions to seeing their children in pain.

Acknowledgements

Authors of this study gratefully acknowledge the contributions of Amer Aridah, King Hussein Cancer Center, Jordan for his assistance in obtaining the ethical approval and collecting data from one site. None of the authors have conflicts of interest with respect to this work.

References

- Abdalahim, M. S., Majali, S. a, Stomberg, M. W., & Bergbom, I. (2011). The effect of postoperative pain management program on improving nurses' knowledge and attitudes toward pain. *Nurse Education in Practice, 11*(4), 250–255.
<http://doi.org/10.1016/j.nepr.2010.11.016>
- Abdel Razeq, N. M., Akuma, A. O., & Jordan, S. (2016). Status of neonatal pain assessment and management in Jordan. *Pain Management Nursing*.
<http://doi.org/10.1016/j.pmn.2016.02.050>
- Agarwal, S., Classen, D., Larsen, G., Tofil, N. M., Hayes, L. W., Sullivan, J. E., ... Sharek, P. (2010). Prevalence of adverse events in pediatric intensive care units in the United States. *Pediatric Critical Care Medicine : A Journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies, 11*(5), 568–78.
<http://doi.org/10.1097/PCC.0b013e3181d8e405>
- Al Qadire, M., & Al Khalailah, M. (2014). Jordanian nurses knowledge and attitude regarding pain management. *Pain Management Nursing, 15*(1), 220–228.
<http://doi.org/10.1016/j.pmn.2012.08.006>
- Ayasrah, S., O'Neill, T., Abdalahim, M., Sutary, M., & Kharabsheh, M. (2014). Pain assessment and management in critically ill intubated patients in Jordan: A prospective study. *International Journal of Health Sciences, Qassim University, 8*(3), 287–298.
- Batiha, A.-M. (2014). Pain management barriers in critical care units: A qualitative study. *International Journal of Advanced Nursing Studies, 3*(1), 1–5. Retrieved from [http://search.proquest.com/docview/1637583983?accountid=14477%5Cnhttps://nevada.ual.es/biblioteca/gtb/sod/poa_login.php?centro=\\$UALMG&sid=\\$UALMG&title=International](http://search.proquest.com/docview/1637583983?accountid=14477%5Cnhttps://nevada.ual.es/biblioteca/gtb/sod/poa_login.php?centro=$UALMG&sid=$UALMG&title=International)

+Journal+of+Advanced+Nursing+Studies&atitle=Pain+management+barriers+in+critical+c
are+units%253

Bursac, Z., Gauss, C. H., Williams, D. K., & Hosmer, D. W. (2008). Purposeful selection of variables in logistic regression. *Source Code for Biology and Medicine*, 3, 17.

<http://doi.org/10.1186/1751-0473-3-17>

Cummings, G. G., Estabrooks, C. a., Midodzi, W. K., Wallin, L., & Hayduk, L. (2007).

Influence of organizational characteristics and context on research utilization. *Nursing Research*, 56(Supplement 1), S24–S39.

<http://doi.org/10.1097/01.NNR.0000280629.63654.95>

Cummings, G. G., Hutchinson, A. M., Scott, S. D., Norton, P. G., & Estabrooks, C. A. (2010).

The relationship between characteristics of context and research utilization in a pediatric setting. *BMC Health Services Research*, 10, 168–177. Retrieved from

<http://ezproxy.net.ucf.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=52804551&site=eds-live&scope=site>

Dopson, S., FitzGerald, L., Ferlie, E., Gabbay, J., & Locock, L. (2002). No magic target!

Changing clinical practice to become more evidence based. *Health Care Management*

Review, 27(3), 35–47. Retrieved from http://sfx.cranfield.ac.uk/cranfield?url_ver=Z39.88-

[2004&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&genre=article&sid=ProQ:ProQ%253Aabi](http://sfx.cranfield.ac.uk/cranfield?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&genre=article&sid=ProQ:ProQ%253Aabi)

[global&atitle=No+magic+target%2521+Changing+clinical+practice+to+become+more+evi](http://sfx.cranfield.ac.uk/cranfield?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&genre=article&sid=ProQ:ProQ%253Aabi)

[dence+based&title=Health+Care+Management+R](http://sfx.cranfield.ac.uk/cranfield?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&genre=article&sid=ProQ:ProQ%253Aabi)

Estabrooks, C. A., Floyd, J. A., Scott-Findlay, S., O’Leary, K. A., & Gushta, M. (2003).

Individual determinants of research utilization: A systematic review. *Journal of Advanced*

Nursing. <http://doi.org/10.1046/j.1365-2648.2003.02748.x>

- Estabrooks, C. A., Squires, J. E., Cummings, G. G., Birdsell, J. M., & Norton, P. G. (2009). Development and assessment of the Alberta Context Tool. *BMC Health Services Research*, 9, 234. <http://doi.org/10.1186/1472-6963-9-234>
- Estabrooks, C. A., Squires, J. E., Strandberg, E., Nilsson-Kajermo, K., Scott, S. D., Profetto-McGrath, J., ... Wallin, L. (2011). Towards better measures of research utilization: A collaborative study in Canada and Sweden. *Journal of Advanced Nursing*, 67(8), 1705–1718. <http://doi.org/10.1111/j.1365-2648.2011.05610.x>
- Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behavior Research Methods*, 41(4), 1149–60. <http://doi.org/10.3758/BRM.41.4.1149>
- Finley, G. A., Forgeron, P., & Arnaout, M. (2008). Action Research: Developing a Pediatric Cancer Pain Program in Jordan. *Journal of Pain and Symptom Management*, 35(4), 447–454. <http://doi.org/10.1016/j.jpainsymman.2007.05.006>
- Fleuren, M., Wiefferink, K., & Paulussen, T. (2004). Determinants of innovation within health care organizations. Literature review and Delphi study. *International Journal for Quality in Health Care*. <http://doi.org/10.1093/intqhc/mzh030>
- FluidSurveys. (2015). Context and pain management in Jordan PICUs. Retrieved August 13, 2015, from <http://fluidsurveys.com/surveys/ahmad-bPN/context-and-pain-management-in-jordan-picus/?code=>
- Forgeron, P. A., Finley, G. A., & Arnaout, M. (2006). Pediatric pain prevalence and parents' attitudes at a cancer hospital in Jordan. *Journal of Pain and Symptom Management*, 31(5), 440–448. <http://doi.org/10.1016/j.jpainsymman.2005.09.003>
- Gelinas, C., Fortier, M., Viens, C., Fillion, L., & Puntillo, K. (2004). Pain assessment and

- management in critically ill intubated patients: a retrospective study. *American Journal of Critical Care*, 13(2), 126. Retrieved from <http://ajcc.aacnjournals.org/cgi/content/abstract/13/2/126>
- Government of Canada. (2016). Canada's health care system. Retrieved March 9, 2017, from <https://www.canada.ca/en/health-canada/services/canada-health-care-system.html>
- Grant, M. J., Scoppettuolo, L. A., Wypij, D., & Curley, M. A. (2012). Prospective evaluation of sedation-related adverse events in pediatric patients ventilated for acute respiratory failure. *Crit Care Med*, 40(4), 1317–1323. <http://doi.org/10.1097/CCM.0b013e31823c8ae3>
- Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of innovations in service organizations: systematic review and recommendations. *Milbank ...*, 82(4), 581–629. <http://doi.org/10.1111/j.0887-378X.2004.00325.x>
- Hanberg, A., & Brown, S. (2006). Bridging the Theory-Practice Gap With Evidence-Based Practice. *The Journal of Continuing Education in Nursing*. <http://doi.org/10.1119/1.1639980>
- IBM Knowledge Center. (2016). Generalized Estimating Equations. Retrieved June 1, 2016, from http://www.ibm.com/support/knowledgecenter/en/SSLVMB_22.0.0/com.ibm.spss.statistics.help/spss/advanced/idh_idd_gee_repeated.htm
- International Association for Study of Pain. (2015). Declaration of Montreal. Retrieved September 27, 2016, from <http://www.iasp-pain.org/DeclarationofMontreal?navItemNumber=582>
- Ismail, A. (2016). The challenges of providing effective pain management for children in the pediatric intensive care unit. *Pain Management Nursing*, 17(6), 372–383.

<http://doi.org/10.1016/j.pmn.2016.08.005>

Jordan Ministry of Health. (2013a). About ministry of health. Retrieved October 3, 2016, from

<http://www.moh.gov.jo/EN/AbouttheMinistryofHealth/Pages/About-MinistryOf-Health.aspx>

Jordan Ministry of Health. (2013b). Annual Statistical Reports. Retrieved April 1, 2014, from

<http://www.moh.gov.jo/EN/Pages/Periodic-Newsletters.aspx>

Kitson, A., Harvey, G., & McCormack, B. (1998). Enabling the implementation of evidence based practice: a conceptual framework. *Quality in Health Care : QHC*.

<http://doi.org/10.1136/qshc.7.3.149>

Meijers, J. M. M., Janssen, M. A. P., Cummings, G. G., Wallin, L., Estabrooks, C. A., & Halfens, R. Y. G. (2006). Assessing the relationships between contextual factors and research utilization in nursing: systematic literature review. *Journal of Advanced Nursing*, 55(5), 622–635. <http://doi.org/10.1111/j.1365-2648.2006.03954.x>

Oakes, L. (2011). *Compact Clinical Guide to Infant and Child Pain Management*. (Y. D'Arcy, Ed.). New York: Springer Publishing.

Rycroft-Malone, J. (2004). The PARIHS framework--a framework for guiding the implementation of evidence-based practice. *Journal of Nursing Care Quality*, 19(4), 297–304. <http://doi.org/10.1097/00001786-200410000-00002>

Rycroft-Malone, J., Kitson, a, Harvey, G., McCormack, B., Seers, K., Titchen, a, & Estabrooks, C. (2002). Ingredients for change: revisiting a conceptual framework. *Quality & Safety in Health Care*, 11(2), 174–180. <http://doi.org/10.1136/qhc.11.2.174>

Samuels, J. G., & Fetzer, S. J. (2009). Evidence-based pain management: analyzing the practice environment and clinical expertise. *Clinical Nurse Specialist CNS*, 23(5), 245–51.

<http://doi.org/10.1097/NUR.0b013e3181b20745>

Squires, J. E., Estabrooks, C. A., Newburn-Cook, C. V., & Gierl, M. (2011). Validation of the conceptual research utilization scale: An application of the standards for educational and psychological testing in healthcare. *BMC Health Services Research, 11*(1), 107.

<http://doi.org/10.1186/1472-6963-11-107>

Squires, J. E., Estabrooks, C. A., Scott, S. D., Cummings, G. G., Hayduk, L., Kang, S. H., & Stevens, B. (2013). The influence of organizational context on the use of research by nurses in Canadian pediatric hospitals. *BMC Health Services Research, 13*(1), 351.

<http://doi.org/10.1186/1472-6963-13-351>

Squires, J. E., Hayduk, L., Hutchinson, A. M., Mallick, R., Norton, P. G., Cummings, G. G., & Estabrooks, C. A. (2015). Reliability and validity of the Alberta context tool (ACT) with professional nurses: Findings from a multi-study analysis. *PLoS ONE, 10*(6), 1–17.

<http://doi.org/10.1371/journal.pone.0127405>

Srouji, R., Ratnapalan, S., & Schneeweiss, S. (2010). Pain in children: Assessment and nonpharmacological management. *International Journal of Pediatrics, 2010*(6), 694–699.

<http://doi.org/10.1155/2010/474838>

Stevens, B., Riahi, S., Cardoso, R., Ballantyne, M., Yamada, J., Beyene, J., ... Ohlsson, A. (2011). The influence of context on pain practices in the NICU: Perceptions of health care professionals. *Qualitative Health Research, 21*(6), 757–70.

<http://doi.org/10.1177/1049732311400628>

Turner, H. N. (2005). Complex pain consultations in the pediatric intensive care unit. *AACN Clinical Issues, 16*(3), 388–95. Retrieved from

<http://www.ncbi.nlm.nih.gov/pubmed/16082240>

Wallin, L., Estabrooks, C. A., Midodzi, W. K., & Cummings, G. G. (2006). Development and Validation of a Derived Measure of Research Utilization by Nurses. *Nursing Research*, 55(3), 149–160. <http://doi.org/10.1097/00006199-200605000-00001>

Chapter Five

Integrated Discussion

Integrated Discussion

Introduction

This dissertation provides insight on pain management for critically ill children cared for in PICUs and consists of three studies: i) a scoping review synthesizing primary research on pain management interventions used or tested in the PICU; ii) an exploration of pain management interventions used in PICUs in Jordan; and iii) a study determining contextual factors influencing the use of research for pain management in Jordanian PICUs.

The PARIHS framework (Kitson, Harvey, & McCormack, 1998) has been used to guide this dissertation. The first two studies focus on the first construct of the PARIHS framework, which is the evidence for pain management in the PICU. The third study focuses on the second construct of the PARIHS framework, which is context, and its influence on the use of pain management evidence in the PICU.

Study One, the scoping review, synthesized primary research on pain management interventions in PICUs world-wide in the last three decades. These findings were used to compare pain management with those in Jordanian PICUs, which were identified in Study Two. The results of the first two studies highlight the variation and similarities between pain management interventions in Jordanian PICUs and pain management interventions used world-wide. These two studies also identified knowledge and research gaps and the areas that need improvement in Jordanian PICUs. Study Three identified important contextual factors that influence the use of research evidence for pain management in the Jordanian PICUs as perceived by Jordanian PICU nurses. Identifying important modifiable contextual factors will help in successful implementation of pain management research evidence in Jordanian PICUs. The findings of the three studies have the potential to improve pain management practices used by

HCPs, including nurses in Jordanian PICUs, which in turn, may lead to relieving or decreasing the suffering of children in Jordanian PICUs as a result of poorly controlled pain. The findings also have relevance for nursing education, practice, research, and policy. Furthermore, the findings provide insights that may help to bring about changes in PICUs in other low and middle income countries.

Given that each study was discussed separately with study specific findings, this integrated discussion will briefly review the key results of the three studies followed by a focused discussion of the common and divergent findings amongst the three studies. The discussion is followed by limitations, implications, and recommendations in terms of pediatric pain management in PICUs.

Summary of Dissertation Findings

Study One. The scoping review identified 7047 articles of which 100 underwent full text screening and 27 studies were included in the final review. Seventeen articles (63%) were non-experimental studies, and 10 (37%) were experimental, of which 8 were randomized controlled trials (RCTs). Interventions were categorized into: Pharmacological, physical, psychological, and others. The majority of the articles solely focused on pharmacological interventions (n= 21, 78%), one on physical, and one on psychological interventions. Four studies included more than one category of interventions. All of these four studies were descriptive and non-experimental in nature. The majority of the studies focused on post-operative pain management (n=18, 67%), three (11%) on analgesia and sedation management mainly for ventilated children, and six (22%) on other pain management for different conditions (e.g., invasive procedures and trauma). Morphine and fentanyl were the most commonly used and studied pharmacological agents and dexmedetomidine was studied in the context of pain control after cardiac surgery. The use of

non-pharmacological interventions was limited in the PICU, and such interventions were only studied in North America. Overall, research on pain management interventions in the PICU is limited and thus research evidence for children in the PICU needs to be supplemented with research from other contexts as well as local evidence (e.g. clinical expertise) to support pain care.

Study Two. Nurse unit leaders of four PICUs in Jordan participated in the survey that captured pain management practices as well as the existence and content of guidelines and policies in Jordanian PICUs. All four units had written pain management guidelines, which included pain assessment, documentation, and management. All four units used one or more pain assessment tools; four units used the FLACC scale and one unit also used the COMFORT scale. In three units, pain management was considered multi-disciplinary and routinely discussed on unit rounds. In two units, continuous infusions of intravenous opioids (fentanyl) were used as well as sedatives (midazolam) and neuromuscular blockers for most ventilated patients. In the two other units, continuous intravenous infusions of opioids were not used and only sedatives (midazolam) were administered for patients on mechanical ventilation. The most commonly used opioids for continuous and non-continuous infusion were fentanyl and pethidine respectively. In two units, there were no specific guidelines on the use of non-opioid analgesics, PCA, or the management of various types of post-operative pain. Only one unit had guidelines on epidural analgesia and procedural pain management and only one unit used non-pharmacological techniques for pain management. No unit used an opioid or sedative withdrawal assessment tool or had pain management guidelines on the use of topical anesthetic agents or sucrose. Overall, the guidelines or policies to support pain management interventions were limited in the four

participating Jordanian PICUs. This potentially puts children at risk for inadequately managed pain.

Study Three. Seventy-three PICU nurses from the four participating PICUs in Jordan completed a survey capturing contextual factors and the use of pain management research evidence in the PICU. Nine contextual factors from the ACT significantly and positively correlated with IRU for pain assessment. These nine factors were: Leadership, culture, evaluation, formal interactions, social capital, structural and electronic resources, organizational slack-staffing, organizational slack-space, and organizational slack-time. Eight of the nine contextual factors significantly and positively correlated with IRU for pain treatment. These eight factors were: Structural and electronic resources, leadership, culture, formal interactions, social capital, evaluation, organizational slack-staffing and organizational slack-space. Six of the nine contextual factors significantly and positively correlated with the CRU for pain management (combination of assessment and treatment). These six factors were: Social capital, culture, evaluation, organizational slack-space, structural and electronic resources, and organizational slack-time. Hospital type (Ministry of Health governmental hospital) predicted IRU for pain assessment. Social capital as well as structural and electronic resources predicted IRU for pain treatment. Social capital predicted CRU for pain management. Overall, context plays an important role in the use of research for pain management by Jordanian PICU nurses. Concentrating on modifiable contextual factors may increase the use of research for pain management. This may ultimately lead to improved pain management for children cared for in Jordanian PICUs.

Discussion

Findings from Studies Two and Three highlight that nurses working in Jordanian PICUs use some evidence-informed pain management strategies but that there were few institutional resources (e.g. guidelines) to support differing approaches to pain management for children in the PICU. The most robust finding was that all the units had a policy that supported pain assessment, including specifying a standardized validated pain intensity tool. However, there was limited use of evidenced informed pain treatment apart from opioid infusions, highlighting the need to improve pain management practices.

