

IDENTIFYING THE CHARACTERISTICS OF PATIENTS WITH COMMUNITY
VERSUS HOSPITAL ACQUIRED PRESSURE ULCERS.

by

AHMAD A. HAMDAN

Presented to the Faculty of the Graduate College of Nursing
The University of Texas at Arlington in Partial Fulfillment

of the requirements

for the Degree of

DOCTOR OF PHILOSOPHY

THE UNIVERSITY OF TEXAS AT ARLINGTON

May 2014

Copyright © by Ahmad Hamdan 2014

All Rights Reserved



Acknowledgements

I would like to thank the committee members for their time, efforts, and patience in the face of several obstacles and making this work a reality. I would never have been able to finish my dissertation without the guidance of my chair, Dr. Jennifer Gray, and the committee members Dr. Barbara Raudonis, and Dr. Daisha Cipher. I would like to thank my wife Tahani for her patience in taking care of my four children during my busy time working on my dissertation. I would like to thank my children Mohammad, Rowa, Omar and Sarah of being away from them and not being able to play with them, or have a fun with them, as children would like to have. I would like to thank my parents for their continuous support and encouragement. I would like to thank the Karla Ramberger for her support. I would like to thank the director of medical records, Candace Adams for her help during the data collection phase. I would like to thank Cheyenne Ruby, Kelsey Sheeley, and Lisa Espinosa for their help in the process of data collection. I would like to thank Dr. Gregory Zarow for his encouragement and support throughout this journey. I would like to thank my colleagues at work Dr. Tony Paterniti, Kimm Wright, Kimberly Griffith, and Margie Jackson for their continuous support and encouragement. Finally, I would like to thank my friends Ali Shaqalaih and Rasmi Jafar for their continuous check-ins on my progress throughout my journey.

April 18, 2014

Abstract

IDENTIFYING THE CHARACTERISTICS OF PATIENTS WITH COMMUNITY VERSUS HOSPITAL ACQUIRED PRESSURE ULCERS

Ahmad Hamdan, PhD

The University of Texas at Arlington, 2014

Supervising Professor: Jennifer Gray

Pressure ulcers (PU) are a common problem with important implications for the nursing community and for patients, including pain and suffering, delayed recovery, morbidity, mortality, and healthcare costs, but little is known regarding what characterizes the difference between community acquired pressure ulcers (CAPU) and hospital acquired pressure ulcers (HAPU). Therefore, the purpose of this descriptive correlational retrospective study was to describe patient characteristics associated with CAPU and HAPU.

Measured variables included gender, age, ethnicity, PU site, albumin, weight, BMI insurance, length of stay, type of bed, type of admission, and weekend admission, as well as Braden Scale measures of moisture, nutrition, activity, friction, sensory, and mobility. Chi-square and Mann Whitney U statistics revealed that CAPU and HAPU groups were similar in gender, ethnicity, PU site, insurance, type of bed, type of admission, and weekend admission. CAPU patients ($\bar{x} = 73.2$ years) were significantly older than HAPU patients ($\bar{x} = 70.4$ years). Albumin, weight, BMI, length of stay, and

Braden measures were higher for HAPU patients than for CAPU patients at the $\alpha < .05$ threshold.

Logistic regression revealed the characteristics that were more likely associated with HAPU. The higher total Braden score, friction, and longer length of stay were associated with HAPU. Combined, these findings fill an important gap in the published nursing literature by demonstrating factors that characterize CAPU and HAPU.

Table of Contents

Acknowledgements.....	iii
Abstract.....	iv
List of Illustrations.....	x
List of Tables.....	xi
Chapter 1 Introduction.....	1
Background.....	2
Purpose.....	2
Significance.....	3
Research Questions.....	4
Conceptual Framework.....	5
Assumptions.....	7
Summary.....	8
Chapter 2 Review of Literature.....	9
Personal System.....	9
Wound Healing.....	9
Medical Diagnosis.....	11
Nutrition.....	12
Age.....	14
Ethnicity.....	15
Gender.....	18
Moisture.....	19
Temperature.....	20
Stressors.....	21

Interpersonal System.....	22
Frequency of Turning and Patient Mobility.....	23
Interface Pressure: Weight and BMI.....	24
Type of Mattress and Body Position.....	25
Social System.....	29
Admission from ER	32
Type of Insurance	32
Length of Stay.....	33
Risk Assessment Tools	33
Background.....	33
The Braden scale.....	35
Summary	37
Chapter 3 Methodology	39
Introduction.....	39
Design	39
Setting	40
Sample.....	40
Inclusion and Exclusion Criteria.....	41
Data Collection Procedure	42
Operational Definitions of the Variables	43
Statistical Analysis.....	46
Research Question # 1	46
Research Question # 2	46
Research Question # 3	47

Human Subjects Protection.....	47
Risks and Benefits of the Study	48
Threats to Validity of the Findings	49
Delimitations.....	50
Summary	50
Chapter 4 Results	51
Research Question 1	51
Personal System Factors	51
Interpersonal System Factors	53
Social System Factor.....	54
Summary of Research Question 1.....	54
Research Question 2	54
Research Question 3	55
Total Braden Score	56
Braden Subscale Scores	56
Summary of Braden Scale	57
Hypotheses Testing Logistic Regression	57
Summary	59
Chapter 5 Discussion	61
Introduction.....	61
Discussion of Results.....	61
Research Question 1	61
Personal System Factors	61
Interpersonal System Factors	67

Social System Factors	70
Research Question 2	72
Research Question 3	73
Limitations	74
Implications.....	75
Gaps in Literature and Areas for Future Research.....	77
Summary	80
References.....	81
Biographical Information.....	96

List of Illustrations

Figure 1. Model for Pressure Ulcer Risk Factors, based on King, 1991. 7

Figure 2. Braden subscale score by group. 57

List of Tables

Table 2-1 Summary of Interface Pressure Studies.....	27
Table 3-1 Operational Definitions of Independent Variables Organized by Systems	44
Table 3-2 Summary of threats to validity and actions taken to minimize them.....	50
Table 4-1 Categorical Characteristics by CAPU and HAPU.....	52
Table 4-2 Characteristics by CAPU and HAPU.....	53
Table 4-3 Medical Diagnosis at Admission by CAPU and HAPU	55
Table 4-4 Braden Score Descriptives by Group	56
Table 4-5 Regression Coefficients for Braden Total Score and Demographics	58
Table 4-6 Regression Coefficients for Braden Components and Demographics	59

Chapter 1

Introduction

Pressure ulcers (PU) are a common problem in both acute and chronic healthcare settings. The nationwide prevalence of pressure ulcers in acute care hospitals ranges from 25.2% to 26.8% (Woodbury, 2004). Pressure ulcers are a significant problem in terms of pain and suffering, delayed recovery, morbidity, mortality, and healthcare costs (Woodbury, 2004) with an incidence of 18% (Moore, Johanssen, & Etten, 2013). The Center for Medicare Services (CMS) no longer pays for care-related pressure ulcers that occur in hospitals. In response to the policy change, decision-makers in hospitals have implemented evidence-based, intensive measures aiming to reduce the incidence of PU. However, the policy change did not consider that the process of PU development may begin before the patient's admission to the hospital and becomes evident during the hospitalization.

