2017

The Impact of Nursing Interventions on Pediatric Pressure Injuries

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Abstract

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Health Services

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Abstract

Hospitalized children are vulnerable to pressure injuries. Multiple methods are available to decrease pressure injuries. One specific method is the pediatric pressure injury prevention bundle, which includes device rotation, moisture management, positioning, skin assessment, and support surface management. Although this prevention bundle is available nationwide, it is not known if this type of bundled methodology helps decrease pressure injuries in hospitalized children. Secondary data regarding nursing interventions implemented as a bundle and pressure injury rates from a large pediatric hospital consortium were used to address this gap in the literature. The research questions explored the impact of the pressure injury prevention bundle on pressure injury rates over time and further dissected the data to determine the significance of each intervention in the treatment bundle. Benoit and Mion's model for performance improvement along with the continuous quality improvement model used by the hospital consortium guided the study. The secondary data sample included 102 children's hospitals participating in the national initiative Solutions for Patient Safety. Pearson correlation statistics revealed a significant inverse relationship between nursing interventions and pressure injury rates for hospitalized children. The findings indicated a 57% reduction in rates of pressure injuries over 5 years with nursing participation in implementing the pediatric pressure injury prevention bundle. The impact of any one intervention over the bundle was inconclusive. Positive social change is seen in the ability to decrease pressure injuries in hospitalized children by nurses' implementation of a pediatric pressure injury prevention bundles.

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Dedication

This study is dedicated to children and my magical children Jenna and Lucas.

Acknowledgments

With the guidance and support from the outstanding Walden University professors this study was possible. Dr. Cheryl Anderson and Dr. Earla White challenged me to think broader and to look at my ideas from different and new perspectives. My years at Lucile Packard Stanford Children's Hospital with mentorship from Dr. Sharek and Dr. Albanese encouraged my passion for quality in health care.

This journey of doctoral studies was unconditionally supported by my husband, Raj who believed in me and was my tech support. My dearest Mom and my sisters, Aileen and Katy who kept everything real and in perspective. Thank you to my cheerleaders who on countless occasions cheered me along when I needed it the most. On many occasions, I felt my Grandparents spirit reminding me that even though I felt overwhelmed balancing work, family, motherhood, and doctoral studies, that it would be o.k.

Through the divine will of Krishna, I had this incredible opportunity to complete a doctorate. I hope to use the findings from my study to promote quality in health care.

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Chapter 1: Introduction to the Study

Introduction

Pressure injuries are preventable hospital-acquired conditions that are of concern for children's hospitals (Children's Hospital Alliance, 2014; Solutions for Patient Safety, 2014). The National Pressure Ulcer Advisory Panel (NPUAP, 2016) introduced the term *pressure injury* to replace *pressure ulcers*. Hospital acquired pressure injuries negatively affect the child, family, and hospital system (Tume, Siner, Scott, & Lane, 2014). The child and family suffer from the often-painful healing process and possible disfigurement (Parnham, 2012). Children's hospitals incur the cost of healing, length of stay, and responsibility for the pressure injury (Parnham, 2012). Preventing pressure injuries from occurring prevents pain and suffering for the hospitalized child and the hospital.

Hospitalized children are vulnerable to hospital-acquired pressure injuries (Schindler et al., 2013). Disfiguring pressure injuries leave a child with painful scars that limit activity and alter a child's well-being (Parnham, 2012; Schindler et al., 2013; Tume et al., 2014). Medically fragile children can die from a pressure injury, which further deepens the impact of pressure injury and the need for prevention (Schindler et al., 2013). Pressure injuries can cause a lifetime of suffering, affect a child's life and body image, and in some instances cause death.

Pressure injuries are preventable in the hospital (AHRQ, 2014; CHA, 2014, Institute for Healthcare Improvement [IHI], 2011; SPS, 2014). The 5 Million Lives Campaign identified pressure injuries as a preventable hospital acquired condition (IHI, 2011). There is a potential to prevent pressure injuries across a hospital system with a system-wide approach. One system-wide approach to pressure injury prevention calls for a specific set of standard nursing interventions aimed at high-risk factors for pressure injuries (Tayyib, Coyer, & Lewis, 2015). The term used for this approach is a *pressure injury prevention bundle* (Tayyib et al., 2015). The IHI (2011) defined a prevention bundle as the implementation of three to five scientific elements to improve clinical outcomes. Clinicians implement interventions every time for every patient (IHI, 2011). A PIPB, which includes three to five nursing interventions, represents a possible method to decrease the incidence of pressure injuries in hospitalized children.

Researchers of adult PIPB address the highest risk factors for pressure injuries, which include device rotation, moisture management, nutrition, oxygenation, position, risk assessments, and support surface (Black et al., 2011). The impact of a PIPB is unknown in pediatrics, but optimizing known risk factor interventions has decreased rates of pressure injuries. Researchers have found this decrease in injuries such as support surfaces, skin integrity, and nutrition in one unit at a specific point in time (Drake, Redfern, Sherburne, Nugent, & Simpson, 2012; Parnham, 2012; Schlüer et al., 2014). From the literature review, I found no exploration of the impact of a pediatric pressure injury prevention bundle (PPIPB) on pressure injury rates across an entire hospital or multiple hospitals in pediatrics.

Bundled nursing interventions aimed at preventing pressure injuries can be effective (Black et al., 2011; Chaboyer & Gillespie, 2014). Implementing interventions as a bundle may be effective in the prevention of pressure injuries in hospitalized children. The bundle by Solutions for Patient (SPS) is a network of 100 children's hospitals collaborating to prevent hospital-acquired conditions (SPS, 2014). Through SPS, a PPIPB is available for children's hospitals to utilize. The SPS (2014) PPIPB includes appropriate bed surface, device rotation, moisture management, patient positioning, and skin assessment. Despite the availability of PPIPBs in children's hospitals, the impact of these nursing interventions on pressure injury rates is unknown.

The impact of nursing interventions as a bundle in children's hospitals to prevent pressure injuries is unknown and the intervention that has the greatest impact on rates is unknown. Researchers have documented incidence rates as high as 27% in pediatric critical care settings in the absence of any prevention interventions (Schindler et al., 2013). Some pediatric critical care units have demonstrated the ability to decrease pressure injury rates to 6.8% immediately after implementing some components of a PPIPB (Schindler et al., 2013). Schindler et al. (2013) demonstrated a reduction in pressure injury rates on a unit but not sustainability across a children's hospital. It is also unknown, which bundle interventions influence pressure injury rates.

The impact of a set of nursing interventions implemented for each hospitalized child as a bundle on pressure injury rates across a children's hospital is unknown. The impact of each nursing interventions is also unknown. By understanding how nursing interventions implemented as a bundle impact pressure injury rates in pediatrics, there is a potential to prevent pressure injuries acquired in a children's hospital.

The following section of Chapter 1 is an overview of the study. The study overview starts with the background, problem statement, and purpose. Research questions and hypotheses, theoretical framework, nature, definitions, assumptions, scope and delimitations conclude the chapter.

Background

Pressure injuries acquired in children's hospitals are avoidable. Hospital-acquired pressure injuries increases morbidity, mortality, and health care costs (Children's Hospital Alliance, 2016; Health Research & Educational Trust, 2016; Solutions for Patient Safety, 2014). The pain, suffering, and long-term effects experienced by children are devastating for the child, family, and hospital (Black et al., 2011; Chaboyer & Gillespie, 2014; Galvin & Curley, 2012). The financial impact of pressure injuries in a children's hospital is unclear because of the variances in incidence rates (Tume et al., 2014). Pressure injuries in children's hospitals drain resources and cause harm to children (Parnham, 2012; Schlüer, Schols, & Halfens, 2014; Tume et al., 2014). Preventing pressure injuries in children's hospitals will prevent pain and suffering experienced by the child and family and save valuable resources for children's hospitals.

Preventing pressure injuries has given rise to numerous nursing approaches. Together these approaches have been termed a pressure injury prevention bundle (IHI, 2014). Specific to this research, this bundle includes five nursing interventions. The five nursing interventions include device rotation, patient position, moisture management, skin assessment, and support surfaces (SPS, 2014). The impact of the recommended bundle of interventions is unknown.

It is unclear if a PPIPB or if a single nursing intervention best prevents pressure injuries and maintains decreased rates across a children's hospital. Nursing interventions implemented at the unit-level have demonstrated reduced rates during the implementation phase (Schindler et al., 2013; Schlüer et al., 2014; Schreuders, Bremner, Geelhoed, & Finn, 2012). The impact of nursing interventions aimed at high-risk factors for pressure injuries across a children's hospital is unknown.

Pediatric Pressure Injury Problem Statement

Pediatric pressure injuries remain of concern for children's hospitals (Black et al., 2011; Chaboyer & Gillespie, 2014; Galvin & Curley, 2012). Beyond identifying nurses as having a valuable role in the prevention of pressure injuries, it is unclear which nursing interventions prevent pressure injuries in children (Chaboyer & Gillespie, 2014; Parnham, 2012; Schlüer et al., 2014; Tume et al.,2014). The general problem is that it is unclear how best to prevent pressure injuries across a children's hospital. The specific problem is that there is limited knowledge on the relationship between pressure injury prevention interventions as a bundle and pressure injury rates across a children's hospital system.

Purpose

The purpose of this retrospective correlational study was to identify the possible relationships between bundled and mutually exclusive individual nursing interventions and the reported rate or incidence of pressure injuries in children's hospitals. I analyzed the relationship between each pediatric nursing intervention of the bundle and the bundle as a whole to pressure injury rates in pediatric hospitals. The data came from SPS. For this study, there were five mutually exclusive independent variables and one dependent variable. Each variable was part of the current SPS bundle to prevent pressure injuries.

The independent variables, which compose the bundle, were five nursing interventions. The five nursing interventions included device rotation, patient position, moisture management, skin assessment, and support surfaces. The dependent variable was the rate of pressure injuries for the children's hospital. The aim of the study was to investigate the possible correlation between a pediatric pressure injury prevention bundle and pressure injury rates.

Research Questions

The research questions with related hypotheses included the following.

Research Question 1: Does implementation of a pediatric pressure injury prevention bundle reduce pressure injury rates in a pediatric hospital over time?

$H_0 1$: There is no difference in rates of pressure injury rates prior to the introduction of the prevention bundle versus after integration of the prevention bundle.

$H_1 1$: There is an inverse relationship between pressure injury rates prior to the introduction of a prevention bundle versus after integration of the prevention bundle.

Research Question 2: Does each factor of the pediatric pressure injury bundle which includes device rotation, moisture management, positioning, skin assessment and support surface impact the rate of pediatric pressure injury in a pediatric hospital?

$H_0 2$: There is no difference between the bundle and each individual elements of the pediatric Pressure injury prevention bundle in the prevention of pressure injuries.

$H_1 2$: The bundle has a greater correlation with the prevention of pressure injuries than the individual elements for preventing Pressure injuries.

Theoretical Foundation

Pediatric pressure injuries are a complex phenomenon. The development of a pressure injury and the prevention of pressure injuries are equally complex (Black et al., 2011). Therefore, I chose a conceptual framework to provide a foundation for the study. The framework provides the bridge for the relationship between a PPIPB within the scope of nursing and pressure injury prevention. The conceptual framework illuminates the risk factors for the development of pressure injuries. This study required two conceptual frameworks.

The conceptual framework of continuous quality improvement (CQI) provided the bridge between pediatric nursing interventions and pressure injury outcomes in pediatrics. Sixty-three percent of all harm that occurs within healthcare systems is within the scope of nursing practice (Wilson et al., 2012). Pressure injuries are harmful events that are nursing-sensitive indicators (Agency for Healthcare Research and Quality, 2012; Centers for Medicare & Medicaid Services, 2013; He et al., 2013). The relationship between implementing a PPIPB and pressure injury rates is unclear in the pediatric literature.

CQI provided the underpinning for the analysis of a PPIPB and application of outcomes. CQI stems from the early 1900s, with roots in industry to improve processes that improve outcomes (Robert Wood Johnson Foundation, 2013; Rubenstein et al., 2013). The total quality improvement was the work of Deming and Shewhart, who hypothesized that applied statistical analysis, improves outcomes or productivity (Robert Wood Johnson Foundation, 2015). The concept grew from an appreciation of the predictability of outputs in manufacturing by measuring processes, which later became known as the Shewhart cycle, or the plan-do-check-act cycle, which further evolved into the current plan-do-study-act (PDSA), see Figure 1 (Rubenstein et al., 2013). By applying statistical analysis, the independent variables present in the workforce could predict outcomes. In my study, the independent variable is the PPIPB, which will not predict pressure injury outcomes but further the understanding of the correlation between intervention and the results.

Understanding the relationship between interventions and outcomes in healthcare is essential for affecting pressure injury rates in pediatrics (Institute for Healthcare Quality Improvement, 2015). The fundamental elements of the CQI process encourage evaluation of interventions and outcomes in healthcare. Through the PDSA cycle, organizations can evaluate the impact of interventions (Institute for Quality Improvement, 2015; Rubenstein et al., 2013). The PDSA cycle includes analyzing and summarizing based on the currently available data that applies to pediatric pressure injury prevention (Wilson, Bremmer, Hauck, & Finn, 2012). Analyzing current data is an important process to make an impact on outcomes. The analysis of the correlation between the PPIPB and pressure injury rates is the study step in the CQI cycle.

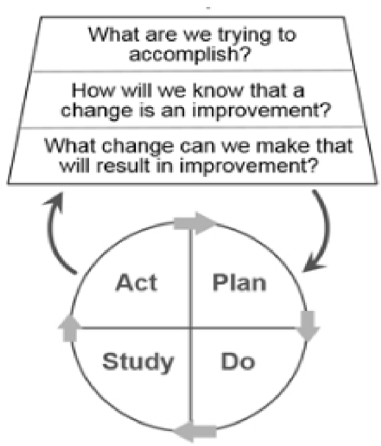

Figure 1. Plan-Do-Study-Act Theory

Source: Institute for Healthcare Improvement; 2015. Reprinted with permission of author. Appendix A.

Conceptual Framework

The conceptual model of pressure injury development by Benoit and Mion (2012) supported this study by identifying the independent variables. Benoit and Mion developed a conceptual model for understanding pressure injury development, building on and updating the seminal model of Braden and Bergstrom (1987) and to a lesser extent that of Defloor (1999). There are 83 risk factors for pressure injuries identified in ongoing research (García et al., 2014), which is beyond the scope of this study. The conceptual framework guided the identification of the five independent variables for pressure injury risk factors to address.