The most commonly used pain assessment tool used in PICUs, as identified in the scoping review (Study One), is the FLACC behavioural scale (Merkel, Voepel-Lewis, Shayevitz, & Malviya, 1997) which was used in 11 of the 27 included studies (Amigoni et al., 2012; Chrysostomou et al., 2006; Chrysostomou et al., 2009; Horvath et al., 2015; Larson et al., 2013; Naguib et al., 2012; Renfrow, 2009; Reiter et al., 2012; Ross et al., 2011; Sharek et al., 2006; Wu et al., 2009). This tool was also identified as the pain assessment tool used in all four Jordanian PICUs. This is not surprising, as the majority of patients in the PICU cannot verbally communicate their pain due to their condition, their developmental level, or both. Thus, an observational pain scale which uses behavioural responses is at present the most suitable scale for this population (Ismail, 2016; Oakes, 2011). Moreover, the FLACC scale is easy to use, does not require a long time to determine a child's pain intensity, and can be used for a wide range of children (Bai, Hsu, Tang, & Van Dijk, 2012; Crellin, Harrison, Santamaria, & Babl, 2015; Harris et al., 2016; Manworren & Hynan, 2003; Merkel et al., 1997; Voepel-Lewis, Zanotti, Dammeyer, & Merkel, 2010). The modified FLACC scale was not identified in the scoping review, and not used in the four PICUs in Jordan. It may be more appropriate however to use the modified

FLACC scale as modifying the criteria for the cry item may be more useful in the PICU with ventilated children unable to vocalize. In the modified FLACC scale, the cry item was modified to include the observation of cry face e.g., facial expressions of crying that indicate crying or moaning (Johansson & Kokinsky, 2009). The lag time between research findings and implementing the findings could be the reason for not using the modified FLACC scale, published in 2009 (Johansson & Kokinsky, 2009).

Study Two found only one Jordanian PICU used another pain assessment tool apart from the FLACC scale. This second pain assessment tool was the COMFORT scale which includes both behavioral and physiologic (e.g. heart rate) indicators of pain (Ambuel, Hamlett, Marx, & Blumer, 1992). Similarly, the use of the COMFORT scale in Study One (scoping review) was limited with only three studies (Amigoni et al., 2012; Benini et al., 2010; Van Der Marel et al., 2001) reporting its use. Of note, is that the modified COMFORT-B version has been recommended for use in the PICU since its publication more than 15 years ago, in 2002, as it does not include physiological indicators for the presence of pain. Physiological indicators such as heart rate, can be altered by medications commonly used in PICUs such as inotropes, and can also be altered due to the patients' conditions (e.g., hypovolemia), therefore are not specific to pain responses (Carnavale & Razack, 2002; Mattsson, Forsner, & Arman, 2011; Thomas, Dhanani, Irwin, Writer, & Doherty, 2010; Van Dijk et al., 2000). Therefore, removing these physiological items reportedly improved the validity and reliability of the scale (Carnavale & Razack, 2002). More research is needed to identify factors influencing the use of the COMFORT-B scale in the PICU, in Jordan and internationally and subsequently, working on KT interventions to increase the uptake of this scale in clinical practice. More studies also need to be

conducted on pain assessment within the PICU given that there are also limitations to using the COMFORT-B scale in critically ill children who are receiving muscle relaxants.

Indeed, internationally, there is no agreement on a specific scale to be used for pain assessment in the PICU. Few guidelines exist (Keogh, Long, & Horn, 2015; Playfor et al., 2006; Thomas et al., 2010). Playfor et al. (2006) recommended to assess pain regularly and to routinely document pain assessment. For children unable to communicate, they recommended assessing for the presence of behavioural and physiological indicators of pain. These authors support the use of behavioural observational scales when possible (e.g., FLACC scale) for children under three years of age, self-reporting techniques when possible, such as faces scales (photographs or drawings) for children three to eight years, and uni-dimensional tools for children above eight, such as the numeric rating scale (NRS). In Canada, Thomas et al. (2010) recommended use of the COMFORT-B Scale (Carnavale & Razack, 2002; Van Dijk et al., 2000) to assess pain for intubated and ventilated children. In Australia, Keogh, Long and Horn (2015) recommended the Multidisciplinary Assessment of Pain Scale (MAPS) (Ramelet, Rees, McDonald, Bulsara, & Huijer Abu-Saad, 2007) for use in the PICU. More recently, Harris et al. (2016) recommended the COMFORT-B scale, FLACC or MAPS for children in the PICU. This variability in recommendations and the use of recommended pain assessment tools is not surprising as there is no one definitive pain assessment tool for children and adolescents in the PICU. However, it is noteworthy that only one PICU in Jordan used the COMFORT tool and no PICU used the COMFORT-B Scale. Clearly more research is needed to understand the relationship between pain assessment using various tools and pain treatment in the PICU.

Study Three indicated that the use of research for pain assessment was affected by the type of hospital in Jordan. Nurses who worked in governmental hospitals (run by the Ministry of

Health) were less likely to use research evidence for pain assessment compared to other hospitals in Jordan (university and non-profit). This finding is consistent with what is found in Study Two. Governmental hospital PICUs had less supporting policies and guidelines for pain management than other hospitals. There was also inconsistency in pain management practices between the hospitals in terms of frequency of pain assessment. In one hospital, pain assessment was routinely conducted and documented every 24 hours and in the other three units, every 2 hours. Many factors influence the frequency of pain assessment such as the medical condition of the patient and the practice setting (RNAO, 2013). Assessment of pain with the assessment of vital signs, which is commonly referred to as pain being the fifth vital sign, has been advocated by professional organizations including the American Pain Society (American Pain Society Quality of Care Committee, 1995; National Pharmaceutical Council, 2001) although the extent to how this happens in practice is variable (Harrison et al., 2014; Stevens et al., 2012; Taylor, Boyer, & Campbell, 2008; Twycross, 2007). When the child receives infusion of analgesia, Harris et al. (2016) recommended assessing pain every one to two hours. In the PICU, vital signs are continuously monitored and recorded hourly. If pain is routinely assessed every hour, this may lead to more effective treatment of pain. However, in some governmental hospitals, as per findings of Study Two, routine assessment of pain may only be done every 24 hours, which places critically ill children at risk for undermanaged pain. Although as stated above, there is no agreement internationally on a specific pain assessment scale to be used in the PICU, the COMFORT-B tool has been recommended as the preferred pain assessment scale to use (Ismail, 2016; Thomas et al., 2010), as it can be used for a wide range of critically ill children in the PICU, ventilated and non-ventilated, and from 0 to 18 years of age (Bai et al., 2012; Carnavale & Razack, 2002; Ista, M, Tibboel, M, & Aneja, 2005; Johansson & Kokinsky, 2009). The finding

that governmental run hospitals did not use the COMFORT scale or the COMFORT-B scale is also consistent with a recent study conducted in Jordan that found that the use of pain assessment tools by NICU nurses was low in Jordanian governmental hospitals (Abdel Razeq et al., 2016). One important indicator for research evidence use is the utilization of research-based appropriate assessment tools such as pain assessment tools (Estabrooks et al., 2011). Abdel Razeq et al. (2016) indicated that governmental hospitals have a higher patient turnover and may be less equipped than other hospitals, and these organizational factors may explain why the use of pain assessment tools is limited in hospitals run by the Ministry of Health. This is consistent with findings of Study Three in this dissertation, which showed that ACT scores on all 10 contextual factors were lower amongst the PICU nurses working for governmental run hospitals compared to university and non-profit hospitals, and that five of these contextual factors were statistically significantly different (structural and electronic resources, evaluation, formal interactions, organizational slack-staffing, and organizational slack-space) in governmental run hospitals compared to other hospitals. More research is needed to understand the underlying challenges faced by Jordanian governmental hospitals run by the Ministry of Health and to understand the contextual factors which may be modifiable, or amendable to intervention.

For pain treatment, Jordanian PICUs used some recommended evidence for pain treatment such as guidelines for pain treatment, using pharmacological and non-pharmacological pain interventions, and multidisciplinary pain management. Yet, there are areas that need improvement, including the use of continuous and intermittent opioid infusions for treatment of pain and distress, and use of recommended non-pharmacological pain and stress reduction strategies. There was only one PICU that had a guideline for non-pharmacological approaches (touch and distraction). Moreover, results of Study Two found that pain treatment in the

governmental hospitals were less informed by research evidence and less supported by CPGs compared to other hospitals. Study One showed that fentanyl was one of the most commonly used pharmacological agents for pain management in the PICU internationally, and Study Two showed similar results for practices in Jordan. Fentanyl was the most commonly used opioid reported for continuous infusion in Jordanian non-governmental PICUs. That is not surprising since the majority of children in the PICU experience moderate to severe pain as a result of different pain sources, including the underlying illness (e.g., surgery, burns, and trauma), complications of the primary illness (e.g., pancreatitis), invasive procedures (e.g., chest tube insertion), or supporting and monitoring systems (e.g., mechanical ventilation) (Ismail, 2016; Stevens et al., 2011). The WHO recommends administration of opioid analgesics for moderate to severe pain in children (WHO, 2012). Playfor et al. (2006) recommend fentanyl by continuous IV infusion for severe pain, and emphasized that adequate analgesia should be provided to all children in the PICU regardless of the need for sedation. However, as found in Study Two, in two governmental run PICUs in Jordan, children on mechanical ventilation do not receive any kind of analgesia. They only received sedation, which leaves children at risk for suffering from unrecognized severe pain caused by various sources such as mechanical ventilation, underlying illness, and painful procedures, as sedative medications diminish behavioural signs of pain as a result of sedation, not analgesia. Study Two showed that the most commonly used opioids for intermittent infusion was pethidine. The use of pethidine in children however is limited especially for those with kidney or liver disease. The use of pethidine is also prohibited in some pediatric hospitals due to drug interactions, adverse effects, and toxicity (Benner & Durham, 2011). Thus, education is needed for HCPs working in governmental hospitals in Jordan to

ensure provision of effective analgesia for children in the PICU when they receive sedation, such as morphine and fentanyl, and limit the use of pethidine.

Study Two also found that the use of PCA to deliver intravenous opioids is limited in Jordanian PICUs. Only one unit in Jordan had a guideline related to the use of PCA. Opioid infusion via PCA is recommended for alert non-sedated children aged seven years and older as this mode of delivery allows them to individualize their own pain control to receive adequate pain control with fewer side effects (Playfor et al., 2006). Study One indicated that PCA was effective for pain control for alert children in the PICU following spinal surgery and thoracoscopic surgery (Butkovic et al., 2007; Weldon, Connor, & White, 1993). Although PCAs are limited in PICUs as many children in PICUs are critically ill and sedated, the lack of policy or guidelines means that this effective form of opioid administration is not used when it is possible to do so.

Study Three indicated that context influences the use of research evidence for pain treatment. The majority of the ACT contextual factors had a positive relationship with both types of research utilization for pain management (IRU and CRU) and social capital and structural and electronic resources were predictors for research use for pain treatment. Scores of these factors were low in the governmental hospitals compared to other hospitals. Relationships and social interaction are important factors that impact research use (Estabrooks, Floyd, Scott-Findlay, O'Leary, & Gushta, 2003; Fleuren, Wiefferink, & Paulussen, 2004; Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004). Research use by different HCPs for pain management in Jordanian PICUs may be increased by encouraging and fostering interaction amongst HCPs as supported by Study Three findings. As per Study Three findings, the greater availability and use of structural (e.g., textbooks) and electronic resources (e.g., online journals, policies, and

procedures) the higher the reported IRU for pain treatment is. A previous study conducted in critical care units which included PICUs in Jordan, noted that the inadequacy in some structural and electronic resources (e.g., clinical practice guidelines and policies) were perceived by nurses as barriers to providing effective pain management in the Jordanian critical care settings (Batiha, 2014). More recently, Abdel Razeq et al. (2016) also indicated that some hospitals in Jordan were less equipped than other hospitals. These contextual factors may explain why pain treatment in some Jordanian PICUs, especially those in governmental hospitals, is not completely informed by research evidence. This suggests that further work on translating recommended research evidence into practice for these PICUs, such as continuous opioid infusions in combination with sedatives as required for mechanically ventilated children, is warranted.

Study One revealed that there was limited research regarding the use of non-pharmacological interventions globally in PICUs, and the few studies published related to use or evaluation of non-pharmacological interventions were conducted in North America only. This limited research evidence base is aligned with results of Study Two, which found that only one of the four participating PICUs in Jordan had a policy or guideline on the use of non-pharmacological strategies for pain management. This one PICU reported using two kinds only including touch and distraction. However, it is unclear what activities registered nurses provided when they perform distraction and touch. A previous study in Jordan indicated that nurses used some forms of simple distraction for children's pain relief, when probed (Finley, Forgeron, & Arnaout, 2008). There is an opportunity to improve and increase the use of non-pharmacological approaches in Jordanian PICUs given that these techniques are within the scope of practice of nurses.

Study Two indicated that all four participating PICUs in Jordan had some pain management practices which were not informed by evidence. For example, no unit used an opioid or sedative withdrawal assessment tool or had pain management guidelines on the use of topical anesthetic agents, sucrose for infants, or involving the patient's family in pain management decisions. Yet, use of a withdrawal assessment tool is recommended after a few days of continuous use of opioids or benzodiazepines, as withdrawal symptoms can develop after five to seven days of continuous infusion or less (Da Silva, Reis, Fonseca, & Fonseca, 2016; Playfor et al., 2006). Local anesthetic agents have been recommended for use before painful needle-related procedures in the PICU (Playfor et al., 2006; Wilson-Smith, 2011). Local anesthetic agents can be topically applied prior to painful procedures such as venous cannulation and arterial puncture (Cregin et al., 2008) as well as injected at the site for more invasive procedures such as central venous catheter placement and chest drain insertion (Ramamurthi & Krane, 2007). Small volumes of sweet solutions such as sucrose or glucose, have long been recommended for infants during painful procedures (Anand, 2001; Harrison, Beggs, & Stevens, 2012; Harrison et al., 2017). Involving the family in pain management processes can also make a positive impact on the child's pain experience (Rennick et al., 2011). It is recommended to involve the family in pain management in the PICU (Harris et al., 2016). One strategy to improve pain management within the PICUs in Jordan may be education on various topics including withdrawal syndrome, use of a withdrawal scale, use of CPGs to guide such practices, encourage the use of topical anesthetic agents and sweet solutions for painful procedures for infants, and advocate for the involvement of the family in pain management decisions.

This dissertation identified important factors that influence the use of pain management evidence in Jordanian PICUs. Study Three revealed that the majority of contextual factors on the

ACT tool were correlated with research use (IRU and CRU) for pain management, and two contextual factors (social capital and structural and electronic resources) were significant predictors of research use by nurses working in Jordanian PICUs. The magnitude of the associations were stronger than previously published studies conducted in Western countries (Estabrooks, Squires, Cummings, Birdsell, & Norton, 2009; Squires et al., 2015), suggesting that although contextual factors may influence Western nurses' use of research, contextual factors may play a more significant role in nurses' use of research for pain management in low to middle income countries such as Jordan.

The third construct of the original PARIHS framework focuses on facilitation. Facilitators can develop facilitation strategies to improve the uptake, adoption, and implementation of the evidence into practice. Nurses, administrators and educators can benefit from the results of this dissertation when they develop, tailor, or implement projects aiming at improving pain management practices in Jordanian PICUs. Studies in other areas have identified different facilitation strategies that have been found to increase successful implementation of evidence into practice such as goal setting, promoting uptake of pain management consensus guidelines, audit, reminders, and audit and feedback. However, it is unclear if these same strategies are applicable in non-Western countries or in PICUs. Therefore research is needed to determine the best facilitation strategies to use in Jordanian PICUs to improve pain management practices.

The adoption of the ChildKind International principles may be a facilitation strategy to improve evidenced informed pain management in Jordanian PICUs. ChildKind International is a global initiative aimed at reducing pain for all children regardless of the setting of care. The organization provides an international certification of excellence to healthcare facilities that have demonstrated strong institutional commitment towards best pain care practices. ChildKind

certification is based on five principles: 1) institutional commitment to pain prevention, assessment, and management; 2) comprehensive ongoing awareness and education on pain for clinician, staff, and patients and families; 3) sustained use of evidenced informed and developmentally appropriate process for pain assessment and documentation; 4) specific and evidenced informed protocols for pain prevention and treatment that include pharmacological, psychological, and physical methods; and 5) regular self-monitoring program for the five principles and their associated criteria (Childkind, 2017). Study Two showed that the four participating PICUs had pain management policies. Ongoing education on pain was not addressed but all four participating PICUs used one or more pain assessment tools. However, the particular pain assessment tools used had limitations for their use in the population of children cared for in PICUs, and the use of more suitable pain assessment tools are recommended. It was also unclear how regularly the pain assessment tools were used. One PICU conducted pain assessments every 24 hours only. Pharmacological pain treatment was the main intervention that was used in Jordanian PICUs but not all the units had a range of pharmacological approaches and pethidine, which has significant efficacy and safety limitations, was the analgesic of choice for intermittent analgesic administration. Regular self-monitoring of pain treatment was not evident in the participating PICUs nor was institutional commitment to pain control. Jordanian PICUs may benefit from adopting the principles and criteria for ChildKind International certification in terms of determining a comprehensive approach to improving their pain management. However further research is warranted, especially in terms of ascertaining ongoing education on pain, determining administrative support for pain management, increasing the use of psychological and physical interventions, and understanding current processes of audit and feedback for self-monitoring of pain management.

This dissertation focused primarily on the first two constructs of the original PARiHS framework (evidence and context). The PARiHS framework has been recently revised and is now referred to as integrated or i-PARiHS (Harvey & Kitson, 2016). The i-PARiHS expands on the original PARiHS, and facilitation is further described in terms of how it enables more effective operationalization of change in practice and thereby improving chances of success of the implementation process. This achievement of implementation goals results from the facilitation of an innovation that enables recipients to adopt and implement the innovation within their context. The context can be local, organizational or a larger health system. The i-PARiHS framework has four constructs which are facilitation, innovation, recipients and context. Facilitation is viewed as an active element assessing and integrating the other three constructs. Consistent with the i-PARiHS, future KT projects aiming at improving the pain management status in Jordanian PICUs should actively involve the multidisciplinary knowledge users as well as parents of children in the PICU in developing, adopting, and implementing pain management evidence (innovation) considering the local, organizational, and the Jordanian health care system.

Limitations

There are limitations to the three studies that formed this dissertation. For Study One, all the articles identified from the literature search were published in English. It is not known if a search which included other databases may have identified studies published in other languages. Secondly, Study One's scoping review focused only on quantitative designs. Including qualitative studies may have provided additional valuable information concerning pain management in the PICU setting. Furthermore, scoping review methodology does not include quality assessment for included studies, thus some studies with positive outcomes may have lacked rigour calling into question their findings. For Studies Two and Three, limitations related

to the sample size, which was drawn from three of the four health sectors in Jordan:

Governmental (Ministry of Health public hospitals), university hospitals, and non-profit

hospitals. No data were collected from military hospitals, which may have different contexts.

Secondly, data included only registered nurses from participating PICUs. Other HCPs in these

PICUs may perceive the same contexts but in different ways.