To date, researchers have described hospital-acquired pressure ulcers (HAPU) and identified characteristics of patients with this type of PU. Current interventions for prevention of HAPU attempt to remove or reduce factors associated with the incidence of PU. The characteristics of patients with community-acquired pressure ulcers (CAPU) and hospital acquired pressure ulcers (HAPU) are not well known. A secondary analysis of clinical data was conducted to describe the characteristics of the patients with CAPU admitted to a two-hospital systems and the characteristics of patients with HAPU during a hospitalization.

Background

Pressure ulcers are caused by oxygen shortage to the tissues due to pressure, and shearing. They occur over bony prominences. The National Pressure Ulcer Advisory Panel NPUAP (2010) defined pressure ulcers as “a localized injury to the skin and/or underlying tissue over a bony prominence, as a result of pressure, or pressure in combination with shear.” There are two major categories of PU: Community-Acquired Pressure Ulcers (CAPU) and Hospital- acquired Pressure Ulcers (HAPU). CAPUs are present upon admission to an acute care hospital and HAPUs are not present at admission, but develop during the course of the hospitalization. Treatment to promote healing of PU requires significant use of human and financial resources. Changes in health care reimbursement have shifted the site of medical treatment to the home. Identifying the outcome of PU is essential because once a PU occurs; it may take a long period to heal. The average healing time for a stage III PU is three months (Chapman, Mills, Pearce, & Crowe, 2011). Moreover, discharged patients with PU may not receive the optimal care that promotes wound healing at home or at the long-term care facility (Alderden, Whitney, Taylor, & Zaratkiewics, 2011).

Purpose

The purpose of this study was to describe patients’ characteristics associated with CAPU and HAPU. The long-term goal is that by increasing the understanding of these characteristics, the overall incidence of PU may be reduced. Healthcare providers may use the information to implement prevention measures. The process of PU development

may begin prior to the patient's hospitalization to acute care, increasing the likelihood of occurrence during the hospitalization.

Significance

The reported incidence and prevalence rates of PU vary greatly across sources. Incidence refers to new cases of PU that occurred in a certain period and prevalence is a cross sectional count of the number of PU in a specific period of time (Gordis, 2004).

Pain is a very common problem in patients with pressure ulcers. Most patients with PU suffer from pain. The nature of pain associated with pressure ulcers is either acute cyclic pain that occurs with routine pressure ulcer care such as routine wound dressing, or a noncyclic pain associated with occasional wound management procedures such as debridement or wound drainage. Some patients with PU experience a constant, continuous pain not related to dressing changes or wound procedures (Quirino et al., 2007).

In terms of delayed recovery, patients with PU stay 10 days longer in the hospital than those without pressure ulcers who have similar medical conditions (Theisen, Drabik, & Stock, 2012). Furthermore, extended lengths of stay may block beds that are needed for other patients. PU can cause pain, discomfort and require additional treatment. If a patient is being discharged with PU, the ulcer's condition may deteriorate and advance to a deeper stage and healing becomes more challenging.

Scarcity of resources mandates that health administrators reduce the cost of treatment. In the present economic environment, efforts to lower the cost of health care are of increasing importance. Concern regarding PU in both acute and chronic health care

settings is growing. It is estimated that 2.1 million people are affected by HAPU in acute care facilities and that the cost of treatment is \$2.2 – 3.6 billion annually (Garza, Okere, Igbino, Novasad, & Pexton, 2006; Stinson, Gillan, & Porter-Armstrong, 2013). In the critical care unit, patients are at high risk for developing pressure ulcers, which may occur within 12 to 24 hours of their admission (Laat et al., 2007). The incidence of PU in intensive care units ranges between 11.2% and 14.3% (Kaitani, Tokunaga, Matsui, & Sanada, 2010; Sayar et al., 2009). Failure to prevent pressure ulcers has resulted in increasing litigation, and these consequences highlight the value of preventing pressure ulcers because prevention of PUs is less costly than providing treatment for them. Sharp and McLaws (2005) estimated that proper management of patients at high risk for PU may reduce the incidence of PU by 80%. Patients admitted to the hospital may have started the process of developing PU prior to the hospitalization and symptoms may have occurred upon admission (Sae-Sia, Wipke-Tevis, & Williams, 2005).

Research Questions

1. What are the characteristics of patients with CAPU and patients with HAPU?
2. What are the admission medical diagnoses of adult patients with CAPU and HAPU?
3. What are the patient characteristics associated with an increased likelihood of developing a CAPU as compared to developing a HAPU?

Conceptual Framework

King (1991) identifies three systems that interact and influence one another. First is the personal system. Second is the interpersonal system when two or more individuals are interacting. Finally, King (1991) analyzes the social system, the moving forces embedded in the dynamics of society, in which the processes of change alter the environment. She identifies hospitals and societies as social systems (p. 11).

The first system in King's model (1991) is the personal system. King (1991) supports the idea that the intactness of the nervous and sensory systems is essential for the person to perceive objects in the environment and interact accordingly. Patients with PU may not be able to perceive objects in the environment or communicate their problems, due to impairment of their nervous systems. This is either due to the disease process itself, such as stroke, or due to the effects of sedative drugs given to some patients in the critical care units.

King (1991) notes that "growth and development are a function of genetic endowment and an environment conducive to helping individuals move toward maturity" (p. 31). This concept is essential in pressure ulcer management. The factors affecting the occurrence of pressure ulcers are (a) intrinsic (genetic) factors and (b) extrinsic factors (i.e., the immediate environment surrounding the patient). In pressure ulcer management, there is minimum control over genetic factors, but the environment may be adjusted to promote the growth and development of tissues. These adjustments within the environment may lead to a positive interaction between the environment and the patient to promote the growth and development of tissues. Such manipulation of the

environment includes nursing interventions geared towards implementing evidence-based guidelines to reduce the risk of PU.

The second system in King's model (1991) is the interpersonal system: The interpersonal system involves individuals interacting with one another. The interactions and transactions that occur between the nurse and the client, or the dyad, represent an example of an interpersonal system. Communication between the nurse and the patient is in either verbal or non-verbal form. One form of nurse-client communication occurs when the nurse performs an assessment of pressure ulcers or assesses the risk of developing pressure ulcers. Nursing interventions in reducing the risk of PU occur during the interaction between the nurse and the client (King, 1991).

Finally, social systems have an influence on the success of pressure ulcer prevention. Their influence includes supporting education and monitoring the implementation of the policies and procedures within that system. The role of patients in the community and the level of social support are within the social system. King (1991) identifies the concepts of organization, power, authority status, decision-making, and control in the social system.