Benoit and Mion's conceptual model of pressure injury development integrates the intrinsic characteristics of the person's ability to redistribute pressure, body habitus, condition of the skin, and metabolic supply and demand. Statistically, significant patient-specific variables that influence the development of a pressure injury are included in the Braden Risk Assessment Scale (Braden & Bergstrom, 1987). The Braden Risk Assessment Scale encompasses Defloor's concepts of shear and friction (Defloor, 1999). Given that Benoit and Mion's theory of pressure injury development encompasses confounding variables, the theory lends itself to creating a robust model for risk analysis.

The current widely used conceptual framework for pediatric pressure injury is a modification of the original Braden and Bergstrom's framework with the inclusion of oxygen saturation (Curley et al., 2003). The pediatric conceptual framework for pressure injury development has foundations in the adult conceptual framework and does not capture the inherent compounding effects of the individual child. The risk factors common to both adults and children include physiologic factors such as nutrition, hydration, infection, inflammation, sensation, and oxygenation; however, the child's age has a significant effect on skin vulnerability (Noonan et al., 2011). External factors include devices placed on the child, support surface, length of exposure to pressure, and exposure to moisture (Peterson et al., 2015). External factors also relate to the impact of the environment on the child (Noonan et al., 2011; Parnham, 2012). Even though Benoit and Mion's framework for pressure injury development is not specific to children it allows for confounding variables.

The Benoit and Mion framework include inherent factors such as severity of illness, which can be seen in Figure 2. Both the Braden Scale (Braden & Bergstrom, 1987) and the Braden Q Scale (Curley et al., 2003) conceptualize sensory perception, moisture, activity, mobility, nutrition, and friction and shear as risk factors for developing pressure injuries. Neither of the two conceptual frameworks addresses the compounding facet of severity of illness. According to Benoit and Mion any alterations in the intrinsic characteristics results in an alteration in the risk for developing a pressure injury. Recognizing the inherent characteristics representing the severity of illness helps to understand the risk factors.

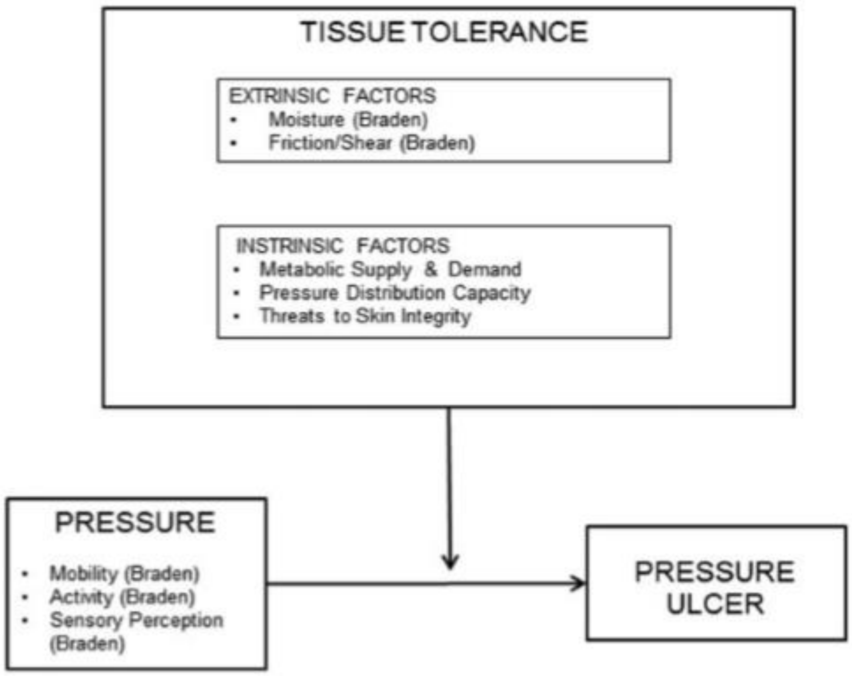

Figure 2. Benoit and Mion Conceptual Framework for Pressure Ulcer Development. Source: Benoit and Mion, 2012, p.359. Reprinted with permission from author. Appendix B.

Nature of the Study

This was a retrospective correlational study with the dependent variable of pressure injuries rates of children's hospitals. The independent variable was the PPIPB, which included five mutually exclusive nursing interventions: skin assessment, device rotation, patient positioning, appropriate bed surface, and moisture management. The participation of each children's hospital in submitting data to Solutions for Patient Safety (SPS) is a covariate or control variable. The purpose of the study was to determine the relationship between the pediatric nursing interventions in the pressure injury prevention bundle and pressure injury rates in children's hospitals.

Definition of Terms

Appropriate support surface: Choice of a support surface, such as the surface the child rests on that meets pressure redistribution needs and allows for adequate repositioning (Manning, Gauvreau, & Curley, 2015).

Bundle: a set of evidence-based interventions for a care setting to improve outcomes (Resar, Griffin, Haraden, & Nolan, 2012)

Deep tissue injury: An area of intact skin that is either a blood-filled blister or a purple or maroon area representing skin damage from pressure and/or shear forces and deeper (Black et al., 2011).

Device: Any medically necessary product placed on the skin (Murray, Noonan, Quigley, & Curley, 2013).

Device rotation: periodic movement of a device to relieve pressure points (Murray et al., 2013).

Moisture management: Managing intrinsic and extrinsic moisture, which renders the skin vulnerable to shear, friction, and pressure (Black, Gray et al., 2011).

Patient positioning: Turning or changing the patient's position to avoid pressure points (Brindle, Creehan, Black, & Zimmermann, 2015).

Pressure injury: Damage to the skin in a localized area related to pressure, friction, or shear forces. The injury to the skin and/or tissue is over a bony prominence (Bryant & Nix, 2012).

Pressure injury prevention bundle: Best available evidence based interventions (Tayyib, Coyer, & Lewis, 2015).

Pressure injury rates: Incidence or occurrence of pressure injuries that develop after admission (Agency for Healthcare Research and Quality, 2012).

Skin assessment: A broad term that refers to assessment of the skin and documentation of the condition of the skin (Brindle et al.,2015).

Assumptions

Assumptions in research relate to those things believed to be true without empirical evidence (Vogt et al., 2014). This study made several assumptions related to the use of secondary data—in particular, assumptions about the accuracy and reliability of the data. Given the vastness of the data, which include secondary data from several children's hospitals, there was no way to evaluate who collected the data and data collection processes. The hospital predetermined the parameters of the collected data. Interrater reliability of the individuals collecting and reporting the data was undetermined. I assumed that individuals collecting and reporting data followed the data reporting guidelines.

Scope and Delimitations

The scope and delimitations of a study define its boundaries (Hulley, Cummings, Browner, Grady, & Newman, 2013). For this study, the scope was limited to analyzing nursing interventions aimed at five identified risk factors for pressure injuries in children and their relationship with pressure injury rates. The study was limited to understanding the relationship and did not extend into determining cause and effect.

In addition, there are 83 risk factors in the development of pressure injuries (García-Fernández, Agreda, Verdú, & Pancorbo-Hidalgo, 2014). The more widely studied risk factors have evolved into risk assessment tools (García-Fernández et al., 2014; Noonan et al., 2011; Parnham, 2012). The risk assessment tools focus on mobility, sensation, nutrition, position, moisture, shear, and friction, (García-Fernández et al., 2014; Noonan et al., 2011; Parnham, 2012). Researchers have recently identified risk factors unique to children, which include devices (García-Fernández et al., 2014; Noonan et al., 2011; Parnham, 2012). This study was limited to focusing on a subset of possible risk factors through specific interventions.

Generalizability

The generalizability of a study relates to the ability to apply its inferences to a general population (Hulley et al., 2013). The sample for this study includes children's hospitals that serve children in an inpatient setting across the United States. Given that the sample was vast, it captures different acuity levels and varying demographics found within a children's hospital. As a result, inferences from the study are generalizable to children's hospitals that have similar characteristics to the children's hospitals represented in the study.

Limitations

The inherent limitations of this study were the data. The first limitations regarding the data were limited demographic information for the children who developed pressure injuries. The second limitation was the minimal demographic data available for each participating children's hospital. Since the data regarding the individual characteristics of the children who developed pressure injuries was unavailable, the covariates inherent to the children were uncontrolled. The analysis of pressure injury occurrence and prevention is limited to the level of the children's hospital. For the purpose of this study having only the pressure injury rates and rates of implementation of the PPIPB, the study was limited to correlation level analysis and not cause and effect. Another limitation of the study related to analyzing the impact of specific nursing interventions on outcomes. Because each children's' hospital utilized different evidence-based nursing interventions, the study results are limited to broad categories of interventions aimed at risk factors and nursing interventions.

Significance

The significance of this study was to understand the relationship between nursing interventions and pressure injury rates in pediatrics. Understanding the relationship between nursing interventions targeted at high-risk factors and the relationship to pressure injury rates could decrease healthcare expenditures and pressure injury rates (Chaboyer & Gillespie, 2014; Parnham, 2012). Despite the ambiguity of costs and rates of pressure injuries in pediatrics, hospitals need to strategize in the prevention of pressure injuries.

Without understanding the relationship between nursing interventions and outcomes, it is unclear if the current prevention interventions has an impact and if the resources allocated to existing intervention is effective (Padula et al., 2012). Understanding the relationship between interventions and outcomes is essential in being able to allocate resources to prevention (Padula et al., 2012). Given that developing a pressure injury while in the hospital is not an acceptable secondary condition, hospitals need to be able to demonstrate an effective prevention program (McInnes, Chaboyer, Murray, Allen, & Jones, 2014). From the perspective of the consumers and health care payers, pressure injuries are inexcusable despite acute illness or immobility (Lawton et al., 2015; McInnes et al., 2014). Health care organizations need evidence-based knowledge on the prevention of pressure injuries in pediatrics.

Beyond increasing the understanding of pediatric pressure injury prevention for health care, the significance of the study was to prevent pain for children suffering from pressure injuries. Preventing pressure injuries in children prevents unnecessary physical and emotional pain for children. This study provides children’s hospitals administration with the evidence to direct resources to prevent pressure injuries. Creating knowledge around the relationship of PPIPB in pediatrics supports pressure injury prevention and ultimately prevents pain and suffering in children.

Summary

Pressure injuries inflict pain and suffering in hospitalized children and have a negative impact on children’s hospitals. Preventing pressure injuries is a national quality initiative and is a reflection of the quality of care provided in the hospital. Understanding the relationship between nursing interventions and pressure injuries in pediatrics has the potential to prevent pain and suffering in hospitalized children and meet the quality initiatives set forth by the Children's Hospital Alliance, Solutions for Patient Safety, Agency for Healthcare Research and Quality, and the Institute for Healthcare Improvement. Preventing pressure injuries is a quality and safety initiative for children's hospitals.

There is limited knowledge regarding the impact of nursing interventions implemented as a bundle across a children's hospital. Implementation of nursing interventions to prevent pressure injuries has demonstrated a reduction in occurrence on single units. The result of this retrospective correlational study contributes to understanding the relationship between nursing interventions aimed at pressure injury prevention and pressure injury rates across a children's hospital. I hope that knowledge gained from this study can provide guidance in the prevention of pressure injuries in pediatrics, making a positive contribution to social change. In the following chapter I analyze the current literature on pediatric pressure injury prevention. Chapter 3 includes an overview of the research methodology that guided this study. Chapter 4 is a report of the data analysis followed by a discussion of the findings in Chapter 5.

Chapter 2: Literature Review

Introduction

In Chapter 2, the review of current literature, I provide an exhaustive analysis of current literature related to pressure injury development in hospitalized children. There are four sections in this chapter. The first section presents the search strategy used to find appropriate research studies. The second part of the chapter is an analysis of the theoretical and conceptual theories that guided the study. The third part of the chapter is a critical analysis of the currently available research on pediatric pressure injury development and prevention. The final section evaluates currents studies that utilized similar research methodology as this study.

Pressure injuries can be a preventable complication for hospitalized children with identified risk factors (Parnham, 2012). The prevention of pressure injuries remains a high priority for hospitals; however, there is a lack of clear direction in prevention interventions (Black et al., 2011; Parnham, 2012). The identification of children at risk for pressure injuries and addressing risk factors identifies as a strategy for preventing pressure injuries (Agency for Healthcare Research and Quality, 2012; Barker et al., 2013; Demarré et al., 2012). Beyond early identification of children at risk for pressure injuries, effective prevention strategies across a children’s hospital is unknown.

Search Strategies

Accessing several databases and consultation with a research librarian ensured an exhaustive search of the literature. Health sciences databases within the Walden

University Library, such as CINHAL, Cochrane, MEDLINE, and PubMed, provided the reviewed articles. A literature search with the term pressure ulcers resulted in 2,821 articles published between 2010 and 2015, which narrowed down to 1,522 with the addition of the term prevention. With the term pediatric added to the search the result was 44 articles. A separate search using the terms pediatric pressure ulcer yielded 77 articles published since 1999 and with the date range condensed to the last five years the number of articles was initially 69 then 49 when the terms pediatric and prevention was interchanged.

Both Google Scholar and Walden Librarian services supplemented the literature search given only 44 articles resulted from the initial search. The Walden Library services confirmed the limited number of articles published on pediatric pressure ulcer within the last 5 years. A search over the last decade resulted in seminal articles that defined current theories of pediatric pressure ulcers.

The key terms for the literature search included *Pressure ulcers, pediatric pressure ulcers*, *prevention of pediatric pressure ulcers*, *pressure ulcers in children, evidence-based practice, pressure ulcer conceptual framework, Braden and Bergstrom's conceptual model, Benoit and Mion's conceptual framework, continuous quality improvement,* and *collaborative.* The searched terms were done separately and in combination. The various search terms initially yielded a large number of articles but quickly narrowed with the combination of terms "pediatric" "Pressure ulcer" and "prevention". The following section begins the literature review of the conceptual framework.

Conceptual Framework: Continuous Quality Improvement

Healthcare utilizes the conceptual framework of Continuous Quality Improvement (CQI) to improve outcomes or mitigates adverse outcomes (Padula et al., 2014). In particular, the Plan-Do-Study-Act (PDSA) cycle formats the process to identify the desired results while understanding the process. In the adult literature identifying the relationship between nursing interventions aimed at pressure injury reduction and pressure injury rates was beneficial (He et al., 2013; Leapfrog Group, 2011; Padula et al., 2014). Implementation of the PDSA cycle identified the relationship between nursing interventions and pressure injury outcomes (Cong, Yu & Liu, 2012). Being able to evaluate process and outcome information using the PDSA cycle is instrumental in reducing pressure injury rates.