Implications

This dissertation focused on the first two constructs of PARIHS framework (evidence and context). This dissertation identified pain management interventions used world-wide in PICUs, provided useful information on pain management practices and use of pain related guidelines in Jordanian PICUs, and identified important contextual factors that influence the use of pain management evidence in Jordanian PICUs. Given the influence of context on research use for pain management, multifaceted KT strategies that consider the context in Jordanian PICUs are needed to move pain management evidence into practice. This baseline knowledge has the potential to be used to improve pain management for children in PICUs in Jordan. The findings of this dissertation can support the health care leaders to review and improve their policies and guidelines for pain management in Jordanian PICUs. The findings can also support clinical and academic educators to design specific educational programs for HCPs as well as undergraduate and graduate students working in PICUs. Quality improvement projects aimed at improving pain management practices in Jordanian PICUs and facilitated by internal and external facilitators are also needed. As the majority of the studies identified in the scoping review were non RCTs, further high quality rigorous research is warranted to determine the effectiveness and usefulness of interventions for pain management in the PICU.

Recommendations

Based on the results of this dissertation, the following recommendations are made that may help improve pain management practices, including pain assessment and treatment, in Jordanian PICUs. For pain assessment, recommendations include: 1) revision and standardization of supporting policies and guidelines based on the research evidence identified in the scoping review; 2) encourage the use of the modified FLACC and/or the COMFORT-B scales for patients unable to self-report their pain, the revised FLACC observational scale for children with cognitive impairment, and use of appropriate tools to enable self-report of pain for children who are able to self-report; 3) standardize pain assessment and documentation in the PICU to at least every one to two hours and re-assessment following pain treatment administration or change in pain management (pharmacological, psychosocial, physical); and 4) provide training for the multidisciplinary HCP team on the use of the recommended pain assessment scales. Furthermore, patients and parents need to be informed about the importance of verbalizing concerns about pain to clinicians and be involved in pain assessment when able.

For pain treatment, recommendations include: 1) revision and standardization of supporting policies and guidelines based on the research evidence identified in the scoping review; 2) consider using opioids (fentanyl or morphine) for mechanically ventilated patients in all PICU settings for moderate to severe pain; 3) encourage the use of paracetamol including IV paracetamol if available for children in mild to moderate pain; 4) consider using topical anesthetic agents for needle-related painful procedures in children, and sucrose for infants during painful procedures; 5) involve the family in the pain management processes and decisions and advocate for their presence and participation in their child's pain care; 6) increase the use of non-pharmacological interventions as adjuncts to pharmacological treatment; 7) consider the use of PCA for alert older children where possible; 8) increase professional collaboration between the

various HCPs involved in pain care; and 9) facilitate the availability and use of structural resources such as textbooks and electronic resources such as online pain journals for pain management. For opioid withdrawal management recommendations include: 1) use of evidence informed recommended approach to tapered weaning from opioids; 2) observe for the development of withdrawal symptoms; and 3) use one of the recommended withdrawal assessment tools. In addition, supporting pediatric units to adopt the five principles of ChildKind would provide a structure in which to work and facilitate setting of goals based on internationally agreed upon best standards of pain care for hospitalized children.

Results of this dissertation suggest many recommendations for future research. Recommendations for future research include: 1) rigorous experimental approaches to study the efficacy and effectiveness of pharmacological and non-pharmacological pain management interventions in PICU as there is little known in this area about these interventions; 2) further studies on pain assessment in the PICU: Identify and control for effects of potential confounders that may affect the pain assessment accuracy when using pain management interventions to establish the validity and accuracy of commonly used tools in different situations; and 3) conduct rigorous systematic reviews to build a high quality synthesized evidence base to use for pain management in the PICU. Such reviews could include the effectiveness of non-pharmacological pain interventions in reducing pain and the comparative effectiveness of different pharmacological interventions, such as morphine, fentanyl, dexmedetomidine, remifentanyl, ketorolac, and intravenous acetaminophen.

For future research specific to the Jordanian context, a KT project, tailoring interventions to the local context and modifying important contextual factors such as access to more structural and electronic resources, with the aim of improving research use by HCPs to achieve better pain

management in Jordanian PICUs is needed. Further research is warranted to explore the facilitators and challenges of utilizing pain management research evidence in practice in Jordanian hospitals. Finally, as a first approach to improving practice, key findings of this dissertation will be shared with HCPs in the Jordanian hospitals who participated in Study Two and Study Three. Multiple KT strategies will be used to disseminate these findings based on the contexts of the units and evidence to support various strategies e.g., a brief card of the findings and recommendations to be sent to the participated units.

Conclusion

This dissertation highlights that there are no best practice evidence-based pain management guidelines for PICU published in the literature. Similarly, the guidelines that are used or available in Jordan PICUs are not standardized. There are similarities as well as differences between the four participating Jordanian PICUs in terms of pain management practices and supporting documents, as well as other PICUs world-wide. Pharmacological pain management interventions are the most commonly used strategies in PICUs in Jordan and the most studied approach published globally, with fentanyl being the most commonly used/studied analgesic. Non-pharmacological interventions are not widely used in the Jordanian PICUs and there are few studies world-wide examining their efficacy or use. Similar to studies conducted in North America, context plays an important role in Jordanian PICU nurses' use of research for pain management. The majority of modifiable contextual factors on the ACT tool correlated with the IRU and CRU for pain management. Social capital was the contextual factor that significantly predicted both IRU and CRU by Jordanian PICU nurses. Contextual factors described as structural and electronic resources also significantly predicted instrumental research use of both pain assessment and pain treatment in Jordanian PICUs. There is an opportunity to improve pain

management in Jordanian PICUs by implementing knowledge translation activities which include the consistent use of best practices for pain management and target modifiable contextual factors.

References

- Abdel Razeq, N. M., Akuma, A. O., & Jordan, S. (2016). Status of neonatal pain assessment and management in Jordan. *Pain Management Nursing, 17*(4), 239–248.
- Al Sutari, M. M., Abdalrahim, M. S., Hamdan-Mansour, A. M., & Ayasrah, S. M. (2014). Pain among mechanically ventilated patients in critical care units. *Journal of Research in Medical Sciences : The Official Journal of Isfahan University of Medical Sciences, 19*(8), 726–32.
- Ambuel, B., Hamlett, K. W., Marx, C. M., & Blumer, J. L. (1992). Assessing distress in pediatric intensive care environments: the COMFORT scale. *Journal of Pediatric Psychology, 17*(1), 95–109.
- Amigoni, A., Catalano, I., Vettore, E., Brugnaro, L., & Pettenazzo, A. (2012). Practice of analgesia and sedation in Italian pediatric intensive care units: Did we progress? *Minerva Anestesiologica, 78*(12), 1365–1371.
- Anand, K. J. (2001). Consensus statement for the prevention and management of pain in the newborn. *Archives of Pediatrics & Adolescent Medicine, 155*(2), 173–80.
- Bai, J., Hsu, L., Tang, Y., & Van Dijk, M. (2012). Validation of the COMFORT behavior scale and the FLACC scale for pain assessment in Chinese children after cardiac surgery. *Pain Management Nursing, 13*(1), 18–26.
- Batiha, A.-M. (2014). Pain management barriers in critical care units: A qualitative study. *International Journal of Advanced Nursing Studies, 3*(1), 1–5.
- Benini, F., Farina, M., Capretta, A., Messeri, A., & Cogo, P. (2010). Sedoanalgesia in paediatric intensive care: A survey of 19 Italian units. *Acta Paediatrica, International Journal of Paediatrics, 99*(5), 758–762.

- Benner, K. W., & Durham, S. H. (2011). Meperidine restriction in a pediatric hospital. *J Pediatr Pharmacol Ther*, 16(3), 185–190.
- Butkovic, D., Kralik, S., Matolic, M., Kralik, M., Toljan, S., & Radesic, L. (2007). Postoperative analgesia with intravenous fentanyl PCA vs epidural block after thoracoscopic pectus excavatum repair in children. *British Journal of Anaesthesia*, 98(5), 677–681.
- Carnavale, F. A., & Razack, S. (2002). An item analysis of the COMFORT scale in a pediatric intensive care unit. *Pediatric Critical Care Medicine*, 3(2), 177–180.
- Childkind. (2017). childkind international.pdf. Retrieved November 24, 2017, from <http://childkindinternational.org/principles>
- Chrysostomou, C., Di Filippo, S., Manrique, A.-M., Schmitt, C. G., Orr, R. a, Casta, A., ... Munoz, R. (2006). Use of dexmedetomidine in children after cardiac and thoracic surgery. *Pediatric Critical Care Medicine : A Journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies*, 7(2), 126–131.
- Chrysostomou, C., Sanchez De Toledo, J., Avolio, T., Mota, M. V, Berry, D., Morell, V. O., ... Munoz, R. (2009). Dexmedetomidine use in a pediatric cardiac intensive care unit: can we use it in infants after cardiac surgery? *Pediatric Critical Care Medicine : A Journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies*, 10(6), 654–660.
- Cregin, R., Rappaport, A. S., Montagnino, G., Sabogal, G., Moreau, H., & Abularrage, J. J. (2008). Improving pain management for pediatric patients undergoing nonurgent painful procedures. *American Journal of Health-System Pharmacy*, 65(8), 723–727.
- Crellin, D. J., Harrison, D., Santamaria, N., & Babl, F. E. (2015). Systematic Review of the FLACC scale for assessing pain in infants and children: Is it reliable, valid, and feasible for

- use? *Pain*, 156(11), 2132–2151.
- Dantas, L. V. R. P., Dantas, T. S. P., Santana-Filho, V. J., Azevedo-Santos, I. F., & DeSantana, J. M. (2016). Pain assessment during blood collection from sedated and mechanically ventilated children. *Revista Brasileira de Terapia Intensiva*, 28(1), 49–54.
- Da Silva, P. S. L., Reis, M. E., Fonseca, T. S. M., & Fonseca, M. C. M. (2016). Opioid and benzodiazepine withdrawal syndrome in PICU patients: Which risk factors matter? *Journal of Addiction Medicine*, 10(2), 110–116.
- Estabrooks, C. A., Floyd, J. A., Scott-Findlay, S., O’Leary, K. A., & Gushta, M. (2003). Individual determinants of research utilization: A systematic review. *Journal of Advanced Nursing*, 43(5), 506–520.
- Estabrooks, C. A., Squires, J. E., Cummings, G. G., Birdsell, J. M., & Norton, P. G. (2009). Development and assessment of the Alberta Context Tool. *BMC Health Services Research*, 9, 234.
- Estabrooks, C. A., Squires, J. E., Strandberg, E., Nilsson-Kajermo, K., Scott, S. D., Profetto-McGrath, J., ... Wallin, L. (2011). Towards better measures of research utilization: A collaborative study in Canada and Sweden. *Journal of Advanced Nursing*, 67(8), 1705–1718.
- Finley, G. A., Forgeron, P., & Arnaout, M. (2008). Action research: Developing a pediatric cancer pain program in Jordan. *Journal of Pain and Symptom Management*, 35(4), 447–454.
- Fleuren, M., Wiefferink, K., & Paulussen, T. (2004). Determinants of innovation within health care organizations. Literature review and Delphi study. *International Journal for Quality in Health Care*, 16(2), 107-123.
- Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of

- innovations in service organizations: systematic review and recommendations. *Milbank ...*, 82(4), 581–629.
- Harris, J., Ramelet, A. S., van Dijk, M., Pokorna, P., Wielenga, J., Tume, L., ... Ista, E. (2016). Clinical recommendations for pain, sedation, withdrawal and delirium assessment in critically ill infants and children: An ESPNIC position statement for healthcare professionals. *Intensive Care Medicine*, 42(6), 972–986.
- Harrison, D., Beggs, S., & Stevens, B. (2012). Sucrose for procedural pain management in infants. *Pediatrics*, 130, 1–8.
- Harrison, D., Joly, C., Chretien, C., Cochrane, S., Ellis, J., Lamontagne, C., & Vaillancourt, R. (2014). Pain prevalence in a pediatric hospital: Raising awareness during Pain Awareness Week. *Pain Research and Management*, 19(1), e24–e30.
- Harrison, D., Larocque, C., Bueno, M., Stokes, Y., Turner, L., Hutton, B., & Stevens, B. (2017). Sweet solutions to reduce procedural pain in neonates: A meta-analysis. *Pediatrics*, 139(1), e20160955.
- Harvey, G., & Kitson, A. (2016). PARIHS revisited: From heuristic to integrated framework for the successful implementation of knowledge into practice. *Implementation Science : IS*, 11, 33.
- Horvath, R., Halbrooks, E. F., Overman, D. M., & Friedrichsdorf, S. J. (2015). Efficacy and safety of postoperative dexmedetomidine administration in infants and children undergoing cardiac surgery: A retrospective cohort study. *Journal of Pediatric Infectious Diseases*, 1(3), 138–145.
- Ismail, A. (2016). The Challenges of providing effective pain management for children in the pediatric intensive care unit. *Pain Management Nursing*, 17(6), 372–383.

- Ista, E., M, van D., Tibboel, D., M, de H., & Aneja, R. (2005). Assessment of sedation levels in pediatric intensive care patients can be improved by using the COMFORT “behavior” scale. *Pediatric Critical Care Medicine*, 6(1), 58–92.
- Johansson, M., & Kokinsky, E. (2009). The COMFORT behavioural scale and the modified FLACC scale in paediatric intensive care. *Nursing in Critical Care*, 14(3), 122–130.
- Keogh, S. J., Long, D. a, & Horn, D. V. (2015). Practice guidelines for sedation and analgesia management of critically ill children: a pilot study evaluating guideline impact and feasibility in the PICU. *BMJ Open*, 5(3), e006428.
- Kitson, A., Harvey, G., & McCormack, B. (1998). Enabling the implementation of evidence based practice: A conceptual framework. *BMJ Quality & Safety*, 7(3), 149-158.
- Manworren, R. C. B., & Hynan, L. S. (2003). Clinical validation of FLACC: preverbal patient pain scale. *Pediatric Nursing*, 29(2), 140–146.
- Mattsson, J. Y., Forsner, M., & Arman, M. (2011). Uncovering pain in critically ill non-verbal children: Nurses’ clinical experiences in the paediatric intensive care unit. *Journal of Child Health Care*, 15(3), 187–198.
- Merkel, S. I., Voepel-Lewis, T., Shayevitz, J. R., & Malviya, S. (1997). The FLACC: A behavioral scale for scoring postoperative pain in young children. *Pediatric Nursing*, 23(3), 293–297.
- Naguib, A. N., Dewhirst, E., Winch, P. D., Simsic, J., Galantowicz, M., & Tobias, J. D. (2012). Pain management after surgery for single-ventricle palliation using the hybrid approach. *Pediatric Cardiology*, 33(7), 1104–1108.
- National Pharmaceutical Council. (2001). Pain: Current understanding of assessment, management and treatments. Retrieved February 28, 2014, from

<https://www.npcnow.org/publication/pain-current-understanding-assessment-management-and-treatments>

- Oakes, L. (2011). *Compact clinical guide to infant and child pain management*. (Y. D'Arcy, Ed.). New York: Springer Publishing.
- Playfor, S., Jenkins, I., Boyles, C., Choonara, I., Davies, G., Haywood, T., ... Wolf, A. (2006). Consensus guidelines on sedation and analgesia in critically ill children. *Intensive Care Medicine*, 32(8), 1125–1136.
- Prins, S. A., Van Dijk, M., Van Leeuwen, P., Searle, S., Anderson, B. J., Tibboel, D., & Mathot, R. A. A. (2008). Pharmacokinetics and analgesic effects of intravenous propacetamol vs rectal paracetamol in children after major craniofacial surgery. *Paediatric Anaesthesia*, 18(7), 582–592.
- Ramamurthi, R. J., & Krane, E. J. (2007). Local anesthetic pharmacology in pediatric anesthesia. *Techniques in Regional Anesthesia and Pain Management*, 11(4), 229–234.
- Ramelet, A.-S., Rees, N. W., McDonald, S., Bulsara, M. K., & Huijjer Abu-Saad, H. (2007). Clinical validation of the Multidimensional Assessment of Pain Scale. *Paediatric Anaesthesia*, 17(12), 1156–1165.
- Registered Nurses Association of Ontario. (2013). Assessment and management of pain. Retrieved March 2, 2017, from <http://rnao.ca/sites/rnao-ca/files/AssessAndManagementOfPain2014.pdf>
- Reiter, P. D., Ng, J., & Dobyms, E. L. (2012). Continuous hydromorphone for pain and sedation in mechanically ventilated infants and children. *Journal of Opioid Management*, 8(2), 99–104.
- Renfrow, T. (2009). *Pediatric intensive care unit pain management in extubated postoperative*

infants and children. ProQuest Dissertations and Theses.

- Rennick, J. E., Lambert, S., Childerhose, J., Campbell-Yeo, M., Filion, F., & Johnston, C. C. (2011). Mothers' experiences of a Touch and Talk nursing intervention to optimise pain management in the PICU: A qualitative descriptive study. *Intensive and Critical Care Nursing, 27*(3), 151–157.
- Ross, P. A., Smith, B. M., Tolo, V. T., & Khemani, R. G. (2011). Continuous infusion of bupivacaine reduces postoperative morphine use in adolescent idiopathic scoliosis after posterior spine fusion. *Spine, 36*(18), 1478–83.
- Sharek, P. J., Wayman, K., Lin, E., Strichartz, D., Sentivany-Collins, S., Good, J., ... Cox, K. (2006). Improved pain management in pediatric postoperative liver transplant patients using parental education and non-pharmacologic interventions. *Pediatric Transplantation, 10*(2), 172–177.
- Squires, J. E., Hayduk, L., Hutchinson, A. M., Mallick, R., Norton, P. G., Cummings, G. G., & Estabrooks, C. A. (2015). Reliability and validity of the Alberta context tool (ACT) with professional nurses: Findings from a multi-study analysis. *PLoS ONE, 10*(6), 1–17.
- Stevens, B., Abbott, L., Yamada, J., Harrison, D., Stinson, J., Taddio, a, ... CIHR Team in Children's Pain. (2011). Epidemiology and management of painful procedures in hospitalized children across Canada. *CMAJ Canadian Medical Association Journal, 183*(7), E403–E410.
- Stevens, B., Harrison, D., Rashotte, J., Yamada, J., Abbott, L. K., Coburn, G., ... Le May, S. (2012). Pain assessment and intensity in hospitalized children in Canada. *Journal of Pain, 13*(9), 857–865.
- Taylor, E. M., Boyer, K., & Campbell, F. A. (2008). Pain in hospitalized children: A prospective

- cross-sectional survey of pain prevalence, intensity, assessment and management in a Canadian pediatric teaching hospital. *Pain Research and Management*, 13(1), 25–32.
- Thomas, M., Dhanani, S., Irwin, D., Writer, H., & Doherty, D. (2010). Development, dissemination and implementation of a sedation and analgesic guideline in a pediatric intensive care unit...it takes creativity and collaboration. *Dynamics (Pembroke, Ont.)*, 21(4), 16–25.
- Twycross, A. (2007). Children's nurses' post-operative pain management practices: An observational study. *International Journal of Nursing Studies*, 44(6), 869–881.
- Van Der Marel, C. D., Van Lingen, R. A., Pluim, M. A. L., Scoones, G., Van Dijk, M., Vaandrager, J. M., & Tibboel, D. (2001). Analgesic efficacy of rectal versus oral acetaminophen in children after major craniofacial surgery. *Clinical Pharmacology and Therapeutics*, 70(1), 82–90.
- Van Dijk, M., Bouwmeester, N. J., Duivenvoorden, H. J., Koot, H. M., Tibboel, D., Passchier, J., & De Boer, J. B. (2002). Efficacy of continuous versus intermittent morphine administration after major surgery in 0-3-year-old infants; a double-blind randomized controlled trial. *Pain*, 98(3), 305–313.
- Van Dijk, M., De Boer, J. B., Koot, H. M., Tibboel, D., Passchier, J., & Duivenvoorden, H. J. (2000). The reliability and validity of the COMFORT scale as a postoperative pain instrument in 0 to 3-year-old infants. *Pain*, 84(2–3), 367–377.
- Voepel-Lewis, T., Zhanotti, J., Dammeyer, J. A., & Merkel, S. (2010). Reliability and validity of the face, legs, activity, cry, consolability behavioral tool in assessing acute pain in critically ill patients. *American Journal of Critical Care*, 19(1), 55–61.
- Weldon, B. C., Connor, M., & White, P. F. (1993). Pediatric PCA: The role of concurrent opioid

infusions and nurse-controlled analgesia. *The Clinical Journal of Pain*, 9(1), 26–33.