King's (1991) model provides a framework for pressure ulcer prevention and management. Concepts of growth and development and perception in the personal system are pertinent to pressure ulcers. The wound healing process is a form of growth and development. Perception as identified in risk assessment tools refers to sensory perception. King (1991) explains the interpersonal system as when two or more individuals interact in a sequence of verbal and nonverbal goal-directed behaviors. The

interaction is influenced by person’s knowledge, experience, needs, expectations and goals to be achieved. Nursing assessment of PU and interventions are considered forms of nurse–patient interactions. Social systems are organized boundary systems of social roles, behaviors, and practices developed to maintain values and the mechanisms to regulate the practices and roles. The concepts of power, organization, power, authority status, decision-making, and control are in the social system. Figure 1 shows how the three levels influence each other.

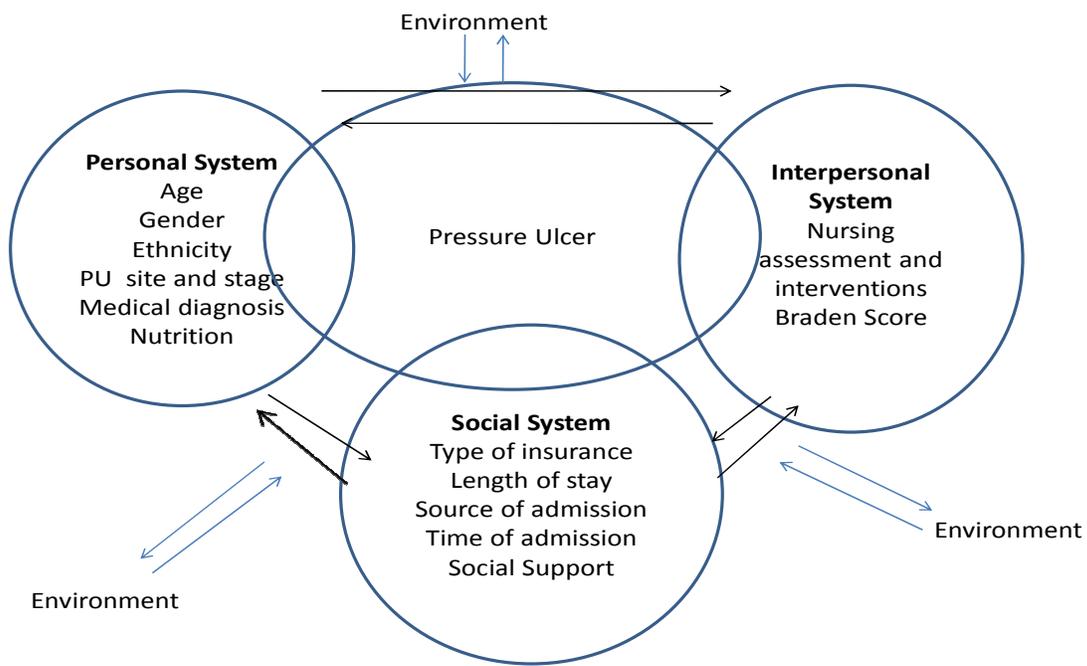


Figure 1. Model for Pressure Ulcer Risk Factors, based on King, 1991.

Assumptions

1. The information in the medical records was accurate.

2. The Braden scale was used by nurses correctly to assess pressure ulcer risk at admission and recorded accurately.
3. A PU present at admission was developed in the community. If a PU is listed as a primary or secondary diagnosis on admission, the patient was eligible for inclusion as a case of community-acquired pressure ulcer (CAPU).
4. If a CAPU was not documented upon admission, it would be considered as a HAPU.
5. The data were collected from the first admission, if repeated admissions occurred during the study period.

Summary

PU is a significant health problem in both acute and chronic health care settings. King's (1991) model provides a framework for understanding the PU phenomena. In the model, personal, interpersonal, and social systems are viewed as open systems. In open systems, the boundaries between each system are permeable allowing interaction. Concepts in one system may influence concepts in the other systems. In PU, the should be identified at the personal, interpersonal, and social level.

Chapter 2

Review of Literature

Using King's (1991) theory; patient characteristics can be categorized belonging to the personal system, the interpersonal system, or the social system. This model provided the conceptual framework for the present study. The purpose of this chapter is to provide a review of what is known from published literature about PU, organized by personal, interpersonal, and social systems. While this review is organized by well-defined systems, according to King (1991), these three systems interact with one another, so changes in one system can influence the other two systems. The patient characteristics in the personal system may influence the characteristics in the interpersonal and social systems.

Personal System

Concerning personal systems, King (1991) considers the patient to be an open system, and all the internal processes within the body to be subsystems. The components for the personal system are the process of wound healing, medical diagnosis of the patient, nutritional status, age, gender, ethnicity, and the patient's response to a stressor, moisture and temperature. The wound healing process is an example of a subsystem interacting within the entire system.

Wound Healing

Wound healing involves the processes of homeostasis, inflammation, proliferation, and remodeling. These processes are overlapping, and, in principle, they are

the same in both chronic and acute wounds; however, the substances involved and the length of each stage are different in acute and chronic wound healing (Baranski & Ayello, 2008).

The homeostasis phase occurs immediately following injury and platelets are trapped forming the bulk of the clot (Falabella & Kirsner, 2005). Growth factors, including Platelet-Derived Growth Factor (PDGF) and Transforming Growth Factor (TGF- β), are released from platelet alpha granules. Growth factors attract neutrophils and monocytes, beginning the inflammatory process.

The inflammatory phase occurs within 24 hours of the injury and involves the release of histamine responsible for the inflammatory process. (Falabella & Kirsner, 2005). The inflammatory stage lasts longer in chronic wounds (Casey, 2011). Neutrophils, monocytes, and macrophages are the key blood cells during the inflammatory phase. Neutrophils are activated by platelet mediators and a coagulation cascade that cleans the wound from bacteria and devitalized cells. Macrophages play a major role in killing bacteria and control the destruction of wound tissue by secreting inhibitors for proteases (Demidova, Hamblin & Herman, 2012).

In the proliferation phase, the fibrin matrix is replaced with a collagen matrix to restore the structure and function of the tissue (Casey, 2011). Activated by platelets, fibroblasts secrete proteases to clear the path and facilitate arrival to the wound site. Fibroblasts synthesize collagen and proteoglycans, the components of granulation tissue. Hydroxyproline is an essential component of collagen structure and helps stabilize collagen, collagen with low levels of hydroxyproline becomes unstable under

temperature changes. Vitamin C increases the level of hydroxyproline. Once collagen is synthesized, lysyl oxidase enzymes act on collagen molecules and help those molecules attach and form fibers that are strong and stable. The arrangement of these fibers is highly organized in normal skin. In scar formation, the fibers are weaker and arranged in a less organized manner (Vega, 2011).