The process of CQI has demonstrated beneficial in the reduction of pressure injury rates in the adult acute care settings (Padula et al., 2014). A 2-year reduction in pressure injury rates from 6.6% to 2.4% in an adult care setting by utilizing the CQI model (Mackie, Baldie, McKenna & O'Connor, 2014). The CQI process also demonstrated the ability to support low rates in an organization that already has low levels in adult acute care hospitals (Cong, Yu & Liu, 2012). Utilization of CQI to reduce and maintain lowered rates of pressure injuries is effective.

Utilization of CQI theory meant engaging leadership because quality outcomes start with leadership (Padula et al., 2014). Identifying hospital leadership engagement is a crucial component for pressure injury prevention (Chaboyer & Gillespie, 2014). Leaders need to build an infrastructure to support pressure injury reduction (Bosch et al., 2011). CQI supports pressure injury reduction through engagement of leadership.

Conceptual Framework: Pressure Injury Development

The conceptual framework of pressure injury development is limited in pediatrics. Built on one common framework is Braden and Bergstrom's (1987) framework, the Braden Q (Curley et al., 2003). Quigley and Curley hypothesized that oxygenation impacts pressure injury development in children (Curley et al., 2003). The pediatric framework does not take into consideration the child's age and therefore does not acknowledge the impact of skin maturation as a risk factor for pressure injury. Noonan hypothesized that premature and neonatal skin is a risk factor for skin breakdown (Noonan, Quigley & Curley, 2011). In the more recent years, Glamorgan's framework for skin breakdown attempts to incorporate the unique features inherent to children but does not encompass the acuity of illness (Kottner, Kenzler & Wilborn, 2014). Currently one framework does not address all pediatric pressure injury risk factors.

Benoit and Mion's (2012) framework of pressure injury development expanded on the original works of Braden and Bergstrom (1987). Although the framework is not unique to pediatrics, the structure incorporates the concept of characteristics inherent to the individual. Given that Benoit and Mion's framework encourages the clinician to assess the patient in recognizing inherent risk factors the model is better suited for this study. Benoit and Mion's framework includes the compounding impact of intrinsic factors inherent to the individual (Benoit & Mion, 2012). Understanding the fundamental factors such as disease processes, nutrition status prehospitalization, response to the stress of illness may help to figure out why someone develops pressure injuries while others in similar circumstance do not (Black et al., 2011). The current theories do not explain the variance in pressure injury development from child to child.

Pressure Injuries

Pressure injury classification is a reflection on the depth of skin breakdown (Tew et al., 2014). The current staging of pressure injuries for the United States includes six stages (Mizokami, Furuta, Utani, & Isogai, 2013). The first stage and last stage – deep tissue injury both imply that there is no opening of the skin but that the deep tissue injury is a process, which starts from deep within the tissue (Mizokami et al., 2013). The implication of the deep tissue injury is an evolution to a full thickness skin ulceration that can prolong hospital stay, cause pain and disfigurement (Tew et al., 2014). Stages 2, 3, and 4 communicate that there is a break in the skin with Stage 4 having exposed either hardware or bone (Tew et al., 2014). Unstageable skin breakdown has no apparent depth to the ulceration that means it is unstageable (Manning, Gauvreau & Curley, 2015). The classification of a pressure injury is dependent on the extent and depth of skin and soft tissue damage.

The extent of skin damage that can occur is dependent on the age of the child and the exertion of pressure (Cousins, 2014; Mizokami et al., 2013). Depending on the child's age, the skin is exponentially vulnerable to skin breakdown because of the immature collagen structures within the epidermis (Cousins, 2014; Lund, 2015). In the premature infant, the skin is translucent and highly susceptible to skin breakdown from friction, shear, or pressure (McNichol, Lund, Rosen & Gray, 2013). Extensive skin damage can occur in the young hospitalized child.

Pediatric Pressure Injury Risk Factors

Not all hospitalized children develop pressure injuries (Schindler et al., 2011). Approximately 10.2 % of 5346 at-risk children in a multisite study of pediatric intensive care units went on to develop a pressure injury (Schindler et al., 2011). A hospitalized child is at risk when a risk assessment tool score suggests the child is at risk (Manning et al., 2015). In the ten published pediatric risk assessment tools, there is no agreement on risk factors other than early identification (Kottner, Hauss, Schlüer, & Dassen, 2013). It is unclear if the risk assessment tool does add value in the prevention of pressure injuries over a trained nurse (Chaboyer & Gillespie, 2014). A prospective study of 198 children in a 20-bed pediatric intensive care unit in China found the sensitivity of the risk assessment tool was 0.71 with a specificity of 0.53 (Lu et al., 2015). There was no significant difference in scores between children developing and not developing pressure injuries (Lu et al., 2015). The impact of a pressure-injury risk assessment tool in prevention is unclear other than early identification of at-risk children.

Recognizing risk factors includes understanding the unique properties of the hospitalized child (Schindler et al., 2011; Scott et al., 2011). Some children are at greater risk for developing pressure injuries than others based on known risk factors (Galvin & Curley, 2012). Broadly categorized the risk factors are mobility, activity, ability to sense, nutrition, moisture, oxygenation, and friction or shear (August, Edmonds, Brown, Murphy, & Kandasamy, 2014). Risk factors also include the lack of assessments and device rotation, as well as mismanagement of moisture, positioning, and support surface (Chou et al., 2013; Coleman et al., 2013). Overall children who developed Pressure injuries had lower Braden Q scores (M_1=18.7, *SD* = 3.38 vs. M_2 = 21.9, *SD* 3.03, p < .001) (Schindler et al., 2013). Risk assessment tools may capture inherent properties that are factors for pressure injury development.

The length of hospital stay is a risk factor for developing pressure injuries (Schindler et al., 2013). Infants who developed pressure injuries had significantly longer hospital stays (*M* = 82.5 days, *SD* = 68.38 vs. *M* = 13.9 days, *SD* = 27.34, p < .001) (Schindler et al., 2013). The repositioning of children did not appear to impact the development of pressure injuries as there was no difference in the repositioning of children between the children who developed pressure injuries and those who did not (*p* = 0.97) (Schindler et al., 2013). Oddly, the repositioning of the child did not correlate with pressure injury development like the length of stay that suggests other factors related to hospitalization may be a risk factor.

The circumstances surrounding an admission into the Pediatric Intensive Care Unit (PICU) could be a risk factor. A prospective study in PICU's across Sweden found pressure injury prevalence of 26.5 %. Fifty–four children developed at least one pressure injury and 38.5 % were due to external devices (Schluer et al., 2013). Another study demonstrated similar results with the length of time greater than four days in the PICU (Schindler et al., 2011). In other PICU's average length of stay was 17 days for children who developed a pressure injury (Manning et al., 2015). Even though the length of time in the PICU varies before developing a pressure injury varies, there is a risk associated with admission to the PICU and pressure injury development.

Paralysis is an association with pressure injury development in children (Wilson, Bremmer, Hauck & Finn, 2012). A retrospective chart review of 79,016 hospitalized children in Australia over a ten-year period demonstrated that the rates of pressure injury were significantly higher for children who had paralysis (Wilson et al., 2012). Ninety-two percent of the 54 children who developed pressure injuries in a retrospective study had paralysis (Parnham, 2012), further suggesting that mobility impacts skin integrity. Repositioning the patient did not affect pressure injury occurrence (Schindler et al., 2013). The child's inherent ability to sense and reposition is a risk factor for pressure injury development.

Pediatric Pressure Injury Prevention Bundle

Having identified the common risks for pressure injuries implementing standard prevention could prevent pressure injuries from occurring. Implementing multiple prevention interventions to prevent pressure injuries from occurring is a prevention bundle (Chou et al., 2013; Coleman et al., 2013). Recommended pediatric pressure injury prevention bundles target risk factors that pose the greatest compromise to skin integrity (Children's Hospital Alliance, 2014; Solutions for Patient Safety, 2014). A pediatric pressure injury prevention bundle (PPIBP) compromised of nursing interventions aimed at high-risk factors has the potential to prevent pressure injuries.

A pressure injury prevention bundle should focus on risk factors relating to both internal and external elements (Chou et al., 2013; Coleman et al., 2013). Currently, the identified risk factor for pressure injuries in pediatrics with suggested interventions as a bundle are moisture, skin assessment, device rotation, patient positioning, and the support surface (Children's Hospital Alliance, 2014; Solutions for Patient Safety, 2014). Interventions aimed at each one of these five risk factors have the potential to mitigate risk factors.

Device rotation

The rotation of devices involves checking the skin under the device and changing the site of the device when possible to relieve pressure (Peterson et al., 2015; Schlüer et al., 2013). The correlation of external devices with pressure injuries in pediatrics has been as high as 33% (Schlüer et al., 2013). Several studies have identified the cause of the pressure injury related to devices (Murray et al., 2013; Peterson et al., 2015; Schindler et al., 2013; Schluer et al., 2013). Early identification of rotatable devices has the potential to prevent pressure injuries.

Many devices used in pediatrics need securement so that a child cannot remove them while other devices complexity or function prohibits removal (Schindler et al., 2013, Schober-Flores, 2012). The inability to move a device results in continuous pressure over a small surface area (Sterken, Mooney, Ropele, Kett, & Vander Laan, 2014). The securement of the device and method of securement affects the extent of skin breakdown (Murray et al., 2013). Thus, even unexpected devices have the ability to cause skin damage.

The skin damage may be minimal and can occur with devices such as tubes, splints, and cables from monitoring equipment (Murray et al., 2013). Even devices such as casts and orthotics, intravenous arm boards and tubing, oximetry probes, respiratory devices, and cervical collars can cause pressure injuries (Apold & Rydrych, 2012). Rotating devices may prevent skin breakdown by relieving pressure (Apold & Rydrych, 2012; Schlüer et al., 2014). The skin under the device is at risk for pressure injuries, and the impact of device rotation is undetermined.

Moisture

Skin breakdown which occurs because of the constant exposure to moisture is moisture maceration (August, Edmonds, Brown, Murphy, & Kandasamy, 2014). Moisture makes the skin vulnerable, and ulcerations occur with minimal friction or pressure (August et al., 2014; Schober-Flores, 2012). Two sources of moisture, intrinsic and extrinsic, can result in moisture maceration in skinfolds and over non-boney prominences (Black et al., 2011). Intrinsic moisture includes sweat, mucus, urine, and feces (Black et al., 2011). Sweat in skinfolds or underneath equipment such as armbands, intravenous hubs, or tubing can result in moisture maceration. The chemicals in feces or urine can cause the pH of the skin to change, and alkalization alters the skin’s elasticity and influences the lipid layer of the skin (August et al., 2014; Schober-Flores, 2012). Macerated skin exposed to pressure, shear, or friction forces is susceptible to skin breakdown.

Building on the concept of how exposure to excessive moisture over time can impact the skin integrity by interfering with the skin’s elastic strength, researchers have suggested protecting all children at risk for exposure to moisture (August et al., 2014; Schober-Flores, 2012). Specific interventions have included use of a moisture barrier ointment to protect the skin of children requiring diapers during their hospital stay and use of skin sealants in skinfolds or moisture-wicking fabric for children who are diaphoretic (Schindler et al., 2013). Protecting the skin from moisture maceration has the potential to prevent skin breakdown. The impact and implementation of nursing prevention measures are unclear for moisture management.

Patient Positioning

Florence Nightingale discussed patient positioning to prevent Pressure injuries (Vollman, 2012). A popular belief of turning patients every 2 hours to maintain skin integrity continues to be a standard of care (Vollman, 2012). Based on a theoretical model of tissue tolerating exposure to pressure for 2 hours, but afterwards, repositioning facilitates blood flow to the tissue (Agency for Healthcare Research and Quality, 2014; Black et al., 2011). Practice guidelines with a 2-hour turn schedule are best practice.

There has been discussion that 2-hour turning schedules alone may not be optimal and disrupts healing (Källman, Bergstrand, Ek, Engström, & Lindgren, 2015). Close attention to patient repositioning can effectively relieve pressure (Demarré et al., 2012; Drake et al., 2012). One study found that nurses did not actually reposition patients to relieve pressure even when 2-hour positioning guidelines were followed (Demarré et al., 2012). The researchers did not find an increased incidence of pressure injuries with less frequent turning but found patient positioning was important (Demarré et al., 2012). The lapse of time between turnings is not as crucial as patient positioning

Skin Assessment

Skin assessment is a fundamental element of nursing assessment (Parnham, 2012). National guidelines state that conducting the skin assessments once per shift and particularly upon admission establishes the baseline (Agency for Healthcare Research and Quality, 2014). Follow up skin assessments, upon discharge from an acute care facility or when moving patients from unit to unit provides continuity (Agency for Healthcare Research and Quality, 2014). The goal of the assessment is to identify and manage areas of concern as soon as possible. Skin assessment is the driver for nursing interventions to prevent skin damage and to identify skin damage in the early phases (Parnham, 2012; Tume et al., 2014). Early identification of children at risk for skin damage and early stages of skin breakdown is crucial in the prevention of further skin breakdown (Chaboyer & Gillespie, 2014; Parnham, 2012). Frequent skin assessment coupled with nursing judgment has the potential to prevent skin damage in pediatrics (Leonard, Hill, Moon, & Lima, 2013; Kottner, Hauss, Schlüer, & Dassen, 2013; Ullman et al., 2013). Detection of early stages of skin injury requires frequent skin assessments to prevent extensive skin damage.

Support surface

There is a gap in the literature regarding bed surfaces for preventing pressure injuries in children (Manning, Gauvreau, & Curley, 2015; Scott, Pasek, Lancas, Duke, & Vetterly, 2011). Current literature on surface selection for preventing pressure injuries focuses on adults and the options for pressure-relieving surfaces for adults (Schindler et al., 2011). Manufacturing guidelines for surface selection based on weight refer to upper limits with no mention of efficacy for lower weights (Schindler et al., 2011). In the acute care organizations' the only choice, other than cribs and isolettes, has been beds for adults (Norton, Coutts, & Sibbald, 2011). There is limited information on the support surface in pediatrics.