Wilson-Smith, E. M. (2011). Procedural pain management in neonates, infants and children.

Reviews in Pain, 5(3), 4–12.

World Health Organization. (2012). WHO guidelines on the pharmacological treatment of

persisting pain in children with medical illnesses. Retrieved September 21, 2016, from

http://apps.who.int/iris/bitstream/10665/44540/1/9789241548120_Guidelines.pdf

Wu, S., Sapru, A., Stewart, M. A., Milet, M. J., Hudes, M., Livermore, L. F., & Flori, H. R.

(2009). Using acupuncture for acute pain in hospitalized children. *Pediatric Critical Care*

Medicine : A Journal of the Society of Critical Care Medicine and the World Federation of

Pediatric Intensive and Critical Care Societies, 10(3), 291–6.

Chapter Six

Contributions of Collaborators

Contributions of Collaborators

This chapter identifies the contributions of collaborators and/or co-authors and distinguishes the contributions of the PI (AI) from those of other collaborators or co-authors. Contributions are discussed as they relate to those who were involved as part of the research team and other collaborators on the manuscripts. This chapter also contains acknowledgments for research assistants who supported some aspects of the research among the three research studies.

Research Team Collaborators

International Committee of Medical Journal Editors (2016) recommends four criteria for authorship to be based on: (1) significant contributions to the design or conception, analysis, or interpretation of data; (2) critically drafting or reviewing the work; (3) approving the final version of the work to be published; and (4) agreement on the integrity and accuracy of the work (ensuring that questions related these aspects are appropriately investigated and resolved).

The primary researcher (AI) participated and led all aspects of the three research studies as part of the fulfillment of the requirements of the degree of Doctorate of Nursing (PhD) at the University of Ottawa. The collaborators in the three studies were AI's dissertation supervisor, Dr. Denise Harrison, R.N., Ph.D. (DH), co-supervisor, Dr. Viola Polomeno, R.N., Ph.D. (VP), and two committee members, Dr. Paula Forgeron, R.N., Ph.D. (PF), and Dr. Huda Gharaibeh, R.N., Ph.D. (HG).

DH, VP, PF, AND HG approved the dissertation proposal for the three studies. They provided content expertise for the proposal and ethics applications. They also critically reviewed, contributed intellectual content, and approved the final versions of the manuscripts. For Study One, they provided consultation and feedback on the research question, framework, software for

article screening, selected studies, and interpreting and synthesizing the data collected from the included articles in the review. For Study Two and Study Three, they provided consultation and feedback on the research questions, designs and modes, and data analysis and presentation. They also contributed to the development of the items of the study questionnaires (see Table 6.1).

Other Collaborators

There were two additional collaborators, who met the International Committee of Medical Journal Editors guideline for authorship on two manuscripts in the dissertation. William Dagg, R.N. (WD) contributed to Study One, and Janet Squires, R.N., Ph.D. (JS) to Study Three. WD had a significant contribution to Study One. He was the second reviewer for the title/abstract and full text screening. He also provided consultation and feedback on interpreting and synthesizing the data, critically reviewed, contributed intellectual content, and approved the final version of the manuscript. JS had a significant contribution to Study Three. She reviewed the study questionnaire and contributed to the modification of the items of the conceptual research utilization scale. She contributed to the analysis and interpretation of the data. She also critically reviewed, contributed intellectual content, and approved the final version of the manuscript (see Table 6.1).

Research Assistants Acknowledgements

For Study One, Marie-Cécile Domecq (medical librarian) facilitated the process of searching for the articles in the five databases. She helped in choosing the search terms and selecting the databases. Colleen Fitzgibbons, Children's Hospital of Eastern Ontario Research Institute Inc. provided expert consultation on the selected articles to be included in the study.

For Study One and Study Two, Allen Finley, MD, FRCPC, FAAP, Centre for Pediatric Pain Research, IWK Health Centre; Sharon Kinney, Nurse Consultant Research, The Royal

Children's Hospital Melbourne, Australia; and Mahmoud Alshalabi, R.N., King Fahad Medical City, Riyadh, Saudi Arabia facilitated the process of development and validation of the study questionnaire items of Study Two and provided expert consultation on the selected articles to be included in Study One. Amer Aridah, R.N., King Hussein Cancer Centre, Jordan facilitated the data collection in King Hussein Cancer Centre. For Study Three, Margot Thomas, R.N., Children's Hospital of Eastern Ontario Research Institute Inc. and Ghalib Hashim, R.N., King Fahad Medical City, Riyadh, Saudi Arabia facilitated the process of development and validation of the study questionnaire items.

Table 6.1. Summary of Collaborators' Contributions

Element	Chapter Two Pain Management Interventions in the Pediatric Intensive Care Unit (PICU): A Scoping Review	Chapter Three Pain Management Practice and Guidelines in Jordanian Pediatric Intensive Care Units (PICU)	Chapter Four The Influence of Context on Utilizing Research Evidence for Pain Management in Jordanian Pediatric Intensive Care Units (PICU)
Conceptualization and Design	AI	AI	AI
Data Collection	AI	AI	AI
Data Analysis and Interpretation	AI DH VP PF HG WD	AI DH VP PF HG	AI DH VP PF HG JS
Draft Content	AI	AI	AI
Revise Manuscript for Important Intellectual Content	AI DH VP PF HG WD	AI DH VP PF HG	AI DH VP PF HG JS

Approve Final Version	AI	AI	AI
	DH	DH	DH
	VP	VP	VP
	PF	PF	PF
	HG	HG	HG
	WD		JS
Ensuring Accuracy or Integrity Investigated and Resolved	AI	AI	AI
	DH	DH	DH
	VP	VP	VP
	PF	PF	PF
	HG	HG	HG
	WD		JS
Responsible for Overall Content	AI	AI	AI

Appendices

Appendix A. Ethics Approval from University of Ottawa

File Number: h05-15-03



Date (mm/dd/yyyy): 08/18/2015

Université d'Ottawa **University of Ottawa**
 Bureau d'éthique et d'intégrité de la recherche Office of Research Ethics and Integrity

Ethics Approval Notice Health Sciences and Science REB

Principal Investigator / Supervisor / Co-investigator(s) / Student(s)

<u>First Name</u>	<u>Last Name</u>	<u>Affiliation</u>	<u>Role</u>
Denise	Harrison	Health Sciences / Nursing	Supervisor
Ahmad	Ismail	Health Sciences / Nursing	Student Researcher

File Number: h05-15-03

Type of Project: PhD Thesis

Title: The influence of context on utilizing research evidence for pain management in Jordanian Pediatric Intensive Care

Approval Date (mm/dd/yyyy)	Expiry Date (mm/dd/yyyy)	Approval Type
08/11/2015	08/10/2016	Ia (Partial)

(Ia: Approval, Ib: Approval for initial stage only)

Special Conditions / Comments:

Partial approval

This approval is valid for recruitment and data collection at the following locations:

- Al Bashir Hospital (permission letter received on August 10, 2015)
- Princess Rahma Hospital (permission letter received on August 10, 2015)
- King Abdullah University Hospital (permission letter received on August 11, 2015)
- King Hussein Cancer Center (permission letter received on August 13, 2015).

Additional sites will be added to the certificate once permission letters have been received.

Ethics Approvals from Jordanian Hospitals



King Hussein Cancer Center

مركز الحسين للسرطان

Institutional Review Board

اللجنة المؤسسية

Date: 08/August/2016

Dear Dr. Ahmad Ismail and Mr. Amer Arida,

In reference to the proposal entitled: "The Influence of Context on Utilizing Research Evidence for Pain Management in Jordanian Pediatric Intensive Care Units." (Proposal No. 15 KHCC 70).

You are kindly informed that the IRB has reviewed and approved the following document(s):

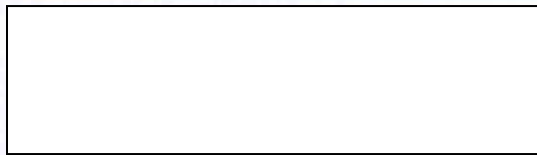
- 1- Request for Continuing Approval, submission date: 02/August/2016

The Request for Continuing Approval was exempted from full IRB review and approved.

Kindly note that if the study extends beyond one year you have to submit an **IRB Request for Continuing Approval Form** and an interim update on the study. For any modifications on the approved proposal please complete the **IRB Request for Modification Form**. At the end of the study, you are requested to submit an **End of Study Report** to the IRB.

Please inform the IRB Office of any publications/ abstracts that may result from this study.

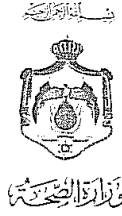
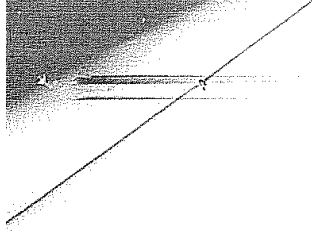
On behalf of KHCC IRB, I would like to wish you a successful study.



Date: 08/August/2016

Dr. Maysa Al-Hussaini
Chair, Institutional Review Board
King Hussein Cancer Center

The IRB consists of members of medical and non medical background including public, lawyers, nurses and pharmacists. It is the policy of the IRB to conduct random audits on a percentage of approved projects. These audits may be conducted at any time after the project starts. In cases where the IRB considers that there may be a risk of adverse events, or where participants may be especially vulnerable, the IRB may request the principal investigator to provide an outcomes report, including information on follow up of participants.
KHCC-IRB is approved by JFDA and is compliant with GCP Guidelines and national Clinical Research Law (2011).



CODE : MOH REC 150085

الرقم

التاريخ

الموافق

قرار لجنة اخلاقيات البحث العلمي

اجتمعت لجنة اخلاقيات البحث العلمي بتاريخ 2015 / 7 / 6 لمناقشة ودراسة
البحث العلمي المقدم من قبل طالب الدكتوراه/ احمد عبدالكريم اسماعيل.
بعنوان :-

ادارة الامم في وحدات العناية المركزة للاطفال

وقد قررت اللجنة بالاجماع الموافقة على اجراء البحث المشار اليه اعلاه .
وعليه تم التوقيع من قبل اعضاء اللجنة حسب الاصول .

عضو اللجنة
رئيس قسم الأشعة العلاجية
أخصائي معالجة داء السكري
الدكتور / رسمي مبيضين

عضو اللجنة
رئيس قسم الجراحة
الدكتور / فايز الحمود

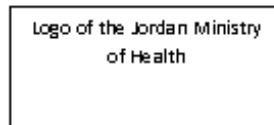
عضو اللجنة
المساعد لشؤون التمريض
هانسي نسوايف / هاني القضاة
مساعد مدير مستشفى البشير
لشؤون التمريض

عضو اللجنة
رئيس قسم التوليد
الدكتور / عبد الملح السليمات

عضو اللجنة
رئيس قسم الباطني
الدكتور / وسيم حموده

عضو اللجنة
رئيس قسم الاطفال
الدكتور / الكنتية مران
مستظفوة لفضائل

رئيس اللجنة /
مدير مستشفى البشير
الدكتور / احمد قطيحات
الدكتور / عبيدة القزويني
المساعد الشخصي



Ministry of Health

Number CODE: MOH REC 150085

Ethics Committee of Scientific Research Decision

Ethics Committee of scientific research met on July 6, 2015 to discuss a scientific research submitted by the doctoral student / Ahmad Abed Alkareem Ismail.



Title:

Pain Management in the Paediatric Intensive Care Unit

The Committee decided fully to approve conducting the research referred above.

Committee member and signature
Committee member and signature
Committee member and signature
Committee member and signature
Committee member and signature
Committee member and signature

Committee head and signature

General Director Office
 ص ب (٦٣٠٠٠١) اربد (٢٢١١٠) الأردن
 مستشفى الملك المؤسس عبدالله الجامعي
 King Abdullah University Hospital
 مكتب المدير العام
 هاتف : (٩٦٢-٢) ٧٢٠٠٦٠٠ فاكس : (٩٦٢-٢) ٧٠٩٥٧٧٧

Ref: 13/3 12055
 Date: 11-8-2015

الرقم : _____
 التاريخ : _____
 الموافق : _____

Denise Harrison (RN, PhD),
 Chair in Nursing Care of Children, Youth and Families
 Children's Hospital of Eastern Ontario (CHEO) and University of Ottawa, Canada
 Tel: +1 613-562-5800, ext 8693
 Email: denise.harrison@uottawa.ca

Dear Dr.

In reference to your letter, in which you confirmed that Mr. Ahmad Ismail is a PhD student at the School of Nursing, Faculty Health Sciences, University of Ottawa, Canada. He will be undertaking a project entitled:


" The Influence of Context on Utilizing Research Evidence for Pain Management in Jordanian Pediatric Intensive Care Units (PICU) "

We would like to inform you that the IRB Committee has granted Mr. Ahmad Ismail the approval to conduct his proposal at King Abdullah University Hospital for the purpose mentioned above, under the following conditions:

1. Confidentiality is required while collecting data.
2. Informed consent is not required.
3. Provide us with final report including copy of participants' consent form, and keep another copy with the researcher.
4. The approval of IRB committee is valid for one year only, and subject for extension upon request of the researcher.

Sincerely,,,

Prof. Ibrahim Bani Hani



EO KAUH

IRB Coordinator/ M.Rawashdeh

962-2) 7200600 Fax: (962-2) 7095777 P.O.Box: (630001) Irbid (22110) Jordan E-mail : kauh@just.edu.jo

Appendix B. Search Strategy1) PsycINFO 1806 to December 2015 (**Total= 181**)

1. exp Pain/
2. (pain adj3 (management or treatment\$ or intervention\$)).tw.
3. 1 or 2
4. exp Intensive Care/
5. Terminally Ill Patients/
6. ((intensive or critical or terminal) adj4 (care or illness or unit)).tw.
7. 4 or 5 or 6
8. exp Child Care/
9. exp Pediatrics/
10. (paediat* or pediat* or baby or babies or neonate* or newborn or infant* or child* or toddler or adolesc* or teen*).tw.
11. 8 or 9 or 10
12. 7 and 11
13. PICU.tw.
14. (pediatric adj4 intensive adj1 (care or unit)).tw.
15. 13 or 14
16. 12 or 15
17. 3 and 16
18. limit 17 to english language
19. limit 18 to yr="1860 - 2015"
20. Book*.pt.
21. 19 not 20

2) Ovid MEDLINE® In-Process & Other Non-Indexed Citations and Ovid MEDLINE® 1946 to December 2015 (**Total= 1110**)

1. exp pain/
2. (pain adj3 (management or treatment\$ or intervention\$)).tw.
3. 1 or 2
4. exp intensive care/
5. Critical Care/
6. exp Terminal Care/
7. Intensive Care Units/
8. Critical Illness/
9. Terminally Ill/
10. ((intensive or critical or terminal) adj4 (care or illness or unit)).tw.
11. or/4-10
12. Adolescent/

13. exp Child/
14. exp Infant/
15. (paediat* or pediat* or baby or babies or neonate* or newborn or infant* or child* or toddler or adolesc* or teen*).tw.
16. or/12-15
17. 11 and 16
18. PICU.tw.
19. Intensive Care Units, Pediatric/
20. (pediatric adj4 intensive adj1 (care or unit)).tw.
21. or/18-20
22. 3 and (17 or 21)
23. limit 22 to (english language and yr="1860 - 2015")

3) Embase Classic+Embase 1947 to 2015 December 31(**Total= 5039**)

1. exp pain/
2. (pain adj3 (management or treatment\$ or intervention\$)).tw.
3. 1 or 2
4. exp intensive care/
5. terminal care/
6. intensive care unit/
7. critical illness/
8. terminally ill patient/
9. ((intensive or critical or terminal) adj4 (care or illness or unit)).tw.
10. 4 or 5 or 6 or 7 or 8 or 9
11. adolescent/ or child/
12. (paediat* or pediat* or baby or babies or neonate* or newborn or infant* or child* or toddler or adolesc* or teen*).tw.
13. 11 or 12
14. 10 and 13
15. PICU.tw.
16. (pediatric adj4 intensive adj1 (care or unit)).tw.
17. exp intensive care nursing/
18. 15 or 16 or 17
19. 18 or 14
20. 3 and 19
21. limit 20 to English language
22. conference*.pt.
23. book*.pt.
24. 22 or 23
25. 21 not 24

26. limit 25 to yr="1900 – 2015"

4) CINAHL (1981 to 2015) (**Total= 659**)

S20 S3 AND S19 Narrow by Language: - english
 S19 S15 OR S16 OR S17 OR S18
 S18 TI ((pediat* or paediat*) N1 icu) OR AB ((pediat* or paediat*) N1 icu)
 S17 TI picu OR AB picu
 S16 (MH "Intensive Care Units, Pediatric")
 S15 S9 AND S14
 S14 S10 OR S11 OR S12 OR S13
 S13 TI ((paediat* or pediat* or baby or babies or neonat* or newborn* or infant* or child* or toddler* or adolesc* or teen*)) OR AB ((paediat* or pediat* or baby or babies or neonat* or newborn* or infant* or child* or toddler* or adolesc* or teen*))
 S12 (MH "Infant") OR (MH "Infant, Hospitalized") OR (MH "Infant, Newborn")
 S11 (MH "Child") OR (MH "Child, Hospitalized") OR (MH "Child, Preschool") OR (MH "Child, Disabled")
 S10 (MH "Adolescence") OR (MH "Adolescent, Hospitalized")
 S9 S4 OR S5 OR S6 OR S7 OR S8
 S8 TI ((intensive or critical* or terminal*) N4 (care or ill* or unit*)) OR AB ((intensive or critical* or terminal*) N4 (care or ill* or unit*))
 S7 (MH "Terminally Ill Patients")
 S6 (MH "Critical Illness") OR (MH "Critically Ill Patients")
 S5 (MH "Critical Care")
 S4 (MH "Intensive Care Units+")
 S3 S1 OR S2
 S2 TI (pain N3 (management or treatment* or intervention*)) OR AB (pain N3 (management or treatment* or intervention*))
 S1 (MH "Pain+")