Epithelialization is the process of epithelial cell migration to the wound. In normal skin, the dermis layer is capable of proliferation; the dermal cells are attached by connectors called desmosomes (Casey, 2011). Growth factors trigger these connectors to dissolve and help cells detach and migrate. Proteolytic enzymes facilitate the movement of these cells (Falabella & Kirsner, 2005).

In the remodeling phase, the metabolic rate decreases and changes in collagen arrangement occur (Falabella & Kirsner, 2005). The strength of the healed tissue is approximately 25% of that of normal uninjured tissue. Within a few months, the strength reaches around 80% of normal tissue strength (Falabella & Kirsner, 2005).

Medical Diagnosis

The pressure ulcer is not a diagnosis *per se*; it is a complication associated with other primary medical conditions. Researchers have identified certain medical diagnoses as a risk factor for PU development. Organ failure, diabetes, altered mental status due to stroke or other causes were identified as risk factors for PUs in acute care hospitals (Bry, Buesher, & Sandrick, 2012). In another study, sepsis, heart disease, diabetes, and malnutrition medical diagnoses were the most common diagnoses associated with PU (Fogerty et al., 2008).

Nutrition

Nutrition is defined as the process whereby food is taken into the body and broken down, allowing for a production in energy (Field & Smith, 2008). The negative consequences of inadequate nutrition include impaired skin healing, reduced immunity, increased fatigue, reduced respiratory function, reduced immunity function, and increased depression (Lewis, Heitkemper, & Dirksen, 2004).

Poor nutritional status is considered one of the risk factors associated with PU and included in several risk assessment tools for PU such as the Braden scale (Bergstrom & Braden, 1992) and the Norton scale (Norton, 1963). Although the nutritional item in both tools is subjective, objective methods are available to measure the nutritional status such as albumin and prealbumin. Due to its short half-life that ranges between two to three days, prealbumin is used to detect acute malnutrition and the longer half-life of albumin makes it appropriate for assessing chronic malnutrition (Kuszajewski & Clontz, 2005). The half-life of albumin is 20 days. Prealbumin is considered the gold standard in assessing and tracking the changes in nutritional status of hospitalized patients (Kuszajewski & Clontz, 2005).

King (1991) viewed the patient as an open system and the input, throughput, and output as the three components of the system. Nutritional ingredients are considered the input for the personal system, the throughput is how the body metabolizes these ingredients, and the output is the level of wound healing or the body's resistance to the occurrence of PUs. Nutrition contributes to wound healing in two respects. Proper

nutrition boosts the patient's immunity and provides the body with substances necessary to help wounds heal (Falabella & Kirsner, 2005). Factors affecting a patient's daily requirement of nutrients are the patient's age, pre-existing medical and surgical conditions, the background of the current problem, and the presence of a wound (Falabella & Kirsner, 2005).

Adequate nutrition reduces the risk of PUs and improves wound healing. Adding vitamins A, E, and C and other micronutrients reduced the risk of PUs in patients with mechanical ventilation in critical care units compared with a standard formula not enriched with these nutrients (Theilla, Cohen, & Dekeyser, 2007). Numerous studies have been conducted examining the role of vitamins and certain electrolytes in wound healing (Crowe & Brockbank, 2009; Singer, 2002; Vega, 2011). Vitamin C and zinc are two of the most commonly used nutrients in dietary interventions. Vitamin C enhances collagen synthesis, neutrophil function, and angiogenesis. The recommended vitamin C intake is 300 mg/day, and could be increased up to 10 times in the case of vitamin deficiency. Collagen production also serves to produce a barrier to pathogens. Zinc, a cofactor for the enzymes involved in DNA synthesis, enhances cell replication and growth and is required by proliferating cells (Vega, 2011).

Protein plays a role in reducing the incidence of PUs. Patients who received tube feedings and had PUs were in poorer nutritional condition compared with tube-fed patients without PUs (Breslow, Hallfrisch, & Goldberg, 1991). The researchers also noted a negative correlation between body mass index and the incidence of PUs. Singer (2002) found patients who received a diet that contains 24% protein diet had higher

healing rates than patients who received a 14% protein diet. The change in total PU area was found to be negatively correlated with dietary protein intake. The recommended daily intake of protein is 1 to 1.5 gm/kg/day (Crowe & Brockbank, 2009). These recommendations are consistent with the recommendations of the European Pressure Ulcer Advisory Panel (EPUAP, 2009).

Hyperglycemia inhibits leukocytes and thus increases the risk of infections. Hyperglycemia also impairs healing, and increases osmotic diuresis, making fluid management more challenging (Doley, 2010). Hyperglycemia is a common problem in patients in acute care facilities and critical care units; patients may receive drugs that increase glucose levels, such as steroids and dextrose administrations, physiologic stress from the disease process itself also increases blood sugar levels. Recent glycemetic control studies recommend that tight glycemetic control increases the risk of mortality due to hypoglycemia. The most recent recommendations for glucose levels are 110-150 mg/dl for critically ill patients and 70-130 mg/dl for non-critically ill patients (Doley, 2010).

Age

Age is another risk factor for PU that has been reported in the literature, older patients are at higher risk for PU than younger patients. The average age of patients with PU is 65 (VanGilder, MacFarlane, & Meyer, 2012; Russo, Steiner, & Spector, 2006).

The changes in skin condition associated with increased age and presence of chronic health conditions increase the risk for PU among older patients (Wann-Hanson, Hagell, & Willman, 2008). Skin changes associated with increasing age include an increase in the influence of shearing and friction forces on skin tear, due to the flattened

junction between the epidermal and dermal layers. Normally the dermal and epidermal layers are attached together by connectors. These connectors flatten and become very weak with older age. Subcutaneous tissue loss further weakens the skin among the older population (Bianchi, & Cameron, 2008). In a retrospective study, Cox (2011) examined 347 patients admitted to a medical-surgical intensive care unit and found increased age was a significant risk factor for PU. In another study, researchers found age as one PU predictor among others in 1229 patients admitted to different medical surgical wards (Shoonhoven et al, 2006). Furthermore, age is a predictor for PU prognosis; the older the patient, the more likely the PU will become worse. (Nixon & Mc Gough, 2001).

Ethnicity

No clear evidence has been published of a relationship between ethnic differences and the incidence of PU. Different ethnicities have different genetic structures and they respond differently to a given treatment regimen. For example, Cambinha-Bacote (2003) explained the concept of ethnic pharmacology, which is the study of variations in drug metabolism among ethnic groups. Although the biologic structures of different ethnic groups have been linked to variations in drugs metabolism, no evidence has linked these differences in biologic structures to the risk of PU.