The properties of appropriate support surfaces for pressure injury prevention continues to evolve (McInnes, Jammali-Blasi, Bell-Syer, Dumville, & Cullum, 2012). Pressure relief and pressure reduction are two terms that have become obsolete since realizing that it is impossible to eliminate all pressure. Appropriate support surfaces should have pressure redistribution properties through immersion (McInnes et al., 2012; Norton et al., 2011). Immersion is the amount of sinking into the support surface that minimizes direct pressure over bony prominences (McInnes et al., 2012). Best practice in pediatrics should include support surfaces that have immersion properties.

Support surfaces' have several components used to categorize the potential pressure redistribution properties that could be useful in the prevention of pressure injuries (Bryant & Nix, 2012). The support surface should accommodate frictional and shear forces (Black, Berke, & Urzendowski, 2012). The internal components of the support surface can be one or a combination of several broad categories—including air, elastomer, foam, gel, viscous fluid, water, and solid—which represent the movement of pressure through the component (Bryant & Nix, 2012). In addition, the final aspect is how the surface responds to load (National Pressure injury Advisory Panel, 2013). A small study evaluated the effective pressure redistribution surface for pediatrics (Higer & James, 2015). The findings from this small study found surfaces that used air had the greatest distribution (Higer & James, 2015). Despite knowing the properties of a surface to mitigate the impact of pressure, there is little guidance in the pediatric literature on the impact of support surface selection and outcomes.

Avoidable and Unavoidable Pressure Injuries

Over the past decade, the Centers for Medicare and Medicaid Services (2013) has shifted its view of avoidable pressure injuries to a “never event”—that is, an event that should never occur. As reimbursements have changed for pressure injuries, researchers have begun to explore the concept of pressure injuries being avoidable. Currently, scholars recognize that most pressure injuries may be avoidable with appropriate interventions (Black et al., 2011). In certain conditions, some pediatric pressure injuries are unavoidable.

Conditions that qualify a pressure injury as unavoidable include both extrinsic and intrinsic factors. Critically ill children are at risk for unavoidable pressure injuries based on multiple physiologic risk factors, extended exposure to pressure and reactive hyperemia, and early stage pressure injuries not detected because of limited ability to assess the child’s skin (Black et al., 2011; Reitz & Schindler, 2016). Another risk factor for unavoidable pressure injuries is multiorgan failure (White, Downie, Bree-Asian, & Iversen, 2014). Studies have found that 90% of adult critically ill patients who experience skin failure had one or more organ systems fail (White et al., 2014). Sepsis was present in 62.1% of cases, and respiratory failure was present in 75% of cases (White et al., 2014). In a large retrospective review of 94,758 patients, at least one system organ failure was associated with skin failure (White et al., 2014). If a patient who develops a pressure injury and does not have organ failure or a critical illness with multisystem organ failure, the notion of unavoidable pressure injury is not applicable.

Even with the patient's intrinsic factors, documentation of prevention practices is required. The child's position, support surface, nutrition, skin assessment, risk assessment, and interventions to support skin integrity must be documented each shift and updated with each change in the child's condition (Ullman et al., 2013; Visscher et al., 2013). Documentation of pressure injury risk assessment and interventions for prevention are essential to demonstrate that a pressure injury was unavoidable (Black et al., 2011). If any component of the documentation is missing, the pressure injury is avoidable even if the patient's circumstances would fit the criteria of unavoidable.

Pressure Injury Prevention Studies

The review of the literature on pediatric pressure injuries provides limited but valuable insight. Researchers have studied older secondary data to provide insight on the prevalence and incidence of pressure injuries in children's hospitals. The primary research has provided greater understanding of the anatomical location of pressure injuries in children and children's characteristics that increase susceptibility to pressure injuries. Within the literature review, there is conflicting and outdated information on the rates of pediatric pressure injuries and there is no information on the impact of nursing interventions on outcomes.

Most studies have reported pediatric pressure injury rates based on secondary data that are more than 5 years old (Drake et al., 2012; Heiss, 2013; Manning et al., 2015; Murray et al., 2014; Schindler et al., 2013; Tume et al., 2014). There is no documentation of pressure injury rates for children in the literature within the past 5 years. Compounding the ambiguity of pressure injury rates, the existing literature presents conflicting information regarding rates of pediatric pressure injuries.

Manning et al. (2015) reported a pediatric pressure injury incidence ranging from 4% to 27%, whereas Drake et al. (2012) reported rates ranging from 1.6% to 27.7%. Reported rates in critical care pediatric units have ranged from 10% to 27% (Drake et al., 2012; Schindler et al., 2013). The highest rates of pressure injury development are among children receiving care in the intensive care unit setting—a finding that appears to be consistent throughout the literature. The maximum rate of 27% for pediatric pressure injuries also appears to be consistent, but there is a lack of consensus on how low the incidence rate can be.

With concerted efforts, pediatric pressure injury rates in one pediatric critical care unit decreased from 18.8% to 6.8% (Schindler et al., 2013). Even with concentrated efforts to reduce the prevalence of pressure injuries, the rate continued to be significant at 6.8%. Researchers have reported a decrease in the prevalence of pressure injuries after an intervention, but not the sustainability. The issue of pressure injuries in pediatrics warrants further exploration in respect to best practice interventions, the sustainability of decreased rates, and the impact of multiunit or multi-organizational approaches to reducing pressure injuries.

With the reduction of pressure injury incidence down from 10.2%, nursing has the potential to impact rates (Schindler et al., 2011). A review of 5346 children's charts over a 20-month period demonstrated a reduction in rates (Schindler et al., 2011). A variety of nursing interventions—use of specialty beds, egg crates, foam overlays, gel pads, dry-weave diapers, urinary catheters, disposable underpads, body lotion, nutrition consultations, change in body position, blanket rolls, foam wedges, pillows, and draw sheets—all had a positive correlation with the reduced incidence of pressure injuries (Schindler et al., 2011). The authors also reported a decrease in pressure injury rates in the pediatric intensive care unit with the implementation of a bundle of interventions that included support surface, frequent turning, incontinence management, nutrition, and education. Among this group, the incidence of pressure injuries decreased from 18.8% to 6.8%. Scott et al., (2011) implemented a similar group of nursing interventions as a bundle that focused on support surfaces, moisture management, and turning schedules but reported no results from the bundle implementation. The literature suggests there is a potential for decreased rates of pressure injuries by implementing nursing interventions aimed at risk factors through a bundle of interventions.

Manning et al. (2015) identified that the occiput is the most common area for pressure injury occurrence in children. Their review of charts identified 60 children who had developed pressure injuries on their occiput. August et al. (2014) found similar findings in the neonatal intensive care unit, with 35.5% of all pressure injuries occurring on the occiput. In their retrospective study, they identified 107 skin injuries in 77 infants. Of the 107 skin injuries, there was an equal distribution between anatomical locations, with the exception of only 9.4% occurring on the abdomen. Even though scholars agree that younger children are vulnerable to skin breakdown over the occiput, it is important to recognize that all children can experience skin breakdown, especially in unexpected areas such as over the abdomen.

According to Tume et al. (2014), the Braden Q risk assessment tool performed moderately well when the pediatric population had similar characteristics—with a sensitivity and specificity of 75% and 72.6%, respectively. In nonhomogeneous groups, the sensitivity and specificity were lower, at 57.1% and 72.5%, respectively (Tume et al., 2014). The authors of the Braden Q reported that the tool continues to be a reliable risk assessment tool for identifying children at risk (Noonan et al., 2011). One of the newer risk assessment tools, the Glamorgan, has demonstrated high interrater reliability similar to that of the Braden Q when used by nurses (Kottner, Kenzler, & Wilborn, 2014). It is unclear from the literature review the completion rates of the Braden Q and Glamorgan risk tools and the impact. Currently, the literature suggests the risk assessment tool as a valuable nursing intervention.

Nursing Interventions Role in Pediatric Pressure Injury Prevention

Nursing is a critical and influential group who affect negative outcomes. The Institute of Medicine identified nursing as an invaluable partner in preventing harm from reaching patients (Agency for Healthcare Research and Quality, 2012). In the setting of pediatric pressure injuries, the sentiment remains true that nurses can make a difference (Wilson et al., 2012). There is an opportunity to explore the correlation between nursing interventions and pediatric pressure injury outcomes.

The pediatric nurse has many roles related to prevention of pressure injuries (August et al., 2014; Bernabe, 2012). The nurse did not influence pressure injuries within a silo but based on processes within the children's hospital (Children's Hospital Association, 2014). Executive pediatric nurse leaders can provide the resources to build the infrastructure to prevent pressure injuries (Padula et al., 2014). This infrastructure is vast and ranges from supplies to availability of staff, access to nurse educators, and access to CQI systems (Chaboyer & Gillespie, 2014; Padula et al., 2014). These aspects relate not only to monetary factors but also to a culture of prevention.

The clinical nurse who provides hands-on care has the greatest burden of the prevention in pressure injuries (Barker et al., 2013). The greatest number of pressure injuries continues to occur in the critical care setting (Wilson et al., 2012). This places the burden on the pediatric critical care nurse of taking care of the most acutely ill child while ensuring the skin remains intact (Wilson et al., 2012). Per the literature, the pediatric nurse is influential in preventing pressure injuries. The nurse impacts pressure injury occurrence by following through on interventions that address risk factors (Manning et al., 2015; Schindler et al., 2011; Scott et al., 2011). The literature has also identified a common theme of providing nursing education and educational resources in the prevention of pressure injuries (Cremasco, Wenzel, Zanei, & Whitaker, 2013; Drake et al., 2012; Heiss, 2013; Scott et al., 2011). Beyond acknowledging the pediatric nurses' role, there needs to be an understanding between the relationship of nursing interventions and pressure injury.

Current Literature on Bundle Interventions and Pediatric Pressure Injury Rates

Practice bundles eliminate the variances in outcomes (Chaboyer & Gillespie, 2014). Achieving predictable results happen by reducing the variances found within the system in which the patient receives care (Padula et al., 2014). One of these systems is the nursing care. By standardizing nursing's approach to pressure injury prevention, there is a potential to predictably reduce pressure injury rates (Chaboyer & Gillespie, 2014; Padula et al., 2014; Fabbruzzo et al., 2016). In pediatrics, recent research has demonstrated that pressure injury rates of a pediatric intensive care unit (PICU) can be reduced by 50% with the implementation of a prevention bundle (Visscher et al., 2013). The bundle implemented at a stand-alone 557-bed children's hospital included: skin assessment, patient skin care, patient care indirectly related to skin, products related to pressure injury and patient/family involvement (Visscher et al., 2013). Over the course of the year, the PICU and neonatal intensive care unit (NICU) participated in ensuring that the elements of the bundle were implemented on a consistent basis with by weekly report outs (Visscher et al., 2013). The results were significant with a reduction of pressure injury from 14.3/1000 patient days to 3.7/1000 patient days in the PICU and an increase in pressure injuries 8/1000 patient days to 11/1000 patient days in the NICU (Visscher et al., 2013). The compliance to the bundle varied with 81% compliance in the PICU and 50% compliance in the NICU (Visscher et al., 2013). Bundle compliance in pediatrics may impact pressure injury outcomes.

Another study demonstrated pressure injury reduction at tracheostomy sites from 8.1 % to 2.6% during pressure injury bundle development and then down to 0.3% after bundle implementation (p = .007) (Boesch et al., 2012). Over the course of two years, 2008 to 2010 an 18-bed ventilator unit in a stand-alone children's hospital developed and implemented a pressure injury prevention bundle for children with tracheostomies

(Boesch et al., 2012). The bundle consisted of three focus areas for nursing interventions: pressure injury risk and skin assessment, moisture–free device interface and pressure–free device interface (Boesch et al., 2012). Bundle compliance was 100% during the last 4 months of the study. This prospective study demonstrated that the development of a pressure injury prevention bundle through the Plan-Do-Study-Act (PDSA) framework can reduce pressure injuries related to tracheostomy tube sites.

A 442–bed adult academic hospital implemented the Continuous Quality Improvement (CQI) process to reduce pressure injuries and had an 80% reduction in pressure injuries (Fabrruzzo-Cota et al., 2016). The replacement of support surfaces was correlated with reduction of pressure injuries rates to below the national benchmark (Fabruzzo–Cota et al., 2016). There was not a bundle of nursing interventions but general guidelines which included a positioning decision tree, unit specific risk factors, and repositioning clocks (Fabruzzo-Cota et al., 2016). There was no reflection on nursing compliance rates to suggested practice changes.

Utilization of CQI process to implement bundle practices demonstrated a decreased rate of pressure injuries which was maintained at 0% for 17 out 20 quarters on an adult surgical unit (Burton et al., 2013). The bundle consisted of three broad areas which included: skin assessment and documentation, nursing education, and a pressure injury algorithm tool (Burton et al., 2013). There was no report of compliance to the bundle, but the process of CQI suggests that maintaining low rates is possible through an active process.

A randomized two-arm experimental control trial in a two different adult intensive care units demonstrated significant rates of pressure injuries between the control and experimental groups (*df* = 1, p < .001) (Tayyib, Coyer, & Lewis, 2015). The study last approximately one year and the results were 12 pressure injuries (17.1%) in the intervention group and 37 pressure injuries (52.8%) in the control group (Tayyib, Coyer, & Lewis, 2015). Compliance of the pressure injury prevention bundle implementation was monitored (Tayyib, Coyer, & Lewis, 2015). The bundle consisted of seven broad areas emphasizing risk and skin assessment, nutrition, repositioning, support surface, medical devices and nursing education (Tayyib, Coyer, & Lewis, 2015). This study reported variances in compliance of bundle elements, which suggest correlations with nursing interventions and outcomes.

Social Change

Despite the current unclear current rates of pediatric pressure injuries, the impact of the pressure injury is clear. The pain and suffering caused by a pressure injury are significant to the child inflicted with a pressure injury (August et al., 2014; Bernabe 2012; Drake et al., 2012; Parnham, 2012). The time, cost, and pain associated with the pressure injury vary but the impact of devastation to the child and families are similar. By contributing to the knowledge of the prevention of pediatric pressure injuries, there is a potential to prevent harm and suffering to the child and family. Preventing pressure injuries also have the potential to impact health care dollars in a children's hospital (Parnham, 2012). Because the pain and suffering caused by a pressure injury is significant, the prevention of a pressure injury will be meaningful to the child, family, and children's hospital. The impact of pressure injury prevention has the potential to have a positive impact on the healthcare system.

Summary

The occurrence of a pressure injury in children's hospital adversely impacts healthcare, the child, and the family. Benoit and Mion's framework best captures the complex and multifactorial process of a pressure injury occurrence. And the correlation of pressure injury prevention interventions and outcomes is best understood with the theory of CQI. Adult literature demonstrated the utilization of a bundle of nursing interventions within a CQI framework decreases the variance in expected outcomes when working to decrease pressure injuries.