5) ProQuest Dissertations & Theses Global to December 2015 (**Total=55**)

((ti(pain) OR ab(pain)) AND (ti(PICU) OR ab(PICU) OR ti((pediatric NEAR/1 ICU OR paediatric NEAR/1 ICU)) OR ab((pediatric NEAR/1 ICU OR paediatric NEAR/1 ICU)))) OR ((ti(pain) OR ab(pain)) AND ((ti("intensive care") OR ab("intensive care")) OR (ti("critical care") OR ab("critical care")))) AND ((ti(pediat*) OR ab(pediat*) OR ti(paediat*) OR ab(paediat*) OR ti((baby OR babies)) OR ab((baby OR babies)) OR ti((neonat* OR newborn*)) OR ab((neonat* OR newborn*)) OR ti((infant* OR child*)) OR ab((infant* OR child*)) OR (ti(toddler*) OR ab(toddler*) OR ti((adolesc* OR teen*)) OR ab((adolesc* OR teen*))))))

Appendix C. Summary of the Studies on Pain Management Interventions Used in the PICU

Author(s), Year, and Country	Aim(s)	Study Characteristics (Design and Sample)	Measures/ data collection methods	Pain management interventions (name, type, frequency, dose)	Main findings
Akinci, Kanbak, Guler, & Aypar, 2005 Turkey	To compare between remifentanyl and fentanyl infusions for short term postoperative analgesia	Prospective randomized, double-blind, ICU children requiring mechanical ventilation post orthopedic spinal surgery N = 22, 3–16 y, M age = 13 y, 17 females Two groups: remifentanyl group n = 11; fentanyl group n = 11	- Pain assessed using behavioural (BPS) pain scale Payen, Bru, & Bosson, 2001 - Age, sex, Mean Arterial Pressure (MAP), and weight - ICU stay (days) - Mechanical ventilation (min)	- Remifentanyl 0.1 µg/kg/min or fentanyl 0.025 µg/kg/min infusions diluted to the same volume titrated to predefined levels of analgesia	- No differences in both groups in demographics, tracheal extubation times, and pain scores, sedation, ICU environment tolerance, and MAP, - After cessation of opioid infusion, sedation scores and heart rate higher in the remifentanyl group, - MAP higher after cessation of infusion in remifentanyl group
Amigoni, Catalano, Vettore, Brugnaro, & Pettenazzo, 2012 Italy	To describe the practice of analgesia and sedation	Descriptive multisite survey Italian PICUs N = 24 M beds = 8.37 M admissions = 322 for the previous year	A questionnaire in 2010: - Characteristics of PICU - Common drugs for analgesia and sedation - Presence of written protocol for analgesia and sedation - Analgesia and sedation monitoring, frequency, and method - Number of adequately sedated patients	- Written protocols for analgesia - Fentanyl (doses not given)	- 14 (58%) PICUs followed written protocols for analgesia and sedation. - 16 (66.6%) PICUs administered sedation for procedures. - 24 (100%) PICUs used the same combination (opioid plus benzodiazepine). - In 16 (66.6%) of PICUs, the most commonly used opioid was fentanyl. - 24 (100%) PICUs

			- Withdrawal syndrome monitoring		commonly used midazolam for sedation. - 12 (50%) referred to regularly monitor the level of sedation, 37% of them used validated tools. - 6 (25%) regularly monitored for withdrawal syndrome.
Bauchner, May, & Coates 1992 USA and Canada	To assess the use of analgesics for invasive procedures	Cross sectional, multisite survey directors of 38 PICUs and 31 NICUs	A questionnaire about: - The use of analgesia for 10 commonly - performed pediatric procedures e.g., venipuncture, intravenous cannulation, chest tube insertion, and central line placement. - Open-ended questions about the use of behavioral techniques to control pain	-Analgesics: lidocaine, morphine, and fentanyl -Behavioral techniques: hypnosis, mental imagery, stroking, or soothing	- Analgesics were used in 25 (66%) PICUs for arterial line placement, bone marrow aspiration 30 (79%), central line placement 35 (92%), chest tube insertion 35 (92%), lumbar puncture 18 (50%), and paracentesis 27 (71%). - The most commonly used analgesics were lidocaine, morphine, and fentanyl (no numbers, percentages, or which procedure mentioned in the article) - 16 PICUs (42%) used behavioral techniques to control pain e.g., hypnosis, mental imagery, stroking, or soothing (no numbers, percentages, or which technique for which procedure mentioned in the article).

Benini, Farina, Capretta, Messeri, & Cogo, 2010 Italy	To analyse the methods used to manage and monitor sedoanalgesia	Multisite survey in 2004 19 medical directors of Italian PICUs	A questionnaire: - characteristics of the unit - used sedoanalgesia policy - recommended drugs - methods used for drugs combination	- Fentanyl IV infusion (1.09 µg/kg/h to 6.9 µg/kg/h) - Bolus (1.22 µg/kg to 3.62 µg/kg) - Remifentanyl IV infusion (0.132 µg/kg/min to 0.84 µg/kg/min) - No bolus - Morphine doses not given	- 14 PICUs (74%) applied a sedation-analgesia protocol - The main indications for sedation and analgesia were: mechanical ventilation (100%), terminal disease (29%), severe trauma (71%), seizures, and status epilepticus (71%). - The first drug choice was the combination between benzodiazepines and opioids (86%); the first choice of analgesics was fentanyl (no number or percentage). The second choice for analgesia includes morphine and remifentanyl (no number or percentage) - The second drug choice was the combination of benzodiazepines, opioids and other drugs (29%), or the combination of opioids with another drug (28%). - Additional bolus was given as necessary in 90% of PICUs.
Butkovic et al., 2007	To compare between epidural block and PCA post	Prospective randomized trial	Pain scores using a 10-point VAS at 2, 4, 6, 12, 18, 24, 36, and 48 h postoperatively,	- Epidural block or PCA	- There were no significant differences in age, sex, body weight,

Croatia	thoracoscopic surgery	<p>28 patients undergone pectus excavatum repair, 8- 19 y,</p> <p>Two groups: epidural block with bupivacaine plus fentanyl group (n = 14, 10 males, 10-19 y, and <i>M</i> weight = 57kg),</p> <p>and IV PCA with fentanyl group (n = 14, 11 males, 8-19 y, and <i>M</i> weight = 53kg)</p>	<p>sedation level by Ramsay sedation score range from 1 to 6 at 2, 6, 12, and 24 h postoperatively, arterial pressure, ventilatory frequency, heart rate, and blood gas (during the first 24 h)</p>	<p>and duration of surgery.</p> <ul style="list-style-type: none"> - Over time, there was a significant decrease in the VAS pain score, Ramsay sedation score, heart rate ventilatory frequency, systolic and diastolic blood pressure, and PaCO₂ in the two groups. - VAS pain scores overtime postoperatively at (2, 4, 6, 12, 18, 24, 36, and 48 h) in PCA patients were: 5.3, 4.2, 3.6, 3.2, 2.8, 2.5, 2, and 1.9 respectively. - VAS pain scores overtime postoperatively at (2, 4, 6, 12, 18, 24, 36, and 48 h) in epidural patients were: 5.5, 4.2, 3.5, 3.0, 2.8, 2.1, 2.0, and 1.9 respectively. - Over time, there was a significant increase in PaO₂ and oxygen saturation in both groups. - PCA group had significantly higher PaCO₂ values.
---------	-----------------------	---	---	--

Chrysostomou et al., 2006	To describe the use of dexmedetomidine in spontaneous breathing as well as in mechanically ventilated patients, after congenital cardiac and thoracic surgery	Retrospective, case series study 33, one unit, spontaneously breathing and 5 mechanically ventilated patients Age 8 ± 1.1 y and weight 29 ± 3.8 kg 27 males	Numeric VAS Wong et al. 1999, FLACC score 0–10 (Merkel, Voepel-Lewis, Shayevitz, & Malviya, 1997), intensive care unit sedation scale (score 0–3), the need for rescue drugs, respiratory rate, heart rate, and blood pressure.	Dexmedetomidine: initial dose was 0.32 ± 0.15 μ g/kg/hr followed by an average infusion of 0.3 ± 0.05 μ g/kg/hr (range 0.1–0.75 μ g/kg/hr).	<ul style="list-style-type: none"> - Dexmedetomidine was used as a primary sedative and analgesic agent. - The mean pain score was 1.5 ± 0.9 (mild pain) - The mean sedation score was 1.3 ± 0.6 (mild sedation) - The duration of the dexmedetomidine infusion was 14.7 ± 5.5 hrs - A total of 49 rescue doses were given, average of 1.3 ± 0.26 boluses per patient - The most frequently rescue drugs administered were fentanyl, morphine, and midazolam. - Six patients (15%) had documented hypotension, and one patient had an episode of considerable bradycardia.
Chrysostomou et al., 2009	To assess clinical response of dexmedetomidine alone or in combination with conventional sedatives/analgesics after cardiac surgery	Retrospective case series 80 patients younger than 1 year. 66 infants and 14 neonates M age = 4.1 ± 3.1 months M weight = 5.5 ± 2 kg 39 males and 41 females Three groups:	Sedation assessed using pediatric intensive care unit sedation scale ranging from 0 to 3 Pain assessed using FLACC scale (Merkel, Voepel-Lewis, Shayevitz, & Malviya, 1997) for patients older than 2 months old, and the CRIES (cries, requires oxygen for saturation less than 95%, increased vital signs,	Dexmedetomidine 0.66 ± 0.26 μ g/kg/hr	<ul style="list-style-type: none"> - 94% documented normal sleep to moderate sedation. - 90% documented no pain to mild pain. - Systolic blood pressure (SBP) decreased from 89 ± 15 mm Hg to 85 ± 11 mm Hg ($p = 0.05$). - Heart rate (HR) decreased from 149 ± 22 bpm to 129 ± 16 bpm ($p < 0.001$). - No changes on respiratory rate were

<p>A dexmedetomidine only (n = 20); B dexmedetomidine with sedatives/analgesics (n = 38); and C dexmedetomidine with sedatives/analgesics and fentanyl infusion (n = 22).</p>	<p>expression, sleepless) (Pasero, 2002) for patients 0–6 months old (Pasero, 2002), respiratory rate, heart rate, blood pressure, and arterial blood gases.</p>	<p>observed. - No difference in dexmedetomidine between mechanically ventilated and nonmechanically ventilated patients ($p = 0.3$) was observed - There was no difference among groups A, B, and C in sedation and pain scores ($p = 0.28$ and 0.62 respectively) - There was no difference among groups A, B, and C in SBP, RR, and arterial blood gases. - HR was higher in group C vs. B ($p = .01$). - There was no difference in dexmedetomidine dose between patients who received fentanyl infusion (group C) and those who did not (groups A and B) ($p = 0.2$) - Dexmedetomidine duration was longer in group C compared to A ($p = 0.03$) and B ($p = 0.002$). - Infants required higher dexmedetomidine doses than neonates ($p = 0.003$)</p>
---	--	--

<p>Chu, Lin, Hsieh, Chan, & Tsou, 2006</p>	<p>To investigate whether an intraoperative initial dose</p>	<p>Randomized controlled trial Morphine group (n = 20,</p>	<p>- Pain intensity using Children’s Hospital of Eastern Ontario Pain Scale</p>	<p>With closure of the sternum, morphine 0.2 mg/kg or tramadol 2 mg/kg. In the PICU,</p>	<p>- The two groups did not differ in baseline characteristics (age, weight, sex,</p>
--	--	--	---	--	---

Taiwan	of tramadol could cause more rapid awakening from general anesthesia, less sedation, and earlier tracheal extubation than morphine in children during the immediate postoperative period after cardiac surgery	<p>Mean age/months = 42 ± 26, and 15 males)</p> <p>Tramadol group (n = 20, Mean age/months 37 ± 35, and 13 males)</p> <p>All patients were received a standardized anesthetic technique was used with thiopental 5 mg/kg, fentanyl 5 µg/kg, and tracheal intubation was facilitated with atracurium 0.5 mg/kg.</p>	<p>(CHEOPS; range 4 – 13; score of 6 or lower not distressed)</p> <ul style="list-style-type: none"> - NCA boluses administered for scores more than 9/13, - Level of sedation assessed using a 5-point score (Collins et al., 1996) (1 fully awake, 2 slightly drowsy, 3 asleep but easily arousable verbally, 4 asleep, easily arousable by tactile stimulation but not verbally, 5 asleep, not arousable), - Timing to tracheal extubation, - Time to awakening (demonstrated by spontaneous eye opening, grimacing, and purposeful movements), and - Daily number of NCA boluses 	morphine group received NCA with bolus doses of morphine, tramadol group received bolus doses of tramadol	<p>intraoperative total amount of fentanyl, or duration of cardiopulmonary bypass and surgery).</p> <ul style="list-style-type: none"> - The daily number of NCA boluses was similar on day 1 ($p = 0.11$) but was significantly fewer in the morphine group on day 2 ($p < 0.001$). - Medians of sedation scores were 2 and 1 for morphine and tramadol, respectively, at 1h ($p = 0.03$) and 2h ($p = 0.01$) postoperatively (afterwards, no differences). - No difference in CHEOPS scores during the 48 h observation period, except at 1 h after surgery (8.5 for morphine and 8 for tramadol ($p = 0.03$)). - Mean time to awakening was 35.2 ± 20.3 min for the morphine group, and 20.8 ± 17.5 min for the tramadol group ($p = 0.02$). - Mean time to tracheal extubation was 47.5 ± 15.8 min for the morphine group, and 30.5 ± 21.3 min for the tramadol group ($p = 0.01$).
--------	--	--	---	---	--

Coffman et al., 1997 To describe how nurses Descriptive For pain assessment: Pharmacological (doses not given): - Among 112

USA	assess and manage pain in critically ill children	A convenience sample of 24 PICU nurses Average nursing experience in PICU = 2.8 years	a modified version of the MICU:SPAT, developed by Curley et al., 1992, For pain treatment: additional questions on the data sheet to indicate the pharmacological and non-pharmacological measures.	morphine meperidine fentanyl acetaminophen with codeine, acetaminophen, and continuous infusion with fentanyl Non-pharmacological (description of each intervention not given): positioning, distraction, music, parent's presence, touch, quiet environment, and holding or rocking	observations, the drugs used were: morphine (53%), meperidine (16%), and fentanyl (11%), acetaminophen with codeine (3%), acetaminophen (2%), and continuous infusion with fentanyl (8%). - Non-pharmacological interventions were: positioning (11%), distraction (7%), music (4%), parent's presence (4%), touch (3%), quiet environment (2%), and holding or rocking (2%).
DeBerry, Lynch, Chernin, Zwischenberger, & Chung, 2005	To determine the general practice guideline used for pain and anxiolytic pharmacotherapy for pediatric patients at extracorporeal membrane oxygenation (ECMO) centres	Survey 46 ECMO centres	Questionnaire (see DeBerry, Lynch, Chernin, Zwischenberger, & Chung, 2005, p. 140)	Pharmacological agents (dosed not mentioned)	- Fentanyl was the most commonly used pain medication (62%). - The preferred route administration was via a central venous catheter (76%). - Continuous infusion was the most commonly administered method (92%). - The majority (70%) did not routinely use paralytics.

Horvath, Halbrooks, Overman, & Friedrichs dorf, 2015	To describe efficacy and safety of dexmedetomidine administration postoperatively in the cardiac intensive care unit, in children undergoing cardiac surgery	Retrospective cohort (single site) 107 patients , age 3 days to 17.5 years, weight 3 to 77.3 kg, 70 ≤ one year old	FLACC scale (0-10) for pain and state behavioral scale (-2-+2) for sedation, duration of administration, heart rate, blood pressure, agitation, delirium	Dexmedetomidine infusion, median dexmedetomidine starting dose median was 0.45 µg/kg/h range (0.8 µg/kg/h to 2.17 µg/kg/h)	<ul style="list-style-type: none"> - In addition to opioid, 107 patients received dexmedetomidine - 92 patients received fentanyl along with dexmedetomidine - Duration of administration was (0–23.9 days), median 1.6 days. - 69 patients were intubated when dexmedetomidine started - Seven patients (6.5%) were discontinued dexmedetomidine due to adverse events, most commonly bradycardia. - The FLACC pain scale and the state behavioral scale scores indicated adequate sedation and good analgesia. - The mean FLACC scores were well below 2/10 before and during the study period, with a statistically significant increase in predexmedetomidi
--	--	---	--	--	--

ne administration compared to day 1 post-initiation from 0.88/10 to 1.39/10

- The SBS sedation scores showed no significant changes either prior to dexmedetomidine administration or after initiation ($p = 0.22$).

- The average heart rate among infants decreased from 145 beats per minute (bpm) at baseline to 125.5 bpm ($p = 0.023$), while older children had a decrease from 112.4 to 102.7 bpm at hour 12 ($p = 0.001$)

- Seven patients (6.5%) experienced adverse reactions following dexmedetomidine initiation.