Several studies have been conducted to compare the incidence of PU in different ethnic groups. Saladin and Krause (2009) compared the prevalence of pressure ulcer (PU) and barriers to treatment in the event of PU development as a function of race-ethnicity in persons with spinal cord injury (SCI). Their sample was comprised of 475 patients from the following four ethnic groups: African American, Caucasian, Hispanic and American

Indian. The prevalence of PU was higher among American Indian and African American patients compared with Caucasian and Hispanic patients, with Hispanics patients reporting the lowest rates of PU. Fogerty et al. (2008) conducted a large case control study utilizing the Nationwide Inpatient Sample (NIS) database to identify the risk factors and demographic differences between the patients who developed PU and those who remained PU free. There were 94,758 PU cases documented as a discharge diagnosis of the 6,610,787 subjects who were enrolled in the study. African American patients were at higher risk for PU than Caucasian patients. In another study, the incidence of PU among white patients was 15% compared to only 5% of the African American patients (Bergstrom et al., 1996).

The inconclusive results of the previous ethnicity studies and their relation to PU were explained by Anthony, Johnson, Reynolds, and Russel (2002) who investigated the relevance of ethnic variations to PU in the United Kingdom. Anthony et al. (2002) identified several obstacles in collecting data related to the ethnicity. The barriers include the lack of instruments that allow mixed ethnicity to be recorded, difficulty in collecting ethnic data from a patient who has parents from two different ethnic groups, and the difficulty of categorizing a person who is in the same ethnic group as another person who was born in a different country, speaks a different language, and practices a different culture. As a result, these variations may be due to social, economic, political, or cultural effects rather than genetic differences. Immigrants do not typically have the same health, or health risk factors, as those from the same ethnic group who were born in the host country (Anthony et al., 2002). Anthony et al concluded that there were no differences

between the Pakistani population as an ethnic minority and the general population in the UK in the incidence of PU. Despite clinical nursing references including the differences between skin structures and colors among various ethnic groups when assessing the skin or PU, a gap in current data remains about differences in the incidence of PU among ethnic groups. In the USA, differences between immigrants and Caucasian Americans exist in health status due to disparities such as income levels. Aday (2000) and Flaskerud and Winslow (1998) consider immigrants as a vulnerable population, and they are at a higher risk to PU not due to genetic differences but due to the presence of disparities. No conclusive evidence has been documented that supports any of these hypotheses related to risk for pressure ulcers.

The Department of Health and Human Services (2010) published the *Healthy People 2020* document. The document clearly stated that the health care disparities and access to care are present among African American population, thus the expectation is to find the incidence of PU to be higher among this group. In contrast, white population is at higher risk for PU than African American. Bergstrom et al. (1996) conducted a multi-site study of incidence of pressure ulcers. One hundred eight of 843 (12.8%) subjects developed pressure ulcers (incidence of 8.5 %). Older Caucasian persons were found to be at higher risk for pressure ulcers. Baumgarten et al. (2004) found that African American were at higher risk for PU than White Americans in a nursing home setting (NH). The incidence of PU was 0.38 per person-year in the NH. The rate for blacks was significantly higher than for whites (0.56 vs 0.35 per person-year) ($P < .001$). Race was significantly associated with PU incidence (hazard ratio comparing blacks with

whites=1.31, 95% confidence interval=1.02–1.66). In conclusion the isolated role of ethnicity is not clear on the incidence of PU due to factors other than the genetic structure such as the level of support that differ from one culture to another and the individual's perception of health that varies according to the cultural background.

Gender

Gender is another factor in King's personal system that has been examined as a risk factor for PU. Researchers in several studies found no difference in the incidence of PU between male and female patients (Bergstrom et al., 1996; Wann-Hanson et al., 2008). Fogerty et al. (2008) found no statistical difference in the incidence of PU between male and female patients. The findings of the Fogerty et al. study were in the report published by the Agency for Healthcare Research and Quality (AHRQ, 2008). Tescher, Branda, Byrne and Naessens (2012) in a retrospective study of 12, 566 patients in an acute care hospital found the PU in women was 42% (p. 0.125). Bergstrom et al. (1996) found that there is no difference in the incidence of PU between male and female hospitalized patients. Raghavan, Raza, & Ahmed (2003) found that in regression analysis, gender is not a predictor of PU among spinal cord injury patients.

In contrast, Lee, Lin, Mills and Kuo (2012) performed a study in Taiwan and found males were at higher risk for PU than females. A possible explanation of why female patients were at lower risk for PU was that female patients have a thicker subcutaneous tissue that acts as a protective cushion against pressure. Because PU is a quality of care issue, it is highly related to the level of care provided to patients prior to their admission or due to lack of quality of care. Opotowsky, McWilliams, and Cannon

(2007) found that women continued to fare worse than men in treatment they receive for heart attacks and congestive heart failure. They found a difference in the care women received. The complications associated with diabetes, cardiovascular disease and other chronic illnesses occurred more frequently in women than men. These chronic illnesses are considered as precursors for the incidence of PU and may provide an implicit explanation of differences in the incidence of PU between men and women.

Moisture

Moisture is considered one of the risk factors for PU and is listed on several risk assessment tools for PU (Braden, 1987; Norton, 1962). The moisture level is greater in the sacral area compared to the other high risk pressure points. Moisture may increase friction and shearing forces and soften the skin, thereby increasing the risk of skin breakdown (Lachenbruch, 2005). Increased moisture levels in the sacral area are due to fecal and urinary incontinence and the accumulated heat between the sacral area and the support surface. Fecal and urinary incontinence may alter the protective PH level of the skin (Sae-Sia et al., 2005). The pH value must be maintained between 4 and 6 to provide a protective effect against bacterial colonization. In addition, proteolytic and lipolytic enzymes found in urine and feces may cause skin dermatitis and skin-stripping (Beldon, 2008). The prevalence rate of incontinence is 19.7%, and 42.5% of incontinent patients have some degree of skin breakdown (Joan & Lerner, 2007).

Moisture damages skin structure and increases the risk of ischemic changes due to high friction and shearing forces. When a patient is turned onto her or his back, a large body surface area remains in contact with the bed and sheet. The larger the body surface

area in direct contact with the mattress and sheets, the greater the moisture level (Beldon, 2008). Moisture from sweat may cause the body to stick to the mattress and increase friction and diminish tissue tolerance by decreasing the tensile strength of the epidermis. Friction stimulates sweat production that softens the skin, which may increase the risk for maceration (McDonagh, 2008).

Temperature

Temperature is another contributing factor to the occurrence of PU. Convective heat accumulation between the skin and the mattress increases moisture levels. Sae-Sia et al. (2005) noted that the sacral area retains heat more than other sites of the body and localized elevated temperature at the sacral area is an early sign of pressure ulcer development. This relative increase in sacral temperature is due to the inflammatory process and convective heat accumulation.