The current pediatric studies emphasize risk factors related to pressure injuries and report the results of efforts to lower rates in intensive care units. Adult literature has demonstrated the correlation between compliance of nursing interventions as a bundle and outcomes. Knowledge of the correlation between pediatric nursing interventions as a bundle versus individual interventions and rates of pressure injuries might lead to reduced rates of pressure injuries across a children's hospital. The following chapter reviews the research design and methodology for this study. Chapter 3 details the study population, sampling methods and data analysis.

Chapter 3: Methodology

Introduction

This chapter addresses the research methodology. I examined the correlational relationship between nursing interventions aimed at risk factors and pressure injury rates in pediatrics. The literature review substantiated the need to explore the relationship between nursing interventions and pressure injury rates in pediatrics (Padula et al., 2014; Schindler et al., 2011; Schindler et al., 2013; Tayyib, Coyer & Lewis, 2015; Visscher et al., 2013). This chapter included information regarding the study's research method and design; research questions and hypotheses; and secondary data in regards to population and sample, instruments and materials; data collection and analysis, and ethical protection.

Secondary data accessed from Solutions for Patient Safety data base was used to answer the research questions. The Solutions for Patient Safety (SPS) is a national network of children's hospital (Solutions for Patient Safety, 2014). The mission of SPS is to reduce harm through shared network goals of preventing hospital acquired condition (Solutions for Patient Safety, 2014). The implementation of a pressure injury prevention bundle is an initiative by SPS to reduce pressure injury rates. There were five mutually exclusive independent variables and one dependent variable.

Research Questions and Hypotheses

Based on the current literature review on pediatric pressure injuries and prevention, this study design was around two research questions and associated hypotheses:

Research Question 1: Does implementation of a pediatric pressure injury prevention bundle reduce pressure injury rates in a pediatric hospital over time?

$H_0 1$: There is no difference in rates of pressure injury rates prior to the introduction of the prevention bundle versus after integration of the prevention bundle.

$H_1 1$: There is an inverse relationship between pressure injury rates prior to the introduction of a prevention bundle versus after integration of the prevention bundle.

Research Question 2: Does each factor of the pediatric pressure injury bundle which includes device rotation, moisture management, positioning, skin assessment and support surface impact the rate of pediatric pressure injury in a pediatric hospital?

$H_0 2$: There is no difference between the bundle and each individual elements of the pediatric Pressure injury prevention bundle in the prevention of pressure injuries.

$H_1 2$: The bundle has a greater correlation with the prevention of pressure injuries than the individual elements for preventing Pressure injuries.

Research Design and Rationale

The purpose of the study was to examine the relationship of known variables on pediatric pressure injury rates. A quantitative research method was an ideal choice for the study. The purpose of this quantitative research was to confirm the relationship between known variables (Hulley, Cummings, Browner, Grady, Newman, 2013). A relationship between variables can be causal or relative (Hulley et al., 2013). The aim of the study was to determine if there was any relationship between the five mutually exclusive nursing interventions implemented as a pressure injury prevention bundle and pressure injury rates.

The other option for a quantitative study was not appropriate. A causal relationship would be difficult to establish with an established data set, however, a correlational relationship from secondary data is possible (Vogt, Vogt, Gardner & Haeffele, 2014). Qualitative research methodology was not ideal because the purpose of qualitative research is to understand a phenomenon as it occurs and does not answer the research question for this study (Padula et al., 2014). Qualitative research was not ideal because of barriers to access children's hospitals, concerns for vulnerable population and confidentiality. The mixed methodology uses both quantitative and qualitative methods to answer a research question. The aim of the study was not to explore the phenomenon of the pressure injury from the perspective of the patient, family, or organizations but to understand the relationship between nursing interventions and pressure injury rates. For these reasons, a qualitative and mixed methodology was not ideal for the study.

The study variables for this study included dependent and independent variables. The dependent variable was the pressure injuries rates of children's hospital. The independent variables included device rotation, position changes, moisture management, skin assessment, and support surface. The independent variable was categorical as either yes or no while the dependent variable was a continuous number in percentages.

A non-experimental correlational research design was optimal to study the relationship between the variables in this study. The design considered non-experimental because there was no control group and there was no treatment before or after data collection (Vogt et al., 2014). In a nonexperimental descriptive correlational study, researchers assess an already established data set to measure the correlation between variables (Hulley et al., 2013). The correlational study design answered the study question-does nursing interventions as a bundle or as individual interventions impact pressure injuries. It was unrealistic to look for cause and effect of nursing interventions and pressure injury prevention because there are many confounding variables intrinsic to the patient that would be a challenge to control for (Black, 2015). The impact of confounding variables needs consideration when choosing study methodology (Hulley et al., 2013; Vogt et al., 2014). Given the nature of pressure injury development, a non-experimental design is ideal.

The experimental model for pressure injury prevention is not ideal. The experimental design requires a control group that receives no intervention while the other group receives the intervention (Hulley et al., 2013). Knowingly withholding treatment, which has beneficial outcomes to a vulnerable population, is unethical (Vogt et al., 2014). Using the experimental model of providing nursing interventions to one group of children while withholding nursing interventions would be unethical.

A case-control study design could be a possibility if data is available at the individual patient level (Hulley et al., 2013). Given that the secondary data available is at the hospital level, a study design analyzing secondary data was appropriate. The retrospective observational study using secondary data was an appropriate study design to explore the impact of five nursing interventions implemented to prevent pressure injuries in children's organizations.

The researcher's time and resource need to be considered when creating the study design (Hulley et al., 2014; Vogt et al., 2013). Some research designs are inherently lengthy and expensive in nature. Designing a prospective research to study the correlation between variables would be expensive and labor intensive (Hulley et al., 2014; Vogt et al., 2013). By obtaining secondary data I focused on analysis and interpretation on variables. Developing a study which enrolled multiple sites would be labor and resource intensive. Using secondary data, from multiple sites breaks down the barriers of time and resources (Hulley et al., 2013). The secondary data provided access to a larger sample size which lends itself to the generalizability of data. As a lone researcher with access to minimal resources using secondary data allowed me to explore the impact of implementing five different nursing interventions as a bundle to prevent pressure injuries.

The design choice was consistent with the research design needed to advance knowledge in pressure injury prevention within a children's hospital. The research design provided insight on the impact of nursing interventions bundled to prevent pressure injuries. The research design did not provide a cause and effect but provided correlational information. The knowledge gained from the research design provided children's hospital with the knowledge needed to make informed decisions on whether or not to allocate resources on nursing interventions and leadership support.

Setting, Population, and Sample

The unit of analysis was nursing interventions reported by children's hospitals participating in a national data bank. The children's hospitals were from around the nation who volunteered data regarding hospital-acquired conditions. The sample was a sample of convenience. Children's hospitals voluntarily submitted data and so the sample for the study is one of convenience. The study did not have a control or experimental group. The inclusion criteria for the study included children's hospital that had been submitting data for a minimum of a year and is a freestanding children's hospital. The exclusion criteria included children's hospital that has not been submitting data on regular intervals for a minimum of a year. A G*Power analysis for an effect size of 0.3 and α probability of 0.05 for a power of 0.80 will need a sample of 74 children's hospitals.

Instrumentation and Materials

I used secondary data without utilization of a survey or study collection instrument. The secondary data for analysis was from a secure central database. The data were in Excel spreadsheet format.

Data Analysis Plan

To answer the two research questions asked in this study, there were two different statistical approaches using IBM SPSS version 22.0. The first research question: does the implementation of a pediatric pressure injury prevention bundle (PPIPB) reduce pressure injury rates in a pediatric hospital over time requires a comparison of means. The means of the rates of pressure injuries for a children's hospital was compared to before and after the implementation of nursing interventions and then after the interventions. Pearson's coefficient (p = .05) tested the impact of nursing interventions on pressure injury rates. The second research question: does each factor of the pediatric pressure injury bundle which includes device rotation, moisture management, positioning, skin assessment and support surface impact the rate of pediatric pressure injuries in a pediatric hospital required a comparison of means and analysis of variance (ANOVA) , α =.05 (two-tailed).

The analysis required pre-analysis of the data to determine the best statistical methods (Field, 2014). The following sections will outline the data analysis plan.

The data analysis began with aggregating the submissions of pressure injury rates and nursing interventions. Aggregating the data minimized the impact of seasonal acuity variability and macro systems variability (He et al., 2013; Padula et al., 2012). Data cleaning by checking for outliers and missing data occurred after data compilation (Field, 2014). Analysis of data followed the management of outlier and missing data.

After validating the assumptions of multicollinearity, normality, outliers, linearity, and homoscedasticity of the data is determined by running graph-based analysis, paired sample *t*-test compared the pressure injury rates of each children's hospital pre and post implementation of nursing interventions. The *t*-test will determine if there is a significant difference between the pressure injury rates pre nursing intervention and post nursing intervention over time. The independent variable displayed as categorical yes or no reflect nursing intervention implementation and the dependent variable displayed as a percentage reflects pressure injuries rates. Both of these variables are ratio variables because there is a true zero point (Field, 2014). Pearson correlation determined the direction of the relationship between the implementation of nursing interventions and pressure injury rates. I anticipated an inverse relationship between nursing interventions and outcomes.

The secondary research question was evaluated using analysis of variance, $\alpha = .05$ (two-tailed). Plotting each dependent variable or predicator variable determined the frequency distribution and the center of distribution (Vogt et al., 2014). It is important to understand the occurrence of each independent variable separate from each other (Vogt et al., 2014). The aggregated data regarding the independent variable provided linear modeling to determine the strength of the relationship to the outcome. The sum of squares determined if the linear relationship was a good fit (Fields, 2014). These statistical tests determined the relationship between each of the five independent variables and the outcome.

Threats to Validity

Threats to validity to the study stemmed from the inherent concerns of using secondary data. The disadvantage of secondary data was in regards to the quality of data collection. With secondary data, the researcher did not have control over the studied population, data collection process or the quality of the data collected. The ability to assess the quality of the data is limited. The reliability of the data was out of the control of the researcher. The secondary data for this study has concerns with the reliability of the data. The data entry was dependent on children's hospital staff entering the data. The data entering process did not determine the level of interrater reliability for the staging of pressure ulcers and bundle documentation. With the lack of interrater reliability, it was unclear to what extent the different individuals collecting the data would label the information in the same fashion. Interrater reliability communicates a level of confidence that the individuals who are making decisions about data collected for analysis are objective (Gwet, 2014). The accuracy of entered data was unconfirmed in this study.

The data collected for submission to the SPS data bank did not have a process to determine interrater reliability. The data was dependent on children's hospital process for collecting the data regarding bundle implementation and pressure injury rates. With the lack of interrater reliability, there was an unknown element of subjectivity (Gwet, 2014). There was an opportunity for subjectivity in the data collection process in regards to bundle implementation and pressure injury rates.

Protection of Participants

Given the use of secondary data there was no interaction with the subjects however, the data collection was voluntary from each children's hospital. Coded data protected the identity of the children's hospital. There were minimal ethical concerns beyond the disclosure of the children's hospitals data. By de-identifying the children's hospital, addressed the ethical concerns regarding anonymity. Informed consent was unnecessary since the data was at the organizational level. The internal review board granted approval (Appendix C). Approval through an application to Solutions for Patient Safety for data usage supported this study (Appendix D). This study met the ethical guidelines established by the American Psychological Association (APA) and Walden University.

Summary

To determine the impact of the nursing intervention on pediatric pressure injury rates in pediatrics I used secondary data for the study. The analysis of secondary data from Solutions for Patient Safety occurred after the Internal Review Board (IRB) from Walden University approved the study. Pearson's coefficient (p = .05) explored the impact of nursing interventions on pressure injury rates, a comparison of means before and after the bundle implementation was used to understand if there is a difference and

ANOVA ($\alpha = .05$) determined the relationship between each nursing intervention and pressure injury rates.

Chapter 4 presents the data analysis results to the two research questions that guided this study. The chapter details of data collection, quality of data and analysis process. Chapter 5 discusses the data analysis results, reviews study limitations, recommendations for future research and concludes with implications for social change.

Chapter 4: Results

Introduction

The purpose of this retrospective correlational study was to explore the relationship between nursing interventions on pressure injury rates in children's hospitals. Solutions for Patient Safety, a collaborative of children's hospitals from across the country, provided the secondary data to explore the relationship between nursing interventions and pressure injury rates. Two research questions framed the study. The two questions were: Is there a significant impact of nursing interventions on pressure injury rates when implemented as a bundle over time? Is there a significant difference in the impact of nursing interventions as a bundle over any one individual nursing intervention on pressure injury rates?

This chapter includes the results and analysis for each research question and hypothesis. The following section includes the research findings. The first section presents the demographics of the secondary data. The second and third sections include the results of each of the two research questions.

Sample Demographics

The data for this study was provided by the children's hospital collaborative for solutions for patient safety. The data was coded and I was blinded to the identity and demographics of the children's hospital. Data had been collected for the last 6 years, 2010 to 2016 and had a total of 102 children's hospitals. Hospitals submitted data on pressure injury rates, patient days and nursing interventions bundle implementation either monthly or quarterly. The available data supported the research plan and there were no discrepancies. The submission of data by the children's hospital to the collaborative represented voluntary participation and engagement in quality improvement initiatives.

The required sample size using G*Power version 3.1 was 74 children's hospitals for the first research question. Seventy-four children's hospital was a result of choosing correlational studies for an effect size of 0.3 with α probability of 0.05 for a power at 0.80. The final sample size of 99 children's hospitals met the sample size requirement for the first research question.

There were three children's hospitals who did not meet the inclusion criteria of having submitted data for at least a year and there were two children's hospitals that had missing data on patient days for several months. The three children's hospitals who did not meet inclusion criteria were excluded from the data analysis but included in the discussion on descriptive characteristics. The three children's hospitals that had missing patient days for one month were assigned values based on the mean patient days from the previous year's corresponding month to account for seasonal variances.

Using G* Power version 3.1 the second research question required a sample size of 88 children's hospitals. Eighty-eight children's hospital yields an effect size of 0.3 with α probability of 0.05 for a power at 0.95. The initial sample size of 99 children's hospitals met the criteria however; the missing data regarding nursing intervention compliance excluded 23 children's hospitals for a final sample size of 76 children's hospital.