- Twenty-three children (21.7%) displayed clinical symptoms of withdrawal upon weaning and discontinuation of the study drug,

- The most

Kline et al., 2010 USA	To compare the effectiveness of teaching mental imagery (MI) to the effectiveness of a detailed inquiry (DI)	<p>Archival analysis between 1999 and 2001 for a QI initiative</p> <p>44 patients, all were victims of non-intentional injuries,</p> <p>Two groups: MI group (n = 24, 9 girls and 15 boys, <i>M</i> age = 13.3 years), 46% of the struck by automobiles, 50% had closed head injuries related to being a passenger in a motor vehicle accident (MVA), and DI group (n= 20, 11 girls and 9 boys, <i>M</i> age = 13.8 years), 40% were pedestrians struck by automobiles, while 60% had closed head injuries as a result of being a passenger in an MVA</p>	Wong-Baker Faces Pain Rating Scale for children 3–7 years (Wong & Baker, 1988) and a 0–10 Likert pain rating scale for children ages 8 and older	Mental imagery (MI) or a detailed inquiry (DI), see (Kline et al., 2010) page 27 and 28	<p>common adverse reaction post-discontinuation was agitation.</p> <p>- No statistically significant difference in baseline characteristics between the two groups</p> <p>- Mean pain ratings decreased among both girls and boys in the MI (for boys, from 5.46 to 3.26 ($p = 0.0015$, for girls from 5.22 to 4.55.</p> <p>- Boys in the MI condition exhibited a significant decrease in average pain ratings [$t(38) = 3.41, p = 0.0015$]</p> <p>- Girls in the MI condition exhibited a non-significant decrease in average pain ratings</p> <p>- Mean pain ratings decreased only among girls in the DI group (from 4.36 to 3)</p> <p>- Mean pain ratings increased in the DI group</p>
---------------------------	--	---	--	---	--

					from 4.56 to 5.33.
Larson, Arnup, Clifford, & Evans, 2013 Australia	To evaluate the impact of the introduction of a pain and sedation guideline on clinical practice.	A pre and post chart audit Single PICU, 19 bed 259 patients' charts audited, 147 pre guideline audit and 112 e post guideline audit	Medication usage pre and post guidelines introduction.	Pain and sedation guideline including: medications, pain assessment, documentation, and communication guidelines. First line medication for analgesia was morphine and midazolam for sedation. Oral clonidine was encouraged for patients received opioid and/or benzodiazepine infusions for more than 5 days. See page 123	- The dosage and administration of the commonly used pharmacology agents (morphine, fentanyl and midazolam) remained constant in the pre and post guideline audits. - In accordance with the guidelines recommendations, the proportion of patients receiving oral clonidine increased ($p = 0.001$) after the introduction of the guideline, and the administration of ketamine, particularly via bolus ($p = 0.003$), reduced after the introduction of the guideline.
Lieh-Lai, Kauffman, Uy, Danjin, & Simpson, 1999 USA	To evaluate the efficacy of a single dose of IV ketorolac compared with IV morphine for postoperative children's pain relief	Randomized, double blind, 102 children 3 to 18 y postoperatively with moderate to severe pain Two groups: morphine group (n= 48, age $M = 10.2$ y, and 18 males)	CHEOPS (McGrath et al., 1985) and/or Oucher (Beyer, Denyes, & Villarruel, 1992), blood pressure, heart rate, urine output, blood urea nitrogen, creatinine, bleeding time, hematuria or proteinuria, aspartate aminotransferase, nausea and vomiting	IV ketorolac or morphine post operation for moderate to severe pain.	- Sixty eight percent of patients who received ketorolac reported pain relief during the first 2 hrs after dosing, compared with 58% of those who received morphine ($p = 0.2$). - No differences between the two groups in

		ketorolac group (n= 54, <i>M</i> age 10.6 y, and 25 males)			physiologic or laboratory variables were observed. - Vomiting was more common in ketorolac group.
Maldini, Radesic, Javorovic, & Fattorini, 1997 Croatia	To assess the efficacy of tramadol (intermittent vs continuous administration) after major surgery	42 children (<i>M</i> 9.2 y, 26 males and 16 females) Two groups: group one intermittent administration, 18 children and group two continuous tramadol administration	Pain assessment based on age: 1) newborns, infants and toddlers, using physiological and behavioral responses (Schaffer, Piepenbrock, Kertz & Schonfield, 1986); 2) preschool using analogue scale from no pain to very severe pain (Lowe, Walker, & MacCallum, 1991); and 3) older children and adolescents by self-report. Systolic and diastolic blood pressure, pulse rate, oxygen saturation, acid base balance, and side effects.	I.V. Intermittent (1.5 mg/kg) or continuous (0.2- 0.6 mg/kg/hr) tramadol administration post major surgeries	- In intermittent tramadol group, satisfactory pain control achieved in 61% of the children in the group, no significant changes in blood pressure or pulse rate, and one child had a cardiovascular collapse. The most common side effects were face flushing (33%), dry mouth (17%), and fatigue (17%). - In continuous tramadol group, satisfactory pain control achieved in 100% of the children in the group, no significant changes in blood pressure or pulse rate, and no respiratory depression. The most common side effects were fatigue (36%), Dizziness (22%), and sweating (18%).
Naguib et al., 2012	To review the experience of the	Retrospective review of patients' records	Patient's age, weight, sex, pain scores using the neonatal pain agitation and sedation	Fentanyl administration by continuous infusion or NCA	- NCA with fentanyl was used in 21 patients.

USA	<p>Nationwide Children's Hospital with the management of postoperative pain in children undergoing the stage one hybrid procedure for hypoplastic left heart syndrome in the pediatric cardiac intensive care unit.</p>	<p>33 patients 19 girls and 14 boys, 2 to 90 days, and from 1.5 to 4.5 kg,</p>	<p>scale (NPASS) or the FLACC scale, sedation level by a modified Penn State sedation score, total fentanyl dose, duration of fentanyl use, adverse effects of fentanyl use, use of adjunctive medications, such as dexmedetomidine, and time of tracheal extubation</p>	<p>after stage one hybrid procedure in neonates with complex congenital heart disease.</p>	<ul style="list-style-type: none"> - Continuous infusion of fentanyl was used in 12 patients. - Patients were more likely to be prescribed NCA compared with continuous infusion if their trachea was extubated in the OR (12 of 13 vs. 9 of 20, $p = 0.0093$). - In 157 documented pain scores, only 12 were ≥ 5 (7.6% of the time) and no patient received a pain score > 7. - Fentanyl requirements were lower in patients whose tracheas were extubated. - Adverse effects happened in 3 patients (9%) and included one episode of respiratory depression pruritus, and excessive sedation. - - Dexmedetomidine was used as an adjunct medication in 5 patients and led to decrease in fentanyl use.
-----	---	--	--	--	--

Prins et al., 2008 Netherlands	To compare between intravenous propacetamol and paracetamol in non-ventilated children post major craniofacial surgery	Double-blind controlled study IV propacetamol group n= 12, 10 males, 0.8 to 2.2 y, 9.3–12 kg, and duration of surgery (4.0–6.8hrs) or rectal paracetamol group n= 14, 6 males, 0.6–2.2 y, 7.5–12.0 kg, and 3.5–6.1hrs duration of surgery	- Paracetamol plasma concentration - The VAS (McGrath et al., 1985) (score 0-10 cm), cut-off point < 4 cm to indicate adequate analgesia - COMFORT Behavior scale (score 6-30) (Van Dijk et al., 2000) 24 hours post-op every blood sample and as necessary depending on the child's clinical condition	Intravenous infusion of 40 mg/kg for 15 min every 6 h of propacetamol or rectal suppositories of 20 mg/kg of paracetamol every 6 h - No significance difference in baseline characteristics - VAS scores were < 4 cm in 22 children. - VAS scores were ≥ 4 cm in four children (two in each group). - Nine children in the rectal group received midazolam for COMFORT-B score exceeding 17. - Three children received midazolam for COMFORT-B score exceeding 17 in the IV group.
Reiter, Ng, & Dobyns, 2012 USA	To describe dosing regimens and efficacy of continuous infusion hydromorphone in mechanically ventilated children	Retrospective charts review 92 critically ill children, M age = 6.88 ± 6 y, median 4 y, m weight = 30.4 ± 26 kg, median = 18, 60 males and 32 females, and 12 patients required extracorporeal membrane oxygenation (ECMO) The primary conditions	Hydromorphone dosing requirements, pain scores every 2 to 6 hours using FLACC pain scale and adverse drug events	Continuous infusion hydromorphone in mechanically ventilated children - Hydromorphone was used as a first line opioid in only 10% of patients, 65 % as a second line and 25% as a third line. - Starting dose was 0.024 ± 0.04 mg/kg/h, maximum dose 0.05 ± 0.1 mg/kg/h, and duration of therapy 182 ± 169 hours. - Most patients received additional pain and sedation

were:
 respiratory failure/pneumonia (32%), malignancy (18%), trauma (15%), ECMO (13%), seizures (5%), infection (4%), and non-descriptive requiring mechanical ventilation (2%).

therapy.
 - Average FLACC scores per patient was 1.004 ± 0.71 , 66% percent of FLACC scores were below one, less than 10% above 3, and one above 6.
 - Non-ECMO patients had a significantly lower initial and maximum dosing requirement than ECMO patients ($p = 0.001$).

<p>Renfrow, 2009 USA</p>	<p>To assess the quality of pain management practices with extubated postoperative infants and children in PICU</p>	<p>Master project, Retrospective chart review in a single PICU 100 patients, six months to 17years old</p>	<p>1-to-10 pain scale such as FLACC, NIPS or Wong-Baker For pain assessment, medications administered</p>	<p>Pharmacological and non-pharmacological</p>	<p>- Pain was less than four for the first 48 hours in 97% of the cases after medication. - FLACC scale was used in 55% of the cases, and Wong-Baker scale was used in 44%. - The most commonly administered analgesics were tylenol (52%), tylenol w/codeine (28%), and fentanyl (28%). - The most commonly non-pharmacological methods were quiet environment</p>
------------------------------	---	--	---	--	--

					(27%), dim lights (12%), limit visitors (9%), music (9%), pacifier (8%), and diversion (5%).
Ross, Smith, Tolo, & Khemani, 2011 USA	To determine whether bupivacaine infusion reduces the need for the IV opioids in Adolescent post posterior spine fusion	Retrospective Single PICU, n= 244, 10 to 18 y, 196 females, two groups: 1) bupivacaine group, n= 129 children with a catheter for continuous bupivacaine infusion and 2) non-bupivacaine, n= 115	<ul style="list-style-type: none"> - Postoperative opioid use, - Pain scores by VAS; FLACC; or a modified Wong-Baker Faces Scale (FACES) side effects, - Depth of catheter placement, and - Fluid resuscitation 	Local continuous infusion of bupivacaine via a catheter placed during surgery adjacent to the spinal instrumentation in the paraspinal muscle.	<ul style="list-style-type: none"> - There were no differences in demographics between the two groups - Children receiving bupivacaine required fewer infusion of morphine than who did not (32.6% vs. 85.2%, $p < 0.001$). - Overall reduction in opioid use on postoperative day one was less in bupivacaine group (18.9 vs. 26.4 mg, $p < 0.001$). - Pain scores were low (< 3) in both groups. - There was no impact of the depth of the catheter on opioid use ($p > 0.15$).
Sharek et al., 2006 USA	To determine the effect of using a combination of parental education	Cohort study comparing between two independent groups: children receiving	Pain scores on postoperative days 0–6 using FLACC, Wong Baker Faces, or 0–10 numerical rating scale, parent perception of their	Combination of: 1) parental education strategies such as psych educational training and parent-to-parent mentorship and 2)	<ul style="list-style-type: none"> - Two groups did not differ in age, sex, ethnicity, weight, and percent with biliary atresia,

	strategies and non-pharmacologic interventions on pain scores, parental perceptions of pain management, and pain scoring compliance in postoperative pediatric liver transplant patients.	transplants pre-intervention and post-intervention. 27 children: 13 historical control group and 14 intervention group	children's pain ratings using a Likert scale: 1 (lowest level of pain) to 5 (highest level of pain), length of stay, ventilator days, total cost, and opioid use.	non-pharmacologic interventions such as hypnosis, positioning, swaddling, acupuncture, and guided imagery options. See page 173-174	PICU length of stay, time to extubation, total cost, and opioid use. - Pain scores were significantly lower in the intervention group 2.12 vs 2.82 in the control group ($p \leq 0.05$). - Parental pain perception scores were significantly lower in the intervention group 2.1 vs 3.1 in the control group ($p \leq 0.05$).
Shayevitz, To Merkel, O'Kelly, Reynolds, & Gutstein, 1996 USA	determine the effect of the method of postoperative pain management (lumbar epidural morphine infusions vs IV opioid) on outcomes in children undergoing cardiac surgery.	Retrospective patients' records review, case control Two groups: lumbar epidural morphine (LEM) and IV opioid (IVO) groups - LEM group (n= 27, age = 5-19 y, weight = 7.3-43.3 kg, and 17 extubated late), - IVO group (n =27, age = 3-18.8y, weight = 4.5- 57.1kg, and 18 extubated late)	Pain intensity score from 0 to 10 (Ross & Ross, 1988) at least once during each 8-hour nursing shift (≤ 4 considered adequate analgesia), times to tracheal extubation, transfer from the intensive care, and resumption of regular diet	Lumbar epidural morphine infusions: A bolus of 50µg /kg of morphine via epidural catheter, followed by a continuous infusion at 3 to 4 µg /kg/h postoperatively	- No difference between the two groups in demographics, - Pain scores in LEM patients were significantly less than in IVO patients on day one post-operation ($p = 0.03$) - More doses of hypnotic medication (midazolam, lorazepam, chloral hydrate, and diphenhydramine) were required for IVO group than for those in the LEM group.

					<p>- No differences in outcome between the two groups patients whose trachea were extubated early except in the time to first spontaneous void (it was longer in LEM group)</p> <p>- Times to tracheal extubation, transfer from the intensive care, and resumption of regular diet were significantly shorter in LEM group.</p> <p>- LEM patients who were extubated late received significantly less supplemental opioids than who extubated late in the IVO group during the first 5 postoperative days.</p>
Sheridan, Stoddard, & Querzoli, 2001 USA	To describe background medication required to achieve an adequate pain and anxiety control among critically burned children	Retrospective review 28 children, age 6 months–16y, wound size 10–95 %, and intubated for 8–112 days	Medication doses, No pain or sedation scales used; the bedside nurse adjusted doses as needed to reach an ideal state described as “lightly asleep but arousable” p 151.	Pain and anxiety protocol, infusions of morphine and midazolam adjusted to comfort. Prior to extubation, infusions were reduced by 40% and then weaned no more than 10% per day thereafter.	<p>- Neuromuscular blocking agents were administered for 65 of 447 (14.5%) ventilator days.</p> <p>- The highest daily infusion of morphine averaged 0.40 mg/kg/hr ± 0.24 mg/kg/hr</p>

requiring prolonged mechanical ventilation (> 7 days) managed under a pain and anxiety protocol that adjusts background infusions to comfort.

(usual starting dose was 0.05 to 0.1 mg/kg/hr).
 - The highest daily infusion dose of midazolam was 0.15 ± 0.07 mg/kg/hr (usual starting dose was 0.04 mg/kg/hr).
 - On extubation day, morphine was 0.22 ± 0.17 mg/kg/hr and midazolam 0.10 ± 0.12 mg/kg/hr.
 - Withdrawal symptoms developed in one child.

<p>Van Der Marel et al., 2001 Netherlands</p>	<p>To determine the differences in effects and plasma of acetaminophen between children receiving doses of acetaminophen rectally or orally after an initial rectal loading dose.</p>	<p>Randomized controlled trial 40 children Rectal acetaminophen (n = 20, 15 males, 8-15 months, and 5.4- 12.2 kg) or oral (n = 20, 14 males, 6-20 months, and 6.7 to 11 kg)</p>	<p>Pain scores every 3 hours using the VAS (McGrath et al., 1985) and the COMFORT scale (Van Dijk et al., 2000), Blood samples</p>	<p>20 mg/kg of oral or rectal acetaminophen every 6 hours after a rectal loading dose (40 mg/kg) during elective craniofacial correction</p>	<p>- There were no significant differences between the two groups in baseline characteristics - Plasma concentrations of acetaminophen were higher in patients receiving rectal acetaminophen. - Majority of patients in both groups had a VAS score < 4 cm: 37 on 3hrs, 37 on 6 hrs, 38 on 9 hrs, 36 on 12 hrs, 39 on 15 hrs, 37 on 18 hrs, 39 on 21 hrs, and</p>
---	---	---	--	--	---

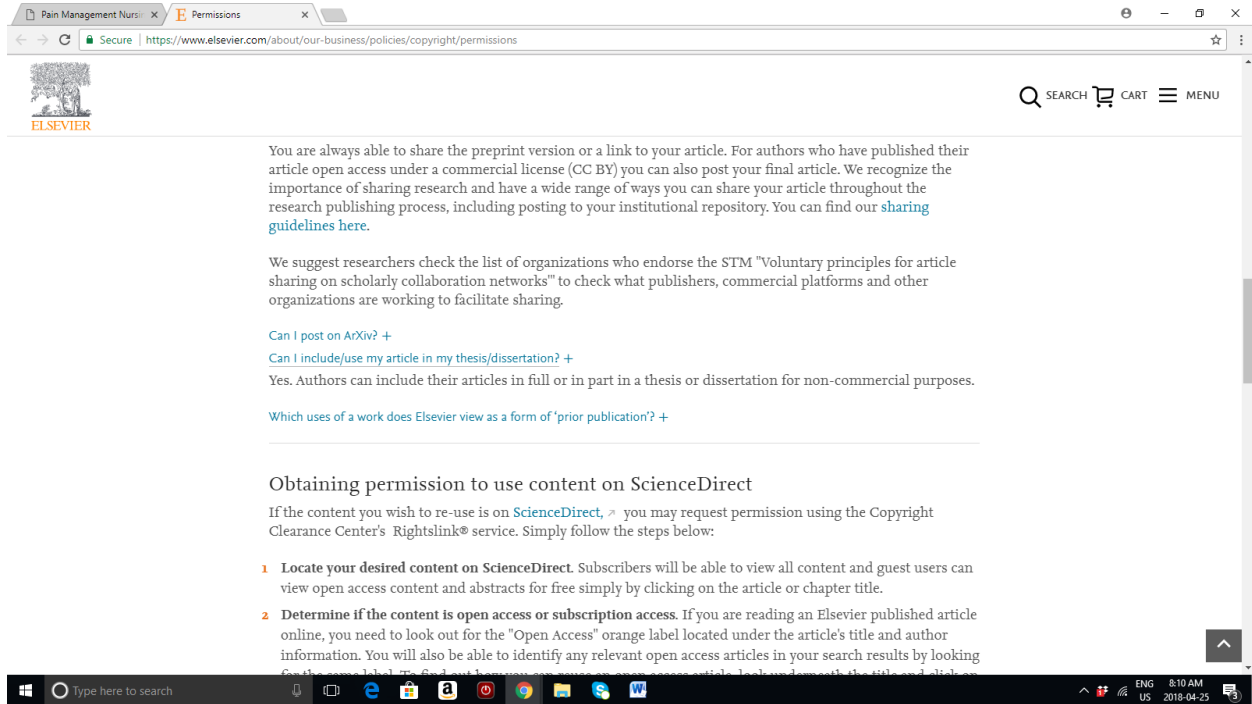
<p>Van Dijk et al., 2002 Netherlands</p>	<p>To compare between continuous IV infusion of morphine and IV bolus post major thoracic or abdominal surgery</p>	<p>Double-blind randomized controlled trial 181 children aged 0–3 y, 35 ≥ one y, 104 males, 75 mechanically ventilated,</p>	<p>Pain scores using COMFORT ‘behavior’ (van Dijk et al., 2000) and the VAS (Lawrence et al., 1993; McGrath et al., 1985; Taddio et al., 1995; Tarbell et al., 1992) for pain, every 3 h</p>	<p>10 µg /kg/h morphine continuous intravenous infusion or 30 µg /kg morphine every 3hrs</p>	<p>38 on 24 hrs. - 12 patients receiving oral acetaminophen vomited once or twice. - Pain scores were higher in patients receiving oral acetaminophen ($p \leq 0.05$). - Plasma concentrations and pain scores did not differ between the two groups after excluding vomited patients from oral group. - No relation was found between plasma concentrations of acetaminophen and pain scores.</p>
		<p>Continuous morphine n = 88, and bolus morphine n = 93</p>			<p>- There were no significant differences in pain scores between the two groups (VAS median was 1.9 in continuous morphine vs 1.8 in bolus group, $p = 0.84$) - A significant interaction between condition and age showed that the continuous morphine was favorable for the</p>