In another study, Kokate et al. (1995) designed an experiment related to PU development in swine. They applied 100 mmHg pressure over a 51 mm diameter to the back of young swine ($n=16$) for a period of 5 hours. Pressure was constant, with different temperature levels in different sites; the temperature was ranging from 25 to 35, 40, and 45 degrees Celsius. After 7 days, at a pressure of 100 mmHg and a temperature of 25 degrees Celsius, no tissue injury was noted. At a temperature of 35, deep injury was noted without superficial injury, and more severe tissue injury with superficial damage was noted at the 40 and 45 degree temperatures. The researchers concluded that lowering the temperature may significantly reduce the risk for PU (Kokate et al., 1995). The mechanism of tissue injury is that 1 degree Celsius increases the metabolic rate by 10% at

the localized area of high temperature, causing vasodilatation. At a higher pressure of more than 30 mmHg, tissue ischemia is more likely to occur due to a dramatic drop in blood supply to the tissue at higher temperatures. The vasodilatory response to the temperature change occurs at low-to-moderate pressures but not at higher pressures, due to mechanical compression of the vessels by higher interface pressure of more than 30 mmHg. Considering this finding, cooling the skin may compensate for the higher interface pressure. Blood flow at a temperature of 28 Celsius and an interface pressure of 56 mmHg is equal to the blood flow when the temperature is 36 Celsius and interface pressure is 40 mmHg (Kokate et al., 1995).

Cooler skin temperature reduces oxygen consumption; for example, a 1 degree Celsius reduction in temperature decreases the metabolic demands by 10% and increases the oxygenation by 10%. However, due to the constriction of blood vessels as a result of cooling the skin, the oxygenation increase would be less than 10% (Lachenbruch, 2005). Furthermore, increased temperature is associated with increased sweat production, which further increase the moisture level in the back.

Another possible cause of increased incidence of pressure ulcers in the sacral area is due to loss of musculature tone in that area. In healthy persons the gluteal muscle tends to elevate the sacrum from the support surface and decrease the pressure on that area; patients at high risk of pressure ulcers may lose the muscular tone so that interface pressure increases at the sacral area (Moody, Gonzales, & Cureton, 2004).

Stressors

King (1991) explains in her model that a patient as a personal system is in continuous interaction with the environment. Examples of this interaction are the internal and external stressors. There are limited studies that correlate the effect of stressors on wound healing. However, Selye (1956) explained the general adaptation syndrome in which the body initially handles a stressor by the fight and flight response, followed by stressor confrontation in which resistance is highest, and then by exhaustion if the threat continues. In Western society, most individuals may have daily minor hassles in their lives. If these hassles occur very frequently, they may have a more negative effect on health than major events due to the exhaustion phase (Jones, 2003).

Kiecolt-Glaser et al (1995) found that wound healing was delayed among women caring for relatives with dementia compared with a control group that did not care for relatives with dementia. Healing time took longer for the caregiver group, with delayed wound healing attributed to higher levels of stress. Although the women did not have PU, the results are evidence of the impact of stress on healing.

The presence of chronic wounds may affect the patient's psychological status and increase the incidence of depression, further delaying wound healing. One of the mechanisms through which depression may affect wound healing is that melatonin levels are low in depression. This neurohormonal substance acts as an antioxidant for free radicals secreted in tissue injury and promotes healing (Sener, Sert, Sehirli, Arbak, & Dulger, 2006). Patients who are depressed are also more likely to have impaired nutrition and even anorexia, leading to delayed wound healing.

Nursing interventions are considered one form of interaction between the nurse and the patient and occur at the interpersonal system (King, 1991). Nursing interventions are geared toward reducing the incidence of PU or PU management that occurs during the patient-nurse interaction such as turning patients.

Wound assessment is another form of patient-nurse interaction within the interpersonal system and requires a comprehensive examination of the patient. This occurs during an interaction between the nurse and the patient (King, 1991). Falabella and Kirsner (2005) proposed the Comprehensive Wound Assessment and Treatment System (CWATS). The system includes two phases or aspects: the patient's medical and surgical history and the social and psychological history. This is followed by a comprehensive wound assessment that includes the assessment of perfusion, oxygenation, infection, nutrition, immune status, psychosocial status, pressure, neuropathy, and wound bed. These recommendations are consistent with the recommendations of the Agency for Healthcare Research and Quality (AHRQ, 2012).

Frequency of Turning and Patient Mobility

Patient's mobility is considered one of the risk factors that was addressed by the risk assessment tools. Turning immobile patients is an essential nursing intervention geared to reduce the risk of PU. The current guidelines recommend different turning frequencies. The Agency for Health Care Research and Quality (AHRQ) (1992) and the National Pressure Ulcer Advisory Panel (NPUAP) (2007) recommended turning patients every 2 hours. The European PU Advisory Panel (EPUAP) (2009) did not specify the turning interval but stated that "the frequency of repositioning should be consistent with

the overall goals”, and Dutch guidelines recommended turning the patient every 3 hours (Vanderwee, Grypdonck, Bacquer, & Defloor, 2006).

There are very few studies investigating the frequency of turning patients to reduce the incidence of PUs. Turning patients every 2 hours is costly and disturbs patients during the night. Moreover, the 2-hour turning schedule is an outdated recommendation in which the quality of mattresses used in the past were not as effective in relieving pressure compared to current mattresses (N. Bergstrom, personal communication, February 1, 2010). Although discrepancies in determining how frequently the patient must be turned exist in the literature, turning is the gold standard in reducing the incidence of PUs (NPUAP, 2007).

Interface Pressure: Weight and BMI

Another form of nurse’s interaction with the patient is the proper positioning of the patient on bed. It helps reduce the effect of interface pressure and shearing forces between the skin and the mattress. Interface pressure is the amount of pressure exerted on a bony prominence and support surface. Body weight, type of mattress, and position affect the amount of pressure.

A significant association exists between the incidence of PU and body weight. Obese patients show larger distribution over the mattress and, thus, relatively lower interface pressure; however, if they develop PU, the damage is extensive (Defloor, 2000). The PU may develop from inside to outside and shearing force is higher in obese patients, possibly contributing to this extensive damage (Jaul, 2011). Alternatively, obesity may lead to a greater risk for deep tissue injury (DTI) due to an increase in compressive

forces from the bones on overlying deep soft tissues, leading to deep tissue injury (Elsner & Gefen, 2008).

Several studies suggested that low body weight increases the risk for PU (Shahin et al., 2010; VanGilder, MacFarlane, Meyers & Lachenbruch, 2009). However, Rondorf-Klym and Langemo (1993) found no statistical difference between interface pressure for those with ideal body weight and with low ideal body weight; therefore, there is no evidence that body weight influences the interface pressure. In summary, overweight and underweight patients are at high risk for PUs in the sacral area, but overweight patients are at higher risk due to shearing forces while underweight patients are more likely malnourished.