Variables and Descriptive Characteristics

Over the last 6 years children's hospitals have been participating in the initiative to implement pressure injury prevention bundles. Data submission in the early years was infrequent with few hospitals (0.6%) but steadily increased so that by the end of 2014 more than half of the total data was being submitted (57.5%). The frequency and number of hospitals submission continued to increase each year (21. 3%, 21.2 %). The sample distribution of hospitals data submission of pressure injury and bundle implementation is presented in Table 1.

Table 1

Frequency of Data Submission

	Frequency	Cumulative Percent
12/31/10	19	.6
12/31/11	174	6.3
12/31/12	415	19.8
12/31/13	534	37.1
12/31/14	628	57.5
12/31/15	657	78.8
12/31/16	651	100.0

The reporting of the dependent variable pressure injuries was equally distributed amongst the six categories (Figure 3). Each of the six categories of pressure injuries was reported on for rates of occurrence (Table 2). Mucosal injuries were an unanticipated category of pressure injury which was reported.

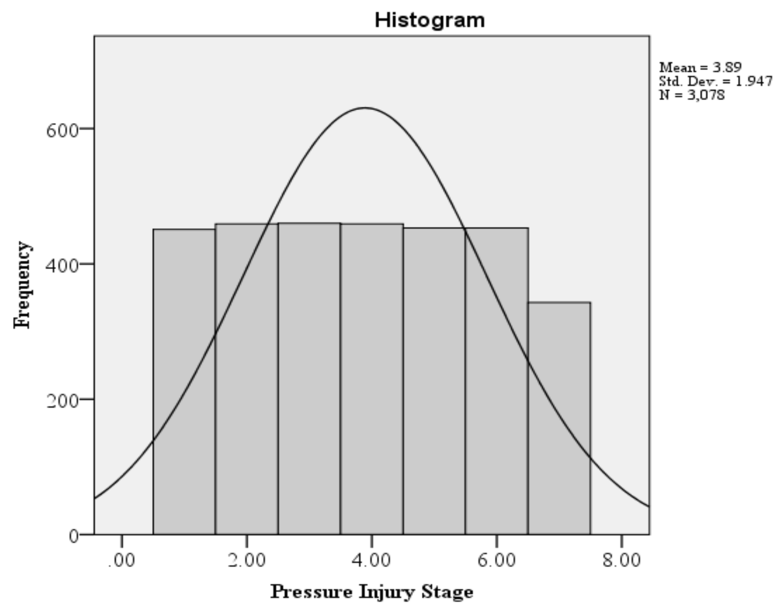

Figure 3. Distribution of reporting of pressure injury stages.

Table 2

Reporting of Pressure Injuries

	Frequency	Percent
Stage 1	451	14.7
Stage 2	459	14.9
Stage 3	460	14.9
Stage 4	459	14.9
Unstageable	453	14.7
Deep Tissue Injury	453	14.7
Mucosal Injury	343	11.1

The most commonly reported pressure injury was stage 2 pressure injuries, followed by stage 1 and unstageable pressure ulcers. Mucosal pressure injuries were an unexpected category and occurred at incidence rates similar to stage 3. The most infrequent pressure injury was stage 4. The incidence of each category of pressure injury is shown in the graph below (Figure 4).

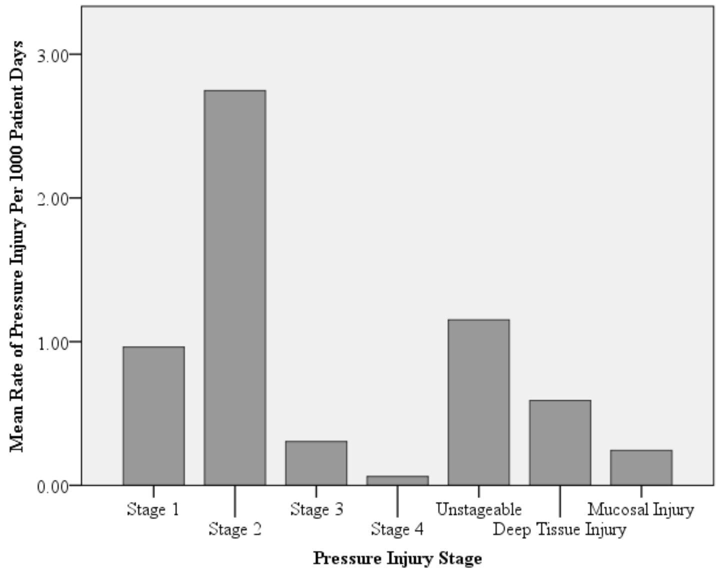

Figure 4. Pressure injury incidence by stage.

The total rates of pressure injury per children's hospital is reported at zero however the spread varies all the way up to a few organizations reporting yearly incidence at 30 per 1000 patient days (Figure 5). While the mean total incidence of pressure injuries has downward trend (Figure 6 and Figure 8).

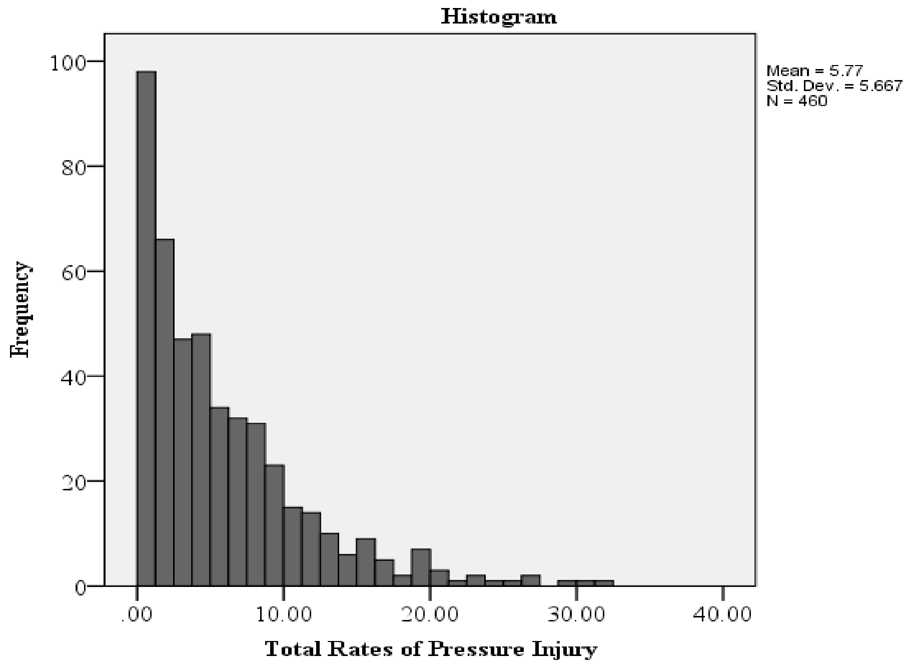

Figure 5. Frequency of total rates of pressure injuries.

Figure 6. Yearly Total Incidences of Pressure injuries

The independent variable, pressure injury prevention bundle compliance was spread over a range of zero to 100 percent compliance with a mean of 44% compliance and standard deviation of .418 (Figure 7).

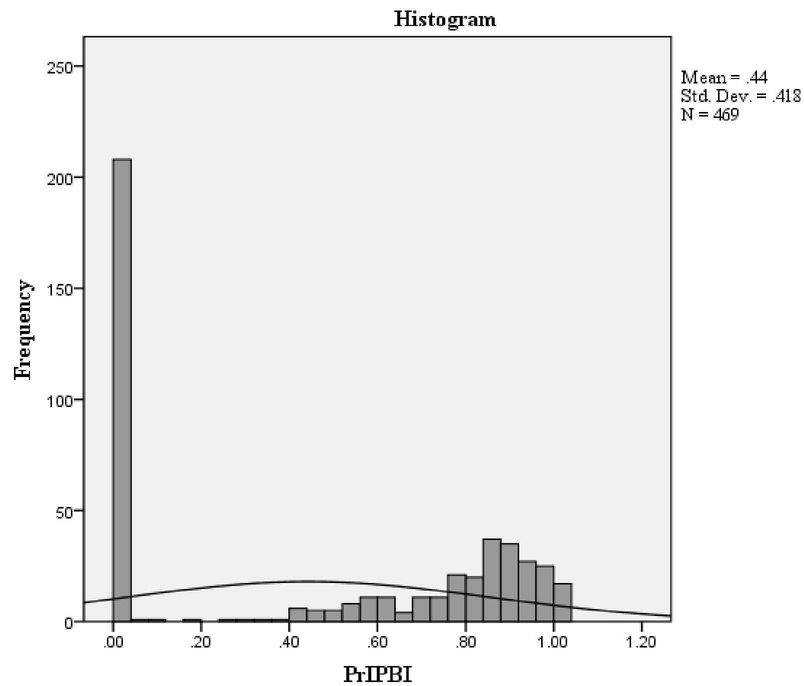

Figure 7. Bundle compliance.

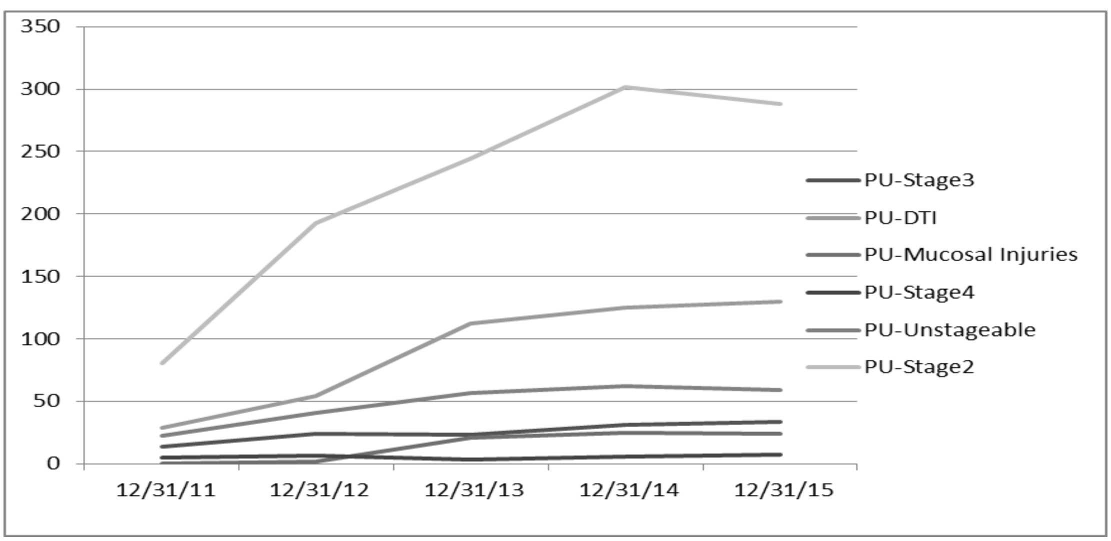

Figure 8. Pressure injury stage yearly total for all hospitals

Research Question 1

For each research question in this study a detailed analysis was completed. This section reviews the analysis of the first question and concludes with an evaluation of the hypotheses. The following section reviews the analysis of the second research question and concludes with an evaluation of the hypotheses.

The first research question was: Does implementation of a pediatric pressure injury prevention bundle reduce pressure injury rates in a pediatric hospital over time? Null hypothesis: there is no difference in rates of pressure injury prior to the introduction of the prevention bundle versus after integration of the prevention bundle. Alternate hypothesis: there is an inverse relationship between pressure injuries rates prior to the introduction of a prevention bundle versus after integration of the prevention bundle. The hypothesis was tested first by Pearson's correlation to determine the relationship between pressure injury prevention bundle implementation. Then secondly by comparing the means of the pressure injury rates before and after the implementation of the pressure injury prevention bundle to determine the impact of nursing interventions on rates.

Pearson correlation coefficient was computed among documentation of pressure injury prevention documentation and rates of pressure ulcers. The Bonferroni approach was used to control for Type I error and determined a p value of less 0.01. The result of the analysis is presented below in Table 3. The sample size included 99 children's hospitals. The relationship between pressure injury rates and documentation of pressure injury prevention bundle is significant ($p<0.01$).

Table 3

Bundle Documentation and Rate of Pressure Injury Correlation Table (n=99)

		Bundle	Pressure Inj
Bundle Documentation		1	-.075**
	Sig. (2-tailed)		.000

** Correlation is significant at the 0.01 level (2-tailed)

The paired sample *t* test was conducted to evaluate whether pressure injury rates was significantly reduced with the implementation of a pressure injury prevention bundle. The results indicated that the mean rates of pressure injury (M = 5.29 sd = 5.69) was significantly greater than the mean rates of pressure injury (M = 3.17 sd = 2.96) t (97) = 3.86 $p < 0.001$ post bundle implementation. The standardized effect size index, *d*, was 0.39. The 95% confidence interval for the mean difference between the before and after rates was 1.03 to 3.22. The alternate hypothesis that there is a significant inverse relationship between bundle documentation and rates as well as a decrease in rates is supported and the null hypothesis that there is no difference is rejected.

Research Question 2

The second research question was: Does each factor of the pediatric pressure injury bundle, which includes device rotation, moisture management, positioning, skin assessment and support surface, impact the rate of pressure injuries in a pediatric hospital? Null hypothesis: There is no difference between the bundle and each individual nursing intervention of the pressure injury prevention bundle in the prevention of pressure injuries. Alternate hypothesis: the bundle has a greater correlation with the prevention of a pressure injury than the individual nursing interventions for preventing a pressure injury. Table 4 summarizes the frequency of the nursing interventions implemented as a bundle.

Table 4

Nursing Interventions Implemented (n=77)

Five Nursing Interventions	Frequency	Cumulative Percent
0	2	2.6
2	2	5.2
4	12	20.8
5	61	100.0

Nursing interventions implemented was skewed to the left with 94% (*n*=73) of the children's hospitals reporting four to five of the five nursing interventions as being implemented (Figure 9). Each of the five nursing interventions was documented at similar rates (Figure 10).