Weldon, Connor, & White, 1993 USA	To determine the safety and efficacy of PCA in children undergoing elective scoliosis surgery and the usefulness of the NCA as an alternative.	<p>Randomized controlled trial</p> <p>Four groups: 1) Intermittent boluses of morphine via the PCA as needed ($n = 21$, M age = 15y, M weight = 50 kg, and 15 females);</p> <p>2) Continuous infusion of morphine plus PCA as needed ($n = 21$, M age = 15y, M weight 52 kg, and 14 females);</p> <p>If child was unable to use the PCA, 3) (NCA) ($n = 6$, M age = 12 y, M weight = 40 kg, and 5 females; and 4) NCA plus continuous infusion ($n = 6$, M age = 12 y, M weight = 24 kg, and 4 females).</p>	Pain scores by the nurse or the patient the VAS (0-100) every 4 hrs, morphine use, side effects, and therapeutic interventions	Morphine during the first 72 h post-operation by 1) PCA 0.03 mg/kg, 2) PCA 0.02 mg/kg + continuous infusion 0.02 mg/kg/h, and 3) NCA 0.03mg/kg, and NCA 0.02mg/kg + 0.02 mg/kg/hr continuous infusion. PCA/NCA devices were set to lockout for 10 minutes at least.	<p>age (1–3 years old).</p> <p>- Extra boluses of morphine were given to 119 patients (66%).</p> <p>- There was no difference between the PCA and the PCA plus continuous infusion groups in the baseline characteristics.</p> <p>- There was no difference between the NCA and the NCA plus continuous infusion groups in the baseline characteristics.</p> <p>- There was no difference between the PCA and the PCA plus continuous infusion groups in morphine use and side effects.</p> <p>-There was no significant difference between the PCA and the PCA plus continuous infusion groups in VAS scores over time except at 9 hours post-operation (lower in the PCA plus continuous</p>
--------------------------------------	--	--	--	---	--

					infusion, $p < 0.05$). - NCA children received less morphine than other PCA children. - There was a significant difference between the self-reported VAS scores and the nurses' VAS scores (lower in nurses' scores, $p < 0.05$)
Wu et al., 2009 USA	To determine if acupuncture feasible and acceptable for acute postoperative pain management .	Nonrandomized clinical trial Single PICU 20 patients (age 7 months to 18 y), Two cohort groups: spinal fusion surgery group (n=11, 7 females, median age 13y) Other surgeries e.g., thoracotomy group (n=9, 3 males, median age 2.7y)	Pain scores 0-10 using a standard numeric scale or FLACC scale if self-report cannot be obtained.	Two sessions of acupuncture (10 to 15 minutes each) by a licensed acupuncturist, the first one on the first postoperative day and the second session on 24–48 hours after the first session.	- There were no adverse events of acupuncture. - 70% of parents and patients believed acupuncture helped the child's pain. - In case of not having insurance for acupuncture, 85% of parents informed that they would pay for it. - In spinal fusion patients, mean pain scores prior to the first session of acupuncture was 3.7, 1.7 after 4 h, and 3.1 after 24 h. Mean pain scores prior to the second session were 3.6, 2.2 after 4 h, and 3.1 after 24 h.

- In the other surgical cohort, the mean pain scores 4 h prior to the acupuncture was 2.5, 0.3 after 4h, and 1.6 after 24 h. Mean pain scores prior to the second session was 3.6, 2.2 after 4 h, and 3.1 after 24 h.

Appendix D. Elsevier Guidelines for Using Published Articles in Dissertation for Non-Commercial Purposes



The screenshot displays the Elsevier website page titled "Permissions". The browser address bar shows the URL: <https://www.elsevier.com/about/our-business/policies/copyright/permissions>. The page content includes the Elsevier logo, a search bar, and a navigation menu. The main text explains that authors can share preprint versions or links to their articles, and that open access under a commercial license (CC BY) allows posting the final article. It also mentions the importance of sharing research and provides a link to "sharing guidelines here".

You are always able to share the preprint version or a link to your article. For authors who have published their article open access under a commercial license (CC BY) you can also post your final article. We recognize the importance of sharing research and have a wide range of ways you can share your article throughout the research publishing process, including posting to your institutional repository. You can find our [sharing guidelines here](#).

We suggest researchers check the list of organizations who endorse the STM "Voluntary principles for article sharing on scholarly collaboration networks" to check what publishers, commercial platforms and other organizations are working to facilitate sharing.

Can I post on ArXiv? +
Can I include/use my article in my thesis/dissertation? +

Yes. Authors can include their articles in full or in part in a thesis or dissertation for non-commercial purposes.

Which uses of a work does Elsevier view as a form of 'prior publication'? +

Obtaining permission to use content on ScienceDirect

If the content you wish to re-use is on [ScienceDirect](#), you may request permission using the Copyright Clearance Center's Rightslink® service. Simply follow the steps below:

- 1 **Locate your desired content on ScienceDirect.** Subscribers will be able to view all content and guest users can view open access content and abstracts for free simply by clicking on the article or chapter title.
- 2 **Determine if the content is open access or subscription access.** If you are reading an Elsevier published article online, you need to look out for the "Open Access" orange label located under the article's title and author information. You will also be able to identify any relevant open access articles in your search results by looking

References

Elsevier. Permissions 2018. <https://www.elsevier.com/about/our-business/policies/copyright/permissions> (accessed April 25, 2018).



Université d'Ottawa
Faculté des sciences
de la santé
École des sciences
infirmières

University of Ottawa
Faculty of Health
Sciences
School of Nursing

Appendix E. Script Used for Telephone Administered Survey of Study Two

PICU Pain Management Practice and Guidelines in Jordanian Pediatric Intensive

Care Units (PICU)

Dear colleagues:

My name is Ahmad Ismail. I am a nurse and PhD candidate at the School of Nursing of the University of Ottawa in Ottawa, Canada. As part of my doctoral studies, I am conducting a survey about pain management guidelines in Jordanian Pediatric Intensive Care Units (PICU). Your participation is completely voluntary. Would you be willing to answer the following questions about pain management guidelines available in your PICU? This telephone survey will take approximately 15 to 20 minutes of your time.

[IF YES, CONTINUE].

[IF NO, THANK THEM FOR THEIR TIME, PROVIDE THEM WITH MY CONTACT INFORMATION [Ahmad Ismail], SO THEY CAN CONTACT ME IN CASE THEY CHANGED THEIR MINDS OR NEED MORE INFORMATION TO DECIDE TO PARTICIPATE, AND POLITELY END THE CALL].

Thank you for agreeing to participate. To help us with our research we would appreciate it if you could answer all the questions the best that you can. However, if you find any of the questions difficult or sensitive in nature and do not wish to answer a question, just tell me and we will skip it, and go on to the next one. The telephone call will be recorded. I appreciate your time.

613 562-5473
613 562-5443

451 Smyth
Ottawa ON K1H 8M5 Canada

www.uOttawa.ca



uOttawa

Université d'Ottawa
Faculté des sciences
de la santé
École des sciences
infirmières

University of Ottawa
Faculty of Health
Sciences
School of Nursing

All of the information that you will provide by phone, including your name and any other identifying information will be kept strictly confidential. All of the data collected from this survey will be kept under lock and key in a cupboard in my thesis supervisor's private office at the University of Ottawa here in Canada for five years after final approval for publication accepted. Identifying information including institutional information will not be used during publications or presentations of this research work.

If you have any questions about this study after you have participated or while you are deciding if you will participate, you can contact me or my supervisor. If you have any questions with regards to the ethical conduct of this study, you may contact the Protocol Officer for Ethics in Research, University of Ottawa.

Do I have your permission to begin asking you questions?

Study Two Questionnaire: PICU Pain Management Practice and Guidelines in Jordanian
Pediatric Intensive Care Units (PICU)

The first 12 questions are being asked to establish the characteristics of your unit.

1. How many beds are there on your unit? _____
2. How many registered nurses are employed as staff nurses on your unit? _____
3. How many registered nurses are employed as staff nurses on your unit per shift? _____
4. How many practical nurses are employed on your unit? _____
5. How many in charge nurses are employed on your unit? _____
6. How many in charge nurses are employed on your unit per shift? _____
7. How many nurses in education are employed on your unit? _____
8. How many nurses in other non-direct patient care are employed on your unit? _____
9. How many other personnel doing nursing care duties to help nurses are employed on your unit e.g., nurse practitioners, advanced practice nurses, and clinical nurse specialists? _____
10. How many other health care clinicians providing patient care (respiratory therapists, physiotherapists, pharmacists, other) are employed on your unit? _____
11. How many physicians are working on your unit? (staff physician; residents) _____
12. How would you describe the type of hospital that you are working for?
 - a) Government
 - b) Military
 - c) Private
 - d) University
 - e) Non- Governmental (NGO's)

13. Do you have a policy or clinical guideline for pain assessment on your unit?
- a) Yes
 - b) No
14. Do you have a pain documentation policy on your unit?
- a) Yes
 - b) No
15. Do you have policies or clinical guidelines for pain management on your unit?
- a) Yes
 - b) No
16. Is pain routinely assessed on your unit?
- a) Yes
 - b) No
17. If yes, how frequently is the pain assessed on your unit?
- a) Every hour
 - b) Every two hours
 - c) Every three to four hours
 - d) Every five to eight hours
 - e) Every nine to twelve hours
 - f) Other: please describe_____
18. Do you routinely document pain assessment on your unit?
- a) Yes
 - b) No

19. Do you consider that pain management on your unit is multi-disciplinary?
- a) Yes, go to question 20.
 - b) No, go to question 21.
 - c) Sometimes, go to question 20.
20. If the answer to question 19 is yes or sometimes, who participates in pain management?
- a) Physicians
 - b) Nurses
 - c) Pharmacists
 - d) Respiratory therapists
 - e) Other: please describe_____.
21. Do you use one or more pain assessment tools for pain assessment on your unit?
- a) Yes, go to question 22.
 - b) No, go to question 23.
22. If the answer to question 21 is yes, what are the common pain assessment tools used on your unit?
- a) Face, Legs, Activity, Cry, Consolability Scale (FLACC)
 - b) Revised FLACC
 - c) Comfort Scale
 - d) Modified Comfort Scale
 - e) Faces Pain Scale (Wong Baker)
 - f) Visual Analog Scale (VAS)
 - g) Numeric Pain Rating Scale (NPRS)

- h) Neonatal Infant Pain Scale (NIPS)
- i) Crying Requires Increased Vital Signs Expression Sleeplessness (CRIES)
- j) The Maximally Discriminate Facial Movement Coding System (MAX)
- k) The Children's Hospital of Eastern Ontario Pain Scales (CHEOPS)
- l) Other e.g., Faces Pain Scale-Revised and Non-communicating Children's Pain

Checklist: please describe _____

23. Do you routinely use a sedation assessment tool for the ongoing assessment of the provision of sedation on your unit?

- a) Yes, go to question 24.
- b) No, go to question 25.

24. If the answer to the question 23 is yes, what is the sedation assessment tool you use on your unit?

- a) Neonatal Pain, Agitation, and Sedation Scale (N-PASS)
- b) Ramsay Sedation Scale (RSS)
- c) Pediatric Sedation-Agitation Scale (P-SAS)
- d) Sedation-Agitation Scale (SAS)
- e) The State Behavioral Scale (SBS)
- f) Motor Activity Assessment Scale
- g) Richmond Agitation-Sedation Scale
- h) Other: please describe _____

25. Do you have a policy or clinical guideline guiding the pain management for patients on mechanical ventilation?

- a) Yes

b) No

26. What are the common strategies used for pain management for patients on mechanical ventilator?

a) Opioids only

b) Sedatives only

c) Opioids and sedatives

d) Opioids and neuromuscular blockers e.g., Cisatracurium

e) Opioids, sedatives, and neuromuscular blockers.

f) Other e.g. Non-steroidal Anti-inflammatory Drugs (NSAIDs): please describe_____

27. Do you have a policy or clinical guideline guiding Intravenous (IV) opioids administration on your unit?

a) Yes

b) No

28. What are the commonly used Intravenous (IV) opioids for continuous infusion on your unit?

a) Fentanyl

b) Morphine

c) Remifentanyl

d) Other e.g., Hydromorphone, Codeine, Tramadol, and Meperidine (Demerol, Pethidine): please describe_____

29. What are the commonly used Intravenous (IV) opioids for non-continuous infusion on your unit?

- a) Fentanyl
 - b) Morphine
 - c) Remifentanyl
 - d) Other e.g., Hydromorphone, Codeine, Tramadol, and Meperidine (Demerol, Pethidine): please describe_____
30. What are the commonly used Intravenous (IV) sedatives for continuous infusion on your unit?
- a) Midazolam
 - b) Lorazepam
 - c) Diazepam
 - d) Other e.g., Propofol: please describe_____
31. What are the commonly used Intravenous (IV) sedatives for non-continuous infusion on your unit?
- a) Midazolam
 - b) Lorazepam
 - c) Diazepam
 - d) Other e.g., Propofol: please describe_____
32. Do you have a policy or clinical guideline guiding the administration of opioid antagonists such as Naloxone on your unit?
- a) Yes
 - b) No
33. Do you have a policy or clinical guideline guiding the administration of sedative antagonists such as Flumazenil on your unit?

- a) Yes
 - b) No
34. Do you use an opioid or sedative withdrawal assessment tool on your unit ?
- a) Yes, go to question 35.
 - b) No, go to question 36.
35. If the answer to the question number 34 is yes, what is the sedatives or opioids withdrawal tool you use on your unit?
- a) Withdrawal Assessment Tool-1
 - b) Sophia Observation Withdrawal Symptom Scale
 - c) Other: please describe_____.
36. Do you have a policy or clinical guideline guiding the administration of non-opioid medications for pain management on your unit?
- a) Yes
 - b) No
37. Do you have a policy or clinical guideline related to epidural analgesia (or other types of regional anaesthesia)?
- a) Yes
 - b) No
 - c) Not sure
38. Do you have a policy or clinical guideline guiding the application of topical anaesthetic agents (i.e. EMLA, AMETOP, L-MAX)?
- a) Yes
 - b) No

39. Do you have a policy or clinical guideline guiding the use of sucrose (or other sweet solution)?
- a) Yes
 - b) No
40. Do you have a policy or clinical guideline guiding the use of non-pharmacological management of pain?
- a) Yes, go to question 41.
 - b) No, go to question 42.
41. If the answer to the question 40 is yes, what are the commonly used non-pharmacological techniques for pain management on your unit?
- a) Touch
 - b) Positioning
 - c) Noise reduction
 - d) Light reduction
 - e) Music
 - f) Other e.g., Distraction, Holy Quran: please describe_____.
42. Do you have a policy or clinical guideline for pain management during commonly performed procedures e.g., venipuncture, peripheral intravascular insertion, and arterial line insertion?
- a) Yes
 - b) No
43. Do you have policy or clinical guideline for pain management for post-operative patients?

- a) Yes, go to question 44.
 - b) No, go to question 45.
44. If the answer to the question 43 is yes, what are the common strategies used for post-operative patients who are not mechanically ventilated?
- a) Opioids
 - b) Regional anaesthesia
 - c) Non-steroidal anti-inflammatory drugs
 - d) Opioids and non-steroidal anti-inflammatory drugs
 - e) Regional anaesthesia and non-steroidal anti-inflammatory drugs
 - f) Other: please describe _____
45. Do you have a policy or clinical guideline guiding Patient Controlled Anaesthesia (PCA) administration on your unit?
- a) Yes
 - b) No
 - c) Not sure
46. Is pain assessment and management routinely discussed on unit rounds?
- a) Yes, go to question 47.
 - b) No, go to question 48.
47. If the answer to the question 46 is yes, who commonly asks about pain during unit rounds?
- a) Physician (consultant)
 - b) Physician (resident)
 - c) Bedside nurse

- d) Charge nurse
- e) Other e.g., pharmacists, respiratory therapists, and family: please describe_____.

48. Is pain assessment and management routinely discussed on nursing hand over at change of shift?

- a) Yes
- b) No

49. If the nurse is concerned about a child's pain, what is the process to inform the medical staff?

- a) Immediately and directly by phone or face to face
- b) By reporting to the charge nurse who informs the medical staff
- c) Waiting until rounds in the morning
- d) Other: please describe_____

50. Is there a policy or guideline to involve families (parents, grandparents, and care-giver) in decisions about pain assessment and management?

- a) Yes
- b) No
- c) Not sure

Would you like to add any other comments regarding pain management in your unit or about the influence of religion or culture on pain management? Please feel free to answer in Arabic.

.....
.....

End of questions

Thank you for participating in this survey.



Appendix F. Third Study Online Information Letter and Informed Consent

Title of the study: The Influence of Context on Utilizing Research for Pain Management in Jordanian Pediatric Intensive Care Units (PICU)

Principal Investigator: Ahmad Ismail
 PhD Candidate
 School of Nursing
 Faculty of Health Sciences
 University of Ottawa
 Ottawa, ON, Canada

Thesis Supervisor: Dr. Denise Harrison
 Assistant Professor
 School of Nursing
 Faculty of Health Sciences
 University of Ottawa
 Ottawa, ON, Canada

Thesis Jordan Committee Member: Dr. Huda Gharaibeh
 Associate Professor
 Department of Maternal and Child Health
 Faculty of Nursing
 Jordan University of Science and Technology

Dear colleagues:

You are invited to participate in the above mentioned research study conducted by PhD candidate, Ahmad Ismail. From this research we wish to gain a beginning understanding of the contextual factors that influence the research utilization to guide pain management in Jordanian PICUs. You will be asked to complete four main sections: (1) demographic items, (2) items about the contextual factors relating to your unit using a validated survey called The Alberta Context Tool, (3) items about the direct application of research findings for pain management, and (4) items about how research findings may alter your way of thinking or practicing regarding pain management. You are under no obligation to participate and if you choose to participate, you may refuse to answer questions that you do not want to answer. Completion and submitting of the survey by you implies consent.