Type of Mattress and Body Position

The type of mattress is another factor that may influence interface pressure. Support-mattresses help distribute the pressure load where the body has direct contact with the support surface, thus either decreasing or eliminating interface pressure. Support mattresses are either pressure reducing, such as the urethane type, or pressure-relieving, such as air mattresses. Both types of support mattresses reduced the interface pressure; however, air mattresses reduced the interface pressure 13% more than urethane mattresses (Moody et al., 2004).

Defloor (2000) examined the effect of 10 various body positions of 62 healthy volunteers on interface pressure. To measure the pressure, 684 sensors covering the mattress were used. Defloor used two different types of mattresses: a standard mattress and a pressure-relieving mattress made of polyethylene-urethane. The lowest interface

pressure among supine positions occurred when the bed was elevated at 30 degrees. For lateral side positions, the interface pressure was higher at 90 degrees than at the 30-degree lateral position. In both supine and lateral positions, the interface pressure exceeded 32 mmHg, except when using a pressure-relieving mattress, for which the semi-Fowler supine position pressure was 27 mmHg. The value of pressure that exceeds the capillary pressure and thus increases the risk for PU is 32 mmHg (Defloor, 2000; Moody et al., 2004; Peterson et al., 2008).

Peterson et al. (2008) found that interface pressure increases when elevating the head of the bed from the supine position; they gradually increased the head of the bed from 0° through 30, 45, 60, and 90 degrees. In all supine positions, the interface pressure was more than the capillary closure pressure of 32 mmHg. However, they did not study interface pressure in lateral positions. They recommended keeping the head of the bed elevated at least 30 degrees to prevent other complications, such as pneumonia or aspiration from feeding tubes. The limitation of their study was the use of healthy subjects ($N = 15$), who may differ from patients in terms of body weight or other factors.

Modern pressure-reading techniques have set the average capillary pressure at 47 mmHg (Agam & Gefen, 2007). Recent studies have suggested the interface pressure needs to exceed the systolic pressure to cut off the blood supply to the tissues because the measured interface pressure reflects the external skin surface pressure, not the internal capillary pressure (Agam & Gefen, 2007; Sakai et al., 2009).

Rondorf-Klym and Langemo (1993) examined the effect of the relationship between body weight, body position, and support surface on interface pressure. They used supine,

semi-Fowler's and Fowler's positions and three different types of mattresses. The mattresses were an air inflated mattress, a foam cushion type of mattress, and a standard hospital mattress. The lowest interface pressure occurred in the semi-Fowler supine position using the pressure-relieving Softcare mattress.

Young (2004) compared the incidence of PUs in two different lateral positions of 30 and 90 degrees and the supine position. Thirty-nine participants in an acute care facility were assessed for the occurrence of non-blanching erythema over 24 hours. No statistical difference was observed between the two positions in terms of the incidence of non-blanching erythema. The limitations of the study were the short period of observation, the limited number of subjects, and the evaluation of only two lateral positions. Table 2-1 shows a summary of the findings of different studies examining different body positions on interface pressure.

Table 0-1 Summary of Interface Pressure Studies

Authors	Purpose and design	Subjects	Interventions and outcome
Defloor (2000)	Effect of type of mattress and body position on interface pressure, clinical trial design	62 healthy volunteers	Pressure was recorded in 10 different positions. Lowest interface pressure in supine and lateral positions with head of bed elevated.
Peterson et al. (2008)	Different supine positions in interface pressure	15 healthy volunteers	Interface pressure lowest at flat supine position.

Table 0-2 – continued

Authors	Purpose and design	Subjects	Interventions and outcome
Young (2004)	Compare the effect of 30-degree (experimental group) vs 90-degree (control group) lateral positions vs supine position on non-blanching erythema. experimental study	39 subjects in acute-care facility	No statistical significance in lateral groups in the incidence of non-blanchable erythema in 24 hours
Peterson, Schwab, Oostrom, Gravenstein, & Caruso (2010)	Effects of lateral turning on skin bed interface pressures on the sacral, trochanter, and buttock region. Participants turned to 30-degree right and left positions and supine with head of bed elevation at 30 degrees	15 healthy subjects	Unrelieved pressure at the sacral and buttock areas in the three positions and remained more than 32 mmHg. The area with unrelieved pressure called <i>triple jeopardy</i> . Pillow wedge had higher interface pressure than the pillow.
Rondorf-Klym & Langemo (1993)	Examine the relationship between body weight, body position, and interface pressure. Descriptive study.	Three types of mattresses: Soft Care® bed cushion, Bioguard® foam, standard mattress. Participants were Older adults, long-term facility, 12 ideal body weight and 6 low weight subjects.	No difference between ideal and below-ideal weight in interface pressure; supine position had highest interface pressure. Soft Care bed cushion had lowest interface pressure.

In analyzing the results of the previous studies, limited evidence present, that links the correlation between external and internal interface pressures. Interface pressure alone is not adequate to cause PU. Shearing force is another contributing factor to the PU that may cause tissue damage; however, it is not measurable in the clinical setting (Sharp & McLaws, 2005). The thick layers of fat and muscle in the buttock area may increase shearing forces and reduce or cut the blood supply to the sacral area (Gefen & Levine, 2007).

Social System

Social systems provide a framework for social interactions and relationships and establish rules of behavior and courses of action (King, 1991). Social systems may include family, friends, the school, and the church. Healthcare facilities such as nursing homes and acute care hospitals are other examples of social systems. Hospital settings may influence the patient's outcome, such as staffing levels, nurse skill mix, hospital's type, and type of equipment used in each hospital (Benoit & Mion, 2012). Organization and power are concepts within the social system in King's (1991) theory. Organizational structure and leadership style influence the implementation of a PU prevention program and ensure that nurses follow the policies and procedures. The process of implementing PU prevention programs depends on the leadership's method of communication with the nurses who are involved in providing the care. The least effective method of ensuring the implementation of PU prevention guidelines by nurses is the provision of educational materials and educational sessions. Automatic reminder systems and audit tools are

considered moderately effective in ensuring that nurses follow the guidelines. The most effective method is the presence of an organizational culture of transformational leadership style. In this environment, leaders pay attention to the organizational context in which nursing care occurs, and the culture supports and values education leading to continuous learning (Marchionni & Ritchie, 2008).

King's (1991) theory stated that a social system is in continuous interaction with the environment. External social forces such as the Joint Commission for Hospital Accreditation (TJC) and Centers for Medicare and Medicaid Services (CMS) are among the environmental factors that influence the healthcare setting, which King views as a social system.

For example, the CMS no longer pays for PUs that occurs in hospitals. In response to this policy, decision-makers in acute care settings have implemented new measures to reduce the incidence of PUs, such as early referral of patients at risk for PU to the wound-care team. There is a great desire to implement strategies for PU prevention that are cost effective, individualized, and evidence-based. To date, no studies are available that evaluate the impact of the CMS's policy change on the incidence of PUs. However, Aday, Begley, Lairson, and Slater (1998) in their access-equity model, emphasize that health policy influences health delivery systems and access to care, which in turn affects the incidence of PU healing outcomes. The changes in the CMS policy are among other external factors that are inputs to the social system and affect the outcome of wound healing.