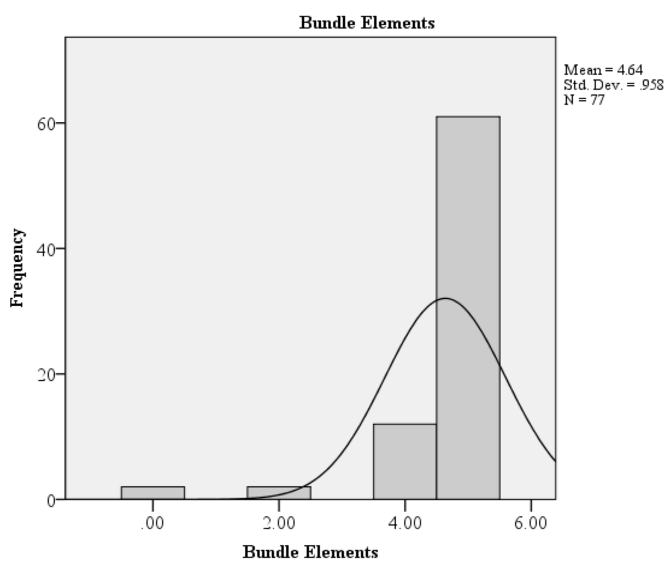

Figure 9. Frequency of Nursing Intervention Implementation

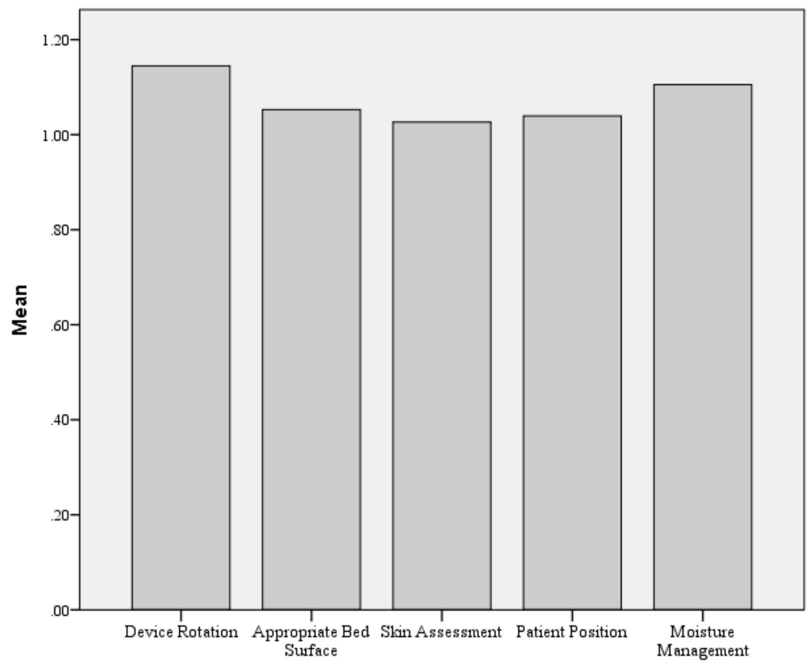

Figure 10. Frequency of Nursing Intervention Documentation

The criterion variable was total rates of pressure injury and the predictor variables were bundle interventions implemented and the five nursing interventions included: device rotation, appropriate surface, skin assessment, patient position and moisture management. Of the 99 children's hospital 77 submitted data on the implementation of nursing interventions of the bundle elements and one was eliminated for missing data. The null hypothesis was not rejected. A one way analysis of variance was conducted to evaluate the relationship between the rates of pressure injuries reported as per 1000 patient days and the implementation of the nursing interventions. The independent variable nursing interventions included nine levels: number of nursing interventions implemented as a bundle - 5, 4, 2, or 0, device rotations, skin assessment, appropriate surface, patient positioning and moisture management. The dependent variable was rates of pressure ulcers per 1000 patient days. The ANOVA was not significant at the level of .05, F (3, 72) = 1.29 p = .28. The null hypothesis was not rejected and further follow up tests were not conducted. I followed up the analysis with two-sample *t*-tests to explore if there was any relevance to an interventions implementation. The difference between the means of each nursing intervention and pressure injury rate also yielded non-significant relationship and small power (Table 5).

Table 5

t-test Nursing Interventions and Pressure injury Rates

		n	Mean	*sd*	*df*	*t*	*P*
Bed Surface	Yes	72	3.37	2.95	74	-.398	.69
	No	4	3.98	4.08			
Moisture Management	Yes	68	3.32	3.02	74	-.70	.49
	No	8	4.10	2.84			
Patient Position	Yes	73	3.45	3.02	74	.76	.45
	No	3	2.10	1.92			
Skin Assessment	Yes	74	3.46	3.00	74	1.03	.31
	No	2	1.20	1.77			
Device Rotation	Yes	65	3.51	2.96	74	.80	.43
	No	11	2.73	3.21			

The null hypothesis that there is no difference between the bundle and each individual nursing intervention of the PPIPB in the prevention of pressure injuries was not rejected. The follow up analysis to determine which intervention does have a significant impact was indeterminate due to a sample size too small to yield significant results.

Summary

The analysis of secondary data for this study tested the two hypotheses presented in chapter 1. The rejection of the first hypothesis established that there is a significant relationship between nursing interventions as a bundle and pressure injury rates. As the compliance with bundle documentation improved pressure injury rates decreased with a 57 % reduction over 5 years. The failure to reject the second hypothesis illustrated that although the significance of any one nursing intervention over the bundle is undetermined because of the small sample size, implementation of four out of the five nursing interventions occurred 94% of the time.

The following chapter includes the conclusions for the two research questions, study limitations, and recommendations for actions. Chapter 5 includes the implications of social change of the study. A discussion of future research recommendations and a summary conclude the chapter.

Chapter 5: Summary, Conclusions, and Recommendations

Introduction

This chapter includes the research questions, limitations, recommendation for action, social change implications, recommendations for future research and summary. The purpose of the study was to evaluate the impact of nursing interventions implemented as a bundle on pressure ulcer rates in children's hospitals. The outcome of the study was from data provided by children's hospitals across the country.

The analysis of the data from Solutions for Patient Safety was to provide insight in the prevention of pressure injuries in children's hospitals. The outcomes demonstrated that pressure injury rates reduced and maintained by 57% over a 5-year period by engaging nursing documentation on the pediatric pressure injury prevention bundle (PPIPB). Nursing interventions implemented as a bundle within collaboration can influence pressure injury rates.

Secondary data from the Solutions for Patient Safety provided data for this study. Data compilation for a yearly total on monthly data submissions of nursing interventions and pressure injury rates provided the data for this study. There was 102 children's hospital of which two hospitals did not meet inclusion criteria and one had missing data for several months. Thus, a total of 99 hospitals' data was part of the analysis. The following section discusses the data interpretation.

Conclusions

The conclusions for each of the research questions and hypotheses tested follow in the paragraphs below.

Research Question 1

Is there a significant impact of nursing interventions on pressure injury rates when implemented as a bundle over time? There was a significant decrease in pressure injury rates over time after bundle implementation (M = 5.29 sd = 5.69; M = 3.17 sd = 2.96; $p <$ 0.001) and a significant correlation with bundle documentation (-.075, p = 0.01). With the increase in bundle documentation there was a decrease in pressure injury occurrence. Pressure rates decreased by 57% even though 44% of the bundle documentation reported not implementing the recommended bundle interventions. Two other studies findings demonstrated decreased pressure injury rates after implementation of a continuous quality improvement program however there was no report of bundle compliance in the study (Brindle et al., 2015; Hopper & Morgan, 2014). The decrease in rates despite poor bundle compliance suggests the process involved in bundle implementation has a positive significant impact.

Active nursing engagement was a requirement of the collaborative through frequent monitoring and bundle documentation of all hospitalized children not only those children at risk for pressure injuries. Pressure injury rates decreased despite hospitals reporting that nurses did not always implement the recommended nursing interventions. Active nursing engagement was identified as a factor in reducing pressure injury in the literature (Chaboyer & Gillespie, 2014; Cremasco et al., 2013; Drake et al., 2012; Heiss, 2013; Padula et al., 2014; Resar et al., 2012; Scott et al., 2011). Nursing's active engagement has a positive impact on the reduction of pressure injury rates.

The data demonstrates that the engagement of children's hospitals in the collaborative to prevent pressure injuries has a positive impact on total incidence rates of pressure injuries (Figure 4 and Figure 5). The incidences of pressure injuries in children steadily decreased as children's hospitals joined the collaborative (Figure 4). The frequency of reporting zero incidences of pressure injuries increased. Being actively involved in a collaboration preventing harm has demonstrated effectiveness in the literature (Barker et al., 2013; Children's Hospital Association, 2014; Moffatt et al., 2015). The findings from this study demonstrated participation in a collaborative is an effective method in supporting nurses to decrease pressure injury rates. This study demonstrated the positive impact of nursing on pressure injury rates when participating in a collaborative.

All six stages of pressure injuries were similar in reporting rates (Table 2) which suggest there were no biases in reporting. The reporting on all stages demonstrates the nurse's awareness of the different degrees of skin injury and acknowledges the need for assessing all stages (Figure 2). Though the incidences of pressure injuries varied (Figure 2), it was for the better. Stage two pressure injuries had the highest mean rate of incidence per 1000 patient days (2.9) and stage 4 had the least (0.2), so fewer children suffered from full thickness skin injuries that include exposed bone. These findings are similar to the findings of adult and pediatric literature with the incidence of increased rates of stage two and decreased rates of full thickness skin injury (Padula et al, 2014). Children suffered less and experienced fewer full thickness skin injuries than before the implementation the bundle.

The rate of pressure injuries differs from the rates of pressure injuries reported in the pediatric literature. Current literature reports pediatric pressure injury rates ranging from 27% to 6.8 % (Drake et al., 2013; Schindler et al., 2013). Children’s hospitals rates of pressure injuries ranged between 31 and 0.7 incidences per 1000 patient days pre-intervention. The post- intervention results of decreased rates are similar to the single unit studies in the literature (Schindler et al., 2013; Scott et al., 2011). Overall, the rates of pressure ulcers are less than reported in the literature. The findings from this study provide current data on rates of pressure injuries.

A substantial finding of from this study is the rate of mucosal injuries. There is limited discussion of mucosal injuries and occurrence rates in the literature. The national pressure injury guidelines do not include mucosal injuries in the staging system (NPUAP, 2011). The anatomy of the mucosa presents a unique situation in how to describe the extent of the injury and until recently consensus was lacking on how to describe the extent of damage (NPUAP, 2011). Testing of a staging system to create reporting consensus for interrater reliability seems promising for the future (Reaper et al., 2016). The findings from this study report mucosal injuries have an incidence rate of 0.5 per 1000 patient days. Although there is no description of the extent of mucosal injury, the incidence suggests further exploration of mucosal injuries.

Both stage one and deep tissue pressure injuries are reported at half the rate of their succeeding stage, stage two and unstageable respectively (Figure 2). Early detection of pressure injuries prevents irreversible damage and is a key step in prevention (Black, 2015). There may be an opportunity to further drive down pressure injury rates by focusing on early identification. Similar to the findings in the literature early identification of skin injury is crucial to the prevention of extensive skin damage (Ullman et al., 2013; Visscher et al., 2013). Not knowing the demographics of the pressure injuries makes it difficult to determine if the child's inherent characteristics such as skin tone impeded early identification.

The low rates of stage three and four pressure injuries 0.3 and 0.1 per 1000 patient days suggest that skin assessments occur on a regular basis. Few pressure injuries identified as a stage three or four upon initial documentation. Again, the demographics of the pressure injuries are unknown so it is unclear if the stage three and four pressure injuries were present on admission or hospital acquired.

Overall fewer children are acquiring pressure injuries in the children's hospitals since nurses have been participating in the collaborative. There was a significant decrease in pressure injury rates even though bundle implementation was not 100%. The findings from the study are consistent with the literature in which pressure injury rates decreased with either implementation of prevention interventions or continuous quality improvement processes. One of the studies finding which is different and unique from the current literature is the maintained lower rates of pressure injuries across a children's hospital. To date pediatric studies on pressure injury prevention is unit based. The findings from this study represent all care units of a children's hospital. Nursing interventions positively influences pressure injury rates and sustains lower rates over time across a children's hospital.

Research Question 2

Is there a significant difference in the impact of nursing interventions as a bundle over any one individual nursing intervention on pressure injury rates?

The data analysis result was not significant to reject the null hypothesis. Thus, there is no difference between the bundle and each individual nursing intervention of the PPIPB in the prevention of pressure injuries. I did further analysis of the data and compared the means of nursing intervention to assess if there was a significant difference. The sample size (n=76) was too small to effectively analyze the influence of any one nursing intervention. With the smaller sample size, it was difficult to determine the predictability of pressure injury occurrence from the implementation or lack of implementation of nursing interventions. Although nursing interventions to prevent injuries from pressure, moisture and devices was present in the majority of the cases it was not enough to yield predictability or correlations.

With a third of the children's hospitals not submitting data on bundle implementation the significance of one intervention over another could not be determined. Regardless, there are some valuable inferences regarding the implemented interventions. Four of the five nursing interventions implemented across 94% of the children's hospitals. Of the five nursing interventions implemented as a bundle appropriate bed surface, patient positioning and skin assessment interventions were implemented 95%, 96% and 97% (n=76) of the time respectively. Moisture management and device rotation implementation was 89 % and 85% (n=76). Overall 96% (n=76) of the children's hospitals implemented four and five of the five nursing interventions.

Interestingly the nursing interventions implementation rate reflects the findings in the literature. There is limited information on moisture management and device rotation in the literature and may explain the lower rates of implementation. There may not be awareness on the effective interventions on moisture management and device rotation. Recent literature identifies the need to rotate devices when possible (Murray et al., 2013; Peterson et al., 2015; Sterken et al., 2014). Given that awareness regarding device rotation is recent, the practice change implementation is lacking. Similarly, moisture management is an evolving area of understanding in the prevention of skin injury (August et al., 2014; Black et al., 2011). Increasing the compliance rate of device rotation and moisture management may further drive down pressure injury rates.

Skin assessment, patient positioning and support surface was implemented on average in 96% of children's hospitals. The literature repeatedly reports that early skin assessment and frequent patient positioning prevents pressure injuries (Demarré et al., 2012; Kotner et al., 2013; Parnham, 2012). Interestingly despite the limited access and options to appropriate pressure relieving support surfaces (Black et al., 2012; Manning et al., 2015; McInnes et al., 2012; Scott et al., 2011), 95% of the children's hospitals reported having appropriate surfaces. Appropriate bed surface warrants further exploration to determine the categorization of available surfaces.

To date there is no documentation in the literature that explores the impact of one prevention intervention over another or the impact of several interventions. The second research question attempted to explore the correlation or predictability power of a single intervention and pressure injury rates. There is still potential for exploration of the impact of one nursing intervention over another with the availability of a larger data set.