Université d'Ottawa
 Faculté des sciences de la santé
 École des sciences infirmières

University of Ottawa
 Faculty of Health Sciences
 School of Nursing

613 562-5473
 613 562-5443
 451 Smyth
 Ottawa ON K1H 8M5 Canada
 www.uOttawa.ca



uOttawa

Université d'Ottawa
Faculté des sciences
de la santé

École des sciences
infirmières

University of Ottawa
Faculty of Health
Sciences

School of Nursing

The survey should take you approximately 15 to 20 minutes to complete. If you agree to participate, please complete the survey using the following link: (link of the survey).

Once you have completed the survey, please click on the submit key. To help us with our research we would appreciate if you could answer all the questions the best that you can. However, if you find any of the questions difficult or sensitive in nature and do not wish to answer a question, just skip it, and go on to the next one.

This research has the potential to improve pain management practices in Jordanian PICUs thereby benefiting children and their families being cared for in PICU. It may raise your awareness and knowledge about pain management and utilization of research for pain management in PICU. However, a risk of social repercussions could be developed due to the participation in this study; you may be negatively judged by peers or employer if they have access to your answers (your answers may have criticism to the workplace or leaders). The following measures are being taken to mitigate this risk: (1) you are not being asked for your name, (2) you are free to not answer any question you want, (3) please use standard safety measures such as signing out of your account, closing your browser and locking your screen or device when you are no longer using them/ when you have completed the survey, and (4) the information you share will remain strictly confidential and will be used solely for the purposes of this research, and the only people who have access to the research data are myself and my supervisor. All of the data collected from this survey will be kept under lock and key in a cupboard in my thesis supervisor's private office at the University of Ottawa here in Canada for five years after final

613 562-5473
613 562-5443

451 Smyth
Ottawa ON K1H 8M5 Canada

www.uOttawa.ca



Université d'Ottawa
Faculté des sciences
de la santé
École des sciences
infirmières

University of Ottawa
Faculty of Health
Sciences
School of Nursing

approval for publication accepted. Results will be published in pooled (aggregate) format.

If you have any questions about this study after you have participated or while you are deciding if you will participate, you can contact me or my supervisor. If you have any questions with regards to the ethical conduct of this study, you may contact the Protocol Officer for Ethics in Research, University of Ottawa.

Please keep this form for your records.

Thank you for your time and consideration.

Please be informed that if you do not agree to participate now, and you changed your mind later, please contact me.

Ahmad Ismail, date and signature

613 562-5473
613 562-5443

451 Smyth
Ottawa ON K1H 8M5 Canada

www.uOttawa.ca



Université d'Ottawa
Faculté des sciences
de la santé

École des sciences
infirmières

University of Ottawa
Faculty of Health
Sciences

School of Nursing

Third Study Paper Information Letter and Informed Consent

Title of the study: The Influence of Context on Utilizing Research for Pain Management in Jordanian Pediatric Intensive Care Units (PICU)

Principal Investigator: Ahmad Ismail
PhD Candidate
School of Nursing
Faculty of Health Sciences
University of Ottawa
Ottawa, ON, Canada

Thesis Supervisor: Dr. Denise Harrison
Assistant Professor
School of Nursing
Faculty of Health Sciences
University of Ottawa
Ottawa, ON, Canada

Thesis Jordan Committee Member: Dr. Huda Gharaibeh
Associate Professor
Department of Maternal
and Child Health
Faculty of Nursing
Jordan University of
Science and Technology

Dear colleagues:

You are invited to participate in the above mentioned research study conducted by PhD candidate, Ahmad Ismail. From this research we wish to gain a beginning understanding of the contextual factors that influence the research utilization to guide pain management in Jordanian PICUs. You will be asked to complete four main sections: (1) demographic items, (2) items about the contextual factors relating to your unit using a validated survey called The Alberta Context Tool, (3) items about the direct application of research findings for pain management, and (4) items about how research findings may alter your way of thinking or practicing regarding pain management. If you wish to participate in this study, please complete the attached survey. You are under no obligation to participate and if you

613 562-5473
613 562-5443

451 Smyth
Ottawa ON K1H 8M5 Canada

www.uOttawa.ca



Université d'Ottawa
Faculté des sciences
de la santé

École des sciences
infirmières

University of Ottawa
Faculty of Health
Sciences

School of Nursing

choose to participate, you may refuse to answer questions that you do not want to answer. Completion and return of the questionnaire by you implies consent. Once you have completed the survey, please return it in the sealable stamped self-addressed envelope provided.

The survey should take you approximately 15 to 20 minutes to complete. To help us with our research we would appreciate if you could answer all the questions the best that you can. However, if you find any of the questions difficult or sensitive in nature and do not wish to answer a question, just skip it, and go on to the next one. This research has the potential to improve pain management practices in Jordanian PICUs thereby benefiting children and their families being cared for in PICU. It may raise your awareness and knowledge about pain management and utilization of research for pain management in PICU. However, a risk of social repercussions could be developed due to the participation in this study; you may be negatively judged by peers or employer if they have access to your answers (your answers may have criticism to the workplace or leaders). The following measures are being taken to mitigate this risk: (1) sealable stamped self-addressed envelope is provided, so you can put the completed questionnaire in, (2) locked box is provided, so you (if you do not prefer to mail) can drop the sealed envelope in, (3) you are not being asked for your name, (4) I will set times (every two weeks) to collect the answered questionnaires, (5) you are free to not answer any question you want, and (6) the information you share will remain strictly confidential and will be used solely for the purposes of this research, and the only people who have access to the research data are I and my supervisor.

613 562-5473
613 562-5443

451 Smyth
Ottawa ON K1H 8M5 Canada

www.uOttawa.ca



uOttawa

Université d'Ottawa
Faculté des sciences
de la santé

École des sciences
infirmières

University of Ottawa
Faculty of Health
Sciences

School of Nursing

All of the data collected from this survey will be kept under lock and key in a cupboard in my thesis supervisor's private office at the University of Ottawa in Canada for five years after final approval for publication accepted. Results will be published in pooled (aggregate) format.

If you have any questions about this study after you have participated or while you are deciding if you will participate, you can contact me or my supervisor. If you have any questions with regards to the ethical conduct of this study, you may contact the Protocol Officer for Ethics in Research, University of Ottawa.

Please keep this form for your records.

Thank you for your time and consideration.

Please be informed that if you do not agree to participate now, and you changed your mind later, please contact me.

Ahmad Ismail, date and signature

613 562-5473

613 562-5443

451 Smyth
Ottawa ON K1H 8M5 Canada

www.uOttawa.ca

Third Study Questionnaire

Thank you for agreeing to participate in this survey. Completing the four sections of the survey will take approximately 15 to 20 minutes. Please record your answers directly on the survey.

Section (1) Demographic Data Sheet

1- Gender: _____

2- Age in years: _____

3- Education

 Diploma in nursing Bachelor degree Master's degree or more

4- Experience in years in PICU: _____

5- Position

 Head nurse Charge nurse Staff nurse Nurse educator Nurse clinician Other: please specify.....

6- Hospital

 Governmental Private Military University Non-Profit

[Section \(2\) the Alberta Context Tool](#)

Section (3) Instrumental Research Utilization for Pain Management

	Never	Rarely	Some- times	Often	Always
1. How often did you use research-based policies, protocols, or guidelines for pain assessment on your last typical workday?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
2. How often did you use research-based policies, protocols, or guidelines for pain treatment on your last typical workday?	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅

Section (4) Conceptual Research Utilization for Pain Management

On **your LAST typical work day** how often did research findings *about pain management* do any of the following?

	Never	Rarely	Someti mes	Often	Always
1. Give you new knowledge about how to care for patients and families.	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
2. Raise your awareness about new ways to care for patients and families.	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
3. Help to change your mind about how to care for patients and families.	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
4. Give you new ideas about how to care for patients and families.	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅
5. Help you make sense of things you have been doing to care for patients and families.	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₅

End of the survey

Thank you for your participation

Appendix G. Permission to Use Alberta Context Tool



Knowledge Utilization Studies Program

Complete and return by fax or e-mail to:

Dr. Carole A. Estabrooks
 Faculty of Nursing
 Level 5, Edmonton Clinic Health Academy
 11405 87 Avenue
 University of Alberta
 Edmonton, Alberta T6G 1C9
 Telephone: (780) 492-6187; Fax: (780) 492-6186
 Email: kusp@ualberta.ca

Alberta Context Tool (ACT): Preview Agreement

The following constitutes an agreement between Ahmad Ismail, PhD nursing student, of University of Ottawa , 451, Chemin Smyth Road Ottawa, ON, K1H 8M5 hereinafter called **Researcher** and the Knowledge Utilization Studies of The University of Alberta, Edmonton, AB, Canada, hereinafter called **KUSP**.

Following completion of this agreement KUSP will provide the researcher with a copy of the Alberta Context Tool (ACT). *This copy and any reproductions made by the researcher may be used for a research project, a research grant application (and related Human Ethics Board application) or other purpose approved by Dr. Carole A. Estabrooks.*

Once the researcher has decided to use the ACT and received approval for the study, the *ACT: Full Use Permission Agreement* must be signed and completed by both the researcher and KUSP for further use of ACT for the research project/thesis specified in this agreement.

Note that use of the ACT in its entirety, part or variations thereof for data collection purposes without completion of the Full Permission Agreement constitutes copyright infringement.

The Alberta Context Tool (ACT) will be provided for data collection purposes once the researcher agrees to the conditions of the ACT: Full Use Permission Agreement (conditions of use are located at the end of this document).

Name of research project or thesis: The Influence of Contextual Factors on Research Utilization:

Relevance to Pediatric Intensive Care Nurses' Pain Management Practice in Jordan

Title of research application: _____

The undersigned agrees to abide by the terms of this agreement:

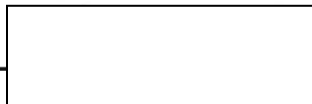
Signatures

Researcher 

Date 25/04/2013

Student's Supervisor (if applicable) _____

Date _____

KUSP 

Date _____

ACT survey to be sent:

Please indicate the survey version that you require:

- Acute Care (Adults)
- Acute Care (Pediatrics)
- Long -Term Care
- Home Care

Please indicate the survey form that you require:

- Nurses (RNs/LPNs)
- Physicians
- Managers
- Practice Specialists (e.g., Clinical Educator, Quality Improvement Specialist)
- Allied Health Care Providers

Alberta Context Tool (ACT): Conditions of Use**(following completion of the ACT Full Use Permission Agreement)**

The Knowledge Utilization Studies Program (KUSP) will provide the researcher with a copy of the Alberta Context Tool (ACT). The researcher is responsible for the reproduction of ACT, the distribution of the survey, and the collection of data.

The researcher will retain full rights to the data for publication. On completion of the study the researcher will forward a digital copy of the ACT and demographic data from their study. These data will be used to assess the psychometric properties of the ACT and to build the ACT's normative record on an ongoing basis. KUSP will retain rights to use these data within analyses of its larger ACT data set but will not publish analyses based on these data alone.

The data should be received within one year of project completion and submitted as follows:

- in Excel format
- with documentation (i.e., codebook)
- by secure courier on a DVD (DVD-R format) OR uploaded to the KUSP secure data site (by arrangement with the KUSP Data Manager)

The researcher will not distribute ACT to any other party. The text will not be copied in any publication, research reports, or theses arising from the research.

The researcher will not adapt or modify the ACT without permission.

Permission to use ACT is granted solely for the project described in the *Full Use Permission Agreement* between KUSP and the researcher and is not transferrable to other researchers or projects.

If the ACT will be distributed in a language other than English, professional translation and back translation from English to the second language is required. Consultation with Dr. Estabrooks during and following completion of the back translation must precede use of the tool. All costs associated with translation and back translation are the responsibility of the requesting researcher. The translated version of ACT will become the property of Dr Estabrooks who will provide it, where requested, to other researchers under the same conditions as have been outlined above.

All copies of ACT must include the following text:

© Carole A. Estabrooks, 2007

All rights reserved. No part of this instrument may be produced, stored in a retrieval system, or transmitted in any form or by any means without the prior written permission of the copyright owner.



Ferenc Toth <floth@ualberta.ca>

9/10/15



to me

Dear Ahmad,

Sorry for the late reply. I have been on vacation. Dr Estabrooks has signed the agreement and I will send you the ACT and the Agreement shortly.

Best wishes,
Ferenc



Ferenc Toth, MA | Research Assistant | [780.492.6198](tel:780.492.6198)
University of Alberta, Faculty of Nursing
Knowledge Utilization Studies Program (KUSP) | www.kusp.ualberta.ca
Translating Research in Elder Care (TREC) | www.trec.ualberta.ca



Ferenc Toth <floth@ualberta.ca>

9/15/15



to me

Dear Ahmad,

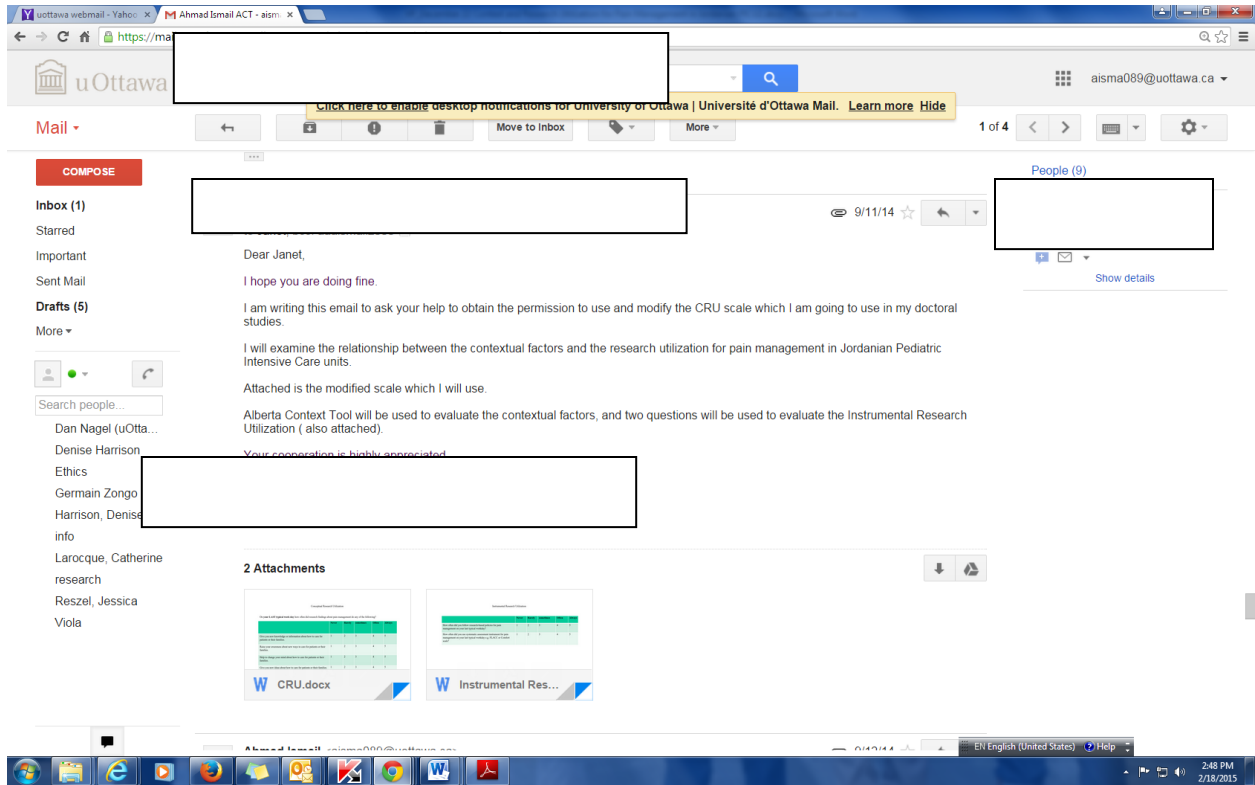
I am attaching the survey you requested along with a demographics questionnaire we also ask you to collect as part of the agreement. Two documents are also included, one an overview of concepts contained in the ACT, and another on scoring post data collection. You will find the ACT Manual on our website here: <http://www.kusp.ualberta.ca/ACT>

In accordance with our agreement we will contact you some time in the future about curating your data in our secure data repository.

I am on leave from KUSP until March. Should you have any further questions, please don't hesitate to contact Fran Russell (fran.russell@ualberta.ca) who will be covering me in my absence.

Best wishes for your research endeavors.

Appendix H. The Permission to Use the Conceptual Research Utilization Scale



The screenshot shows a Gmail interface in a browser window. The address bar displays the URL: <https://mail.google.com/mail/u/1/#search/jasquires%40ohri.ca/13e56a70fc362c0b>. The sender is identified as jasquires@ohri.ca. A notification banner at the top reads: "Click here to enable desktop notifications for University of Ottawa | Université d'Ottawa Mail. Learn more Hide".

The email content is partially redacted with black boxes. The visible text includes:

9/12/14 ☆ ↶

Re CRU scale, the first item should be just knowledge. Knowledge or information is double barrelled and as reported in my paper on the instrument did not perform well because of this. in subsequent work we just use information.

Also patients or families sounds strange to me, do you mean patients and families? This would be your call though. In ACT for pediatrics we use patients and families, just FYI

The left sidebar shows the "COMPOSE" button and folders for "Inbox (1)", "Starred", "Important", "Sent Mail", and "Drafts (5)". A contact list is visible with names: Dan Nagel (uOtt...), Denise Harrison, Ethics, Germain Zongo, Harrison, Denise info, Larocque, Catherine research, Reszel, Jessica, and Viola.

The Windows taskbar at the bottom shows the system tray with the language set to "EN English (United States)" and the date/time as "2:52 PM 7/18/2015".

The screenshot shows a webmail interface for the University of Ottawa. The browser tabs include 'uottawa webmail - Yahoo' and 'Ahmad Ismail ACT - aism...'. The address bar shows a URL starting with 'https://'. The page header includes the University of Ottawa logo and the email address 'aisma089@uottawa.ca'. A notification banner reads: 'Click here to enable desktop notifications for University of Ottawa | Université d'Ottawa Mail. Learn more Hide'. The main content area displays an email thread with the following text: '[Message clipped] View entire message', 'Thank you Janet.', 'Yes, I will remove information, and I will add and instead of or.', 'Can I have your permission to use the CRU scale with this modification.', and 'Best regards,'. The thread includes several redacted sections (black boxes) and dates '9/12/14'. On the right side, there is a 'People (9)' section with a 'Show details' link. The left sidebar shows navigation options: 'COMPOSE', 'Inbox (1)', 'Starred', 'Important', 'Sent Mail', 'Drafts (5)', and 'More'. Below these is a 'Search people...' field and a list of contacts: Dan Nagel (uOtt...), Denise Harrison, Ethics, Germain Zongo, Harrison, Denise info, Larocque, Catherine research, Reszel, Jessica, and Viola. The Windows taskbar at the bottom shows various application icons and the system clock indicating '2:53 PM 2/18/2015'.