Assumptions and Limitations

I made several assumptions for this study. The first assumption was regarding the staging of the pressure injuries. Since there was no statement of interrater reliability for the clinicians, who staged and reported the pressure injuries, I assumed that the pressure injury staging was according to the National Pressure Ulcer Advisory guidelines. The second assumption I made was regarding the implementation of the nursing interventions. It was unclear if the chart review of nursing interventions was daily or done retrospectively on random days. I assumed the data on nursing interventions was a summation of daily interventions.

There were several inherent limitations for this study. The first limitation was the lack of demographic data on the children's hospital. I was not able to control for acuity of the hospital or the nursing structure. The second limitation was not having the information regarding the severity of the child's illness. I was not able to factor in the acuity of the child when analyzing the rates of pressure injuries. The third limitation was not having the demographic data on the pressure injuries. Not knowing information on the pressure injuries restricted the scope of the study to the hospital level.

The final limitation of this study was the incomplete data on the implementation of nursing interventions. Of the 99 children's hospitals that were included in the study, 23 children's hospitals had not completed the survey required to answer the second research question. The completion rate was 77% and the missing information may have influenced the outcomes. The unexpectedly small sample size prevented me from conclusively reporting on the influence of one nursing intervention over another versus the bundle.

Recommendations for Future Research

The limitations and the findings of this study warrants further research in the phenomenon of children's pressure injuries. This study encompasses the influence of a bundle implemented across a children's organization however, there was no insight gained on the merit of one nursing intervention over another or the bundle. There was also no insight gained on the unique properties of the pressure injury. The findings from the study identified several areas of needed research in the prevention of pressure injuries.

The first possibility for future research pertains to understanding the impact of each nursing intervention on pressure injury rates. From this study, it was unclear if any one nursing intervention influences pressure injury rates over another or over the bundle. Further research looking at each individual nursing intervention in PPIPB may result in knowledge that can support allocation of nursing interventions. Further research on nursing interventions may confirm the need for all five areas of nursing interventions in the bundle or may identify a modified bundle.

The second area of research identified from the findings from this study pertains to deep tissue and unstageable pressure injuries. In this study, the rates of unstageable pressure injuries are double the rates of deep tissue injury (Figure 2). Ideally, the rates deep tissue injury is greater than unstageable injuries. Deep tissue injuries can evolve into an unstageable pressure injury and is an early sign of deeper tissue damage. The high rate of unstageable pressure injury rates presents as an opportunity for research to understand the phenomenon of unstageable pressure injuries.

The third opportunity for research identified from the study is a deeper look at the pressure injuries. It was not the focus of this study to look at the demographics and characteristics of the pressure injuries but exploring the pressure injuries may provide insight in prevention. Prevention intervention individualization could result from having an understanding of how and why the pressure injuries occurred in children,

The fourth area of research identified from the results of the study pertains to the nurse. The findings suggest that there is another element in the prevention of pressure injuries with rates decreasing as bundle documentation increased regardless of bundle compliance. The study findings demonstrate the influence of bundle documentation on rates but there is no explanation. Current literature pertaining to pressure injuries in adults may offer an explanation. Pressure injury literature in adults identifies nursing approach and attitude towards pressure injury prevention as a variable affecting pressure injury rates (Chaboyer & Gillespie, 2014; Demarre et al., 2012). The influence of nurses' approach to pressure injury prevention needs exploration to understand why compliance with documentation influenced pressure injury rates. Exploration into pediatric nursing's approach and attitudes towards pressure injury prevention may provide insight into sustaining prevention.

Recommendation for Action

Given that there was a 57%, overall reduction in pressure injuries with some children's hospitals experiencing reductions by as much as 100% implies that nursing interventions do influence outcomes. Children's hospitals administration should be encouraged to be a part of a collaborative that provides structure in engaging and supporting nursing to prevent adverse outcomes from pressure injuries. The findings from the study support nursing interventions as a bundle and the process to implement and check on bundle implementation as an effective method to decrease pressure injury rates.

Leaders of children's hospitals should be encouraged to build a process that engages nurses in a Continuous Quality Improvement (CQI) framework. The CQI framework predicts improved outcomes with active engagement through studying and evaluating the process (Mackie, Baldie, McKenna & O'Connor, 2014). The finding from this studying suggests nurses' participating in a pressure injury prevention collaboration sustains decreased rates of pressure injuries.

The findings from the study regarding should encourage nurses to engage in CQI activities to prevent pressure injuries. The process of implementing interventions, collecting and reporting data has a positive impact on preventing pressure injuries in this study. Nursing leadership may use the findings from this study to advocate for support for nursing to prevent pressure injuries through CQI processes when implementing nursing interventions.

In this study even though the bundle implementation was not 100% the active engagement process of preventing pressure injuries and reporting data influenced rates. The structure of monitoring and collecting data on a bundle of nursing interventions has demonstrated a positive impact on outcomes. Even with 44% of the children's hospitals reporting that the lack of nursing interventions as a bundle pressure injury rates went down (Figure 5). The overall trend of pressure injury rates is downward (Figure 4) which supports the recommendation for children's hospitals to embrace the process to implement a pressure injury prevention bundle across a hospital.

A final recommendation for action based on findings from the study pertains to the prevalence of deep tissue injuries and unstageable injuries. The rates of unstageable injuries are twice that of deep tissue injuries. An unstageable pressure injury is an evolved form of deep tissues injuries (NPUAP, 2016). By identifying skin injuries at the deep tissue stage further skin injury is preventable (NPUAP, 2016). Education focused on identification and treatment of deep tissue injuries may reduce the rate of unstageable injuries. Children's hospital administration and nurse leaders should target early identification of unstageable pressure injuries.

Social Change Implications

Children in children's hospitals are vulnerable to pressure injuries. This study has shown the positive influence of nursing interventions on pressure injuries. For the first time a study has ventured to understand the relationship between pressure injury prevention interventions implemented within collaborative, as a bundle and as individual interventions across children's hospitals. The identified nursing relationship on pressure injuries has positive social implications.

The Institute of Medicine and the Institute of Healthcare Improvement both identified nursing as influencing negative outcomes in the hospital (Leapfrog Group, 2011). Both organizations identified pressure injuries as an avoidable harm that cost lives and health care dollars in hospitals (AHRQ, 2012). The findings from the study may contribute to the mandate set forth by both organizations to save lives, prevent harm, improve quality, and preserve health care dollars. The findings from the study identify the integral role nursing engagement and interventions have in the prevention of pressure injuries.

The first research question findings support the correlation between nursing interventions and pressure injury rates. As the documentation rates of bundle implementation increased pressure injury rates decreased. The severity of pressure injuries and frequency decreased. Over the last 5 years, there has been an overall 57% reduction in pressure injuries across children’s hospitals in which nurses were actively engaged in prevention. As a positive social change, this translates to a 57% decrease in hospitalized children experiencing a pressure injury. The ripple effect extends out to the children’s families, friends, community, and the medical community by preventing the pain and suffering associated with pressure injuries further extending the impact of positive social change. Preventing harm by understanding the impact of nursing intervention on vulnerable hospitalized children is a positive social change. Findings from this study may contribute to sustaining positive social change by fostering understanding in preventing pressure injuries.

The financial burden of pressure injuries on health care is significant. Pressure injuries cost health care approximately 11 billion dollars annually (NPUAP, 2015). A single full thickness pressure injury may cost up to $70,000 to heal (NPUAP, 2015). Decreasing the rates of full thickness pressure injuries positively influences health care expenses. The findings from this study may support positive social by contributing to saving health care dollars by preventing injuries.

Summary

The purpose of this study was to understand the impact of nursing interventions on pressure injury rates in children's hospitals. Children are especially susceptible to permanent disfigurement from pressure injuries acquired in a children's hospital. The hospital environment exposes vulnerable children to skin injuries related to devices, moisture, and immobility. Beyond the devastating impact that pressure injuries have on children and their families, there is a devastating impact on the hospital system. The impact to the hospital is multifold with a drain on the financial system and negative perception of nursing. Nursing is accountable for the hospital-acquired pressure injuries and the rates of pressure injuries are a reflection of the quality of care. Thus, the prevention of pressure injuries is invaluable for children's hospitals.

The findings from the study provided valuable insight on the prevention of pressure injuries. The process of monitoring and collecting data on a bundle of nursing interventions demonstrated a positive impact on outcomes. Even with 44% of the children's hospitals reporting partial implementation of nursing interventions as a bundle, pressure injury rates decreased by 57% (Figure 5). The overall correlation was a downward trend of pressure injury rates as bundle documentation increased (Figure 4). The conceptual framework of Continuous Quality Improvement, which was a pillar of the study, helped to understand the outcomes.

The study finding was indeterminate in identifying which individual nursing intervention versus the bundle has the greatest impact on pressure ulcer rates. The study finding does create knowledge for evidence-based practice given the findings of the data analysis. The data analysis identified appropriate bed surface, patient positioning and skin assessment interventions were implemented 95%, 96% and 97% (*n*=76) of the time respectively. Moisture management and device rotation were implemented 89 % and 85% (*n*=76). Overall 96% (*n*=76) of the children's hospitals implemented four and five of the five nursing interventions. Children's hospitals can use these findings from the study to direct resources in nursing interventions to prevent pressure injuries.

The study findings regarding implementation rates of prevention intervention can provide hospital administration with information on directing resources. Knowing that active engagement in a quality improvement process and implementation of specific nursing intervention decreased pressure injury rates by 57% is valuable information to support decisions regarding process implementation and participation in a collaborative. Children's hospitals administration may further benefit from the results of this study by developing positive relationships with families by avoiding harmful pressure injuries. This findings from this study identified mucosal injuries, deep tissue, and unstageable pressure injuries at unexpected prevalence rates. This finding may encourage future researchers to explore the prevention of mucosal injuries, deep tissue and unstageable pressure injuries. Additionally ongoing research in the phenomenon of children's pressure injuries may lead to a fuller understanding of prevention.

The key finding from this study, which is the reduction of pressure injury prevalence rates, supports positive social change. The influence of nursing engagement and interventions in the prevention of pressure injury was positive. With hospital administration support, nursing can be empowered to prevent harmful pressure injuries in children. Both the Institute of Healthcare Improvements and the Institute of Medicine identifies nursing as a crucial component in preventing harmful pressure injuries. The findings from the study may support positive social change by preventing suffering in children and saves health care dollars.

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Licensed Content Date	Apr 17, 2012
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Type of Use	Dissertation/Thesis
Requestor type	University/Academic
Format	Print
Portion	Figure/table
Number of figures/tables	1
Original Wiley figure/table number(s)	Figure 3
Will you be translating?	No
Title of your thesis / dissertation	Impact of Nursing Intervention on Pressure Ulcer Rates
Expected completion date	Jan 2017
Expected size (number of pages)	120
Requestor Location	Charleen Deo 7190 Sierra Drive

Appendix C: Internal Review Board Approval

July 22, 2016

Dear Ms. Deo,

This email is to notify you that the Institutional Review Board (IRB) has approved your application for the study entitled, "The Impact of Nursing Interventions on Pediatric Pressure Ulcers." Our records indicate that you will be analyzing data provided to you by Solutions for Patient Safety as collected under its oversight. Since this study will serve as a Walden doctoral capstone, the Walden IRB will oversee your capstone data analysis and results reporting. The IRB approval number for this study is 07-22-16-0367736. When you obtain the final approval from Solutions for Patient Safety, please submit a copy to the Walden IRB to be included in your study file.

This confirmation is contingent upon your adherence to the exact procedures described in the final version of the documents that have been submitted to IRB@waldenu.edu as of this date. This includes maintaining your current status with the university and the oversight relationship is only valid while you are an actively enrolled student at Walden University. If you need to take a leave of absence or are otherwise unable to remain actively enrolled, this is suspended.

If you need to make any changes to your research staff or procedures, you must obtain IRB approval by submitting the IRB Request for Change in Procedures Form. You will receive confirmation with a status update of the request within 1 week of submitting the change request form and are not permitted to implement changes prior to receiving approval. Please note that Walden University does not accept responsibility or liability for research activities conducted without the IRB's approval, and the University will not accept or grant credit for student work that fails to comply with the policies and procedures related to ethical standards in research.

When you submitted your IRB materials, you made a commitment to communicate both discrete adverse events and general problems to the IRB within 1 week of their occurrence/realization. Failure to do so may result in invalidation of data, loss of academic credit, and/or loss of legal protections otherwise available to the researcher.

Both the Adverse Event Reporting form and Request for Change in Procedures form can be obtained at the IRB section of the Walden website:
http://academicguides.waldenu.edu/researchcenter/orec

Researchers are expected to keep detailed records of their research activities (i.e., participant log sheets, completed consent forms, etc.) for the same period of time they retain the original data. If, in the future, you require copies of the originally submitted IRB materials, you may request them from Institutional Review Board.

Please note that this letter indicates that the IRB has confirmed your study meets Walden University's ethical standards. You may not begin the doctoral study analysis phase of your doctoral study, however, until you have received the **Notification of Approval to Conduct Research** e-mail. Once you have received this notification by email, you may begin your study's data analysis.

Both students and faculty are invited to provide feedback on this IRB experience at the link below:

http://www.surveymonkey.com/s.aspx?sm=qHBJzkJMUx43pZegKlmdiQ_3d_3d

Sincerely,

Libby Munson
Research Ethics Support Specialist
Office of Research Ethics and Compliance
Email: irb@waldenu.edu
Fax: 626-605-0472
Phone: 612-312-1283

Office address for Walden University:
100 Washington Avenue South, Suite 900
Minneapolis, MN 55401

Appendix D: Solutions for Patient Safety Agreement to Use Data

Cincinnati Children's

Date: July 29, 2016

Walden University
Attn: IRB Office
100 S Washington Ave #900
Minneapolis, Minnesota 55401

RE: Ms. Charleen Deo Singh Dissertation

To Whom It May Concern,

I am writing at the request of Charleen Deo Singh regarding the collection and use of Solutions for Patient Safety (SPS) data and her dissertation project.

Please note that SPS has approved the use of de-identified pressure injury and children's hospitals data related to the children's hospitals participating in the collaborative to Ms. Singh to complete her dissertation. SPS will send this to data to Ms. Deo Singh in a secured manner. This data will be available after she submits her IRB approval letter from Walden University.

Should you have any questions, please do not hesitate to call (513-803-4588) or email me (Kathleen.walsh@cchmc.org).

Sincerely,

Kathleen Walsh, MD, MSc
SPS, Research Lead
James M. Anderson Center
Cincinnati Children's Hospital Medical Center
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