King's (1991) theory is congruent with the assumptions made by vulnerable population theories that older patients with PUs are vulnerable populations. Flaskerud and Winslow's (1998) vulnerability model further explains the social system in King's model. The concepts of social support, education, income, and healthcare quality found in the vulnerability model represent the input ingredients for the social system in King's model, which further explains the PU phenomena in a broader light. Vulnerable populations are defined as "social groups with limited resources and consequently a high relative risk for morbidity, premature mortality, and reduced quality of life" (Flaskerud & Winslow, 1998).

The Agency for Healthcare Research and Quality (AHRQ) published the National Healthcare Disparities Report (2005), which identified lack of preventive care as one of its seven key findings. Many patients at high risk of developing PUs did not receive preventive care. These findings support the value of preventive measures prior to hospital admission.

For example, inadequate nutritional intake is a risk factor for the incidence of PU's that has been identified by the RATs. If a patient has prolonged inadequate nutritional intake prior to hospital admission, the risk of PUs due to nutritional inadequacy still exists, even though adequate and good quality nutrition is received during the hospitalization period. Patients need additional nutrition to rebuild body structures, such as atrophied muscle. Rebuilding muscle is a lengthy process. Prolonged malnourishment requires adequate nutrition and a period of time that extends beyond the length of stay in the hospital to have an effect (Roubenoff, 1999).

Another risk factor is the level of social support patients receive prior to hospitalization. Social support is theoretically defined as an exchange of positive affect, a sense of social integration, emotional concern, and direct aid or services between two persons (Frey, 1989). The effect of social support has two dimensions, the direct effect in which social support has positive health outcomes irrespective of the presence of stress, and the buffering effect from reducing the negative outcomes of stress (Jones, 2003).

Social support was identified by *Healthy People 2020* as a social determinant of health. In the report, the social determinants of health were defined as “conditions in the environments in which people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risk.”

Admission from ER

In the Nationwide Inpatient Sample (NIS) data set, almost 70% of patients with PUs as a primary diagnosis were admitted through the ER (Hamdan, 2008). This may mean that these patients were more likely to have a lower level of social support and a minimum level of preventive follow-up care. The same analysis showed that the average age of patients when admitted with a PU diagnosis was 64.5 years. Older patients with chronic health conditions are more vulnerable to PU's.

Type of Insurance

Type of insurance is another factor within the social system that may influence the incidence of PU. The type of insurance may influence the incidence of pressure ulcers depending on what the insurance covers. Russo et al. (2006) found that the most common

primary payer for hospitalizations related to pressure ulcers was Medicare. Nearly 3 out of 4 hospitalizations with a pressure ulcer diagnosis were billed to Medicare. This finding raises the question of quality of care provided to patients who have Medicare coverage. Does Medicare insurance provide a lower quality care than other types of insurance, which may lead to higher rate of incidence of PU among those patients with Medicare insurance? On the other hand, is it that patients with Medicare insurance could not afford to cover the necessary treatment expenses? Jones and Fennie (2007) conducted a study to identify factors influencing PU healing; they found that the type of insurance is a strong predictor of wound healing. In patients who have PU and are covered by Medicare insurance, the wound is less likely to heal in 6 months compared with other types of insurance.

Length of Stay

Length of stay in an acute care hospital is an important measure of quality of care and a predictor of PU in acute care hospitals (Cox, 2011). Length of stay can be considered a part of the social system of King (1991) because several social system factors impact length of stay, including insurance and healthcare facility.

Risk Assessment Tools

Background

The standardized risk assessment tools (RATs) are widely used in the clinical settings. They are the gold standard in assessing the PU risk on a daily basis and have been used to quantify the risk for PU (Benoit & Mion, 2012). In the literature, more than

40 tools are available that measure PU risk. This large number of risk assessment tools is due to presence of different clinical settings and different groups of patients. For example, risk assessment tools used in the hospital settings are not appropriate for patients in the community and do not satisfy the end users in terms of their clarity, validity and reliability (Anthony, Parboteeah, Saleh, & Papanikolau, 2008).

The first RAT is the Norton scale (Norton & Smith 1962). The tool consists of five items: physical condition, mental state, activity, mobility and incontinence. Each score ranges from 1 to 4. The maximum score is 20 indicating a minimum risk and 5 indicating the patient is at high risk for PU. The cutoff score in Norton scale for patients at risk for PU is 12 or below. To test the scale's predictive validity, Defloor and Grypdonck (2005) conducted a study on 1772 older patients in 11 long-term healthcare settings. Patients were divided into turning and non-turning groups. For the turning group, the number of patients was 314 and 1458 for the non-turning group. Patients in the turning group who have a score of 12 or less in Norton scale were turned every 2 or 4 hours and patients in the non-turning group received the care based on the clinical judgment of the nurses, not based on the Norton scale. They found that identifying patients at risk for PU using a risk assessment scale is better than relying on the clinical judgment. They found a statistical difference in the incidence of PU in the turning group in which Norton scale was used to assess the risk of PU, and the non-turning group in which preventive measures were used according to the clinical judgment. The incidence of PU was 5.1% in the turning group and 11.7% in the non-turning group. In Hong Kong, Cho and Noh (2009) assessed 185 patients upon admission for the risk of PU using

Norton and Waterlow scales. The Norton scale was found to be superior to Waterlow scale. The Waterlow scale misidentified 72 patients at risk although they were not.

Schoonhoven et al. (2006) conducted a prospective study on 1229 patients admitted to an acute health care hospital and found that the Norton scale may over predict the risk for PU, which may lead to ineffective resource utilization. Maylor (2006) argued that the current tools have several shortcomings, such as multidimensionality. Maylor explained that some concepts in some scales are multidimensional and are complex, such as the concept of stability and criticality found in Norton scale. For example, the concepts of agitation and mental condition are found in the same category, but have different effects. Agitation yet has different effects, as agitated patients are more likely to move. Decreased awareness may have a harmful effect, as the patients may be less likely to move.

The Braden scale

The Braden scale (Braden, 1987) is the most common tool used in the clinical setting and the most tested tool for its reliability and validity in several countries (Benoit & Mion, 2012; Stechmiller et al., 2008). The Braden score for predicting pressure sore risk also called Braden scale was first introduced in 1987 (Bergstrom, Braden, Laguzza & Holman, 1987) and was tested for its validity and reliability in different clinical settings. The scale consists of six subscales that reflect the degree of sensory perception, skin moisture, physical activity, nutritional intake, friction and shear, and ability to change position independently. The total score of the scale is 23. The cut off score for at risk patients is 18 or below, at moderate risk 14 and at high risk the score is below 12. All

item scores range from 1 to 4 except the friction and shearing subscale that ranges from 1 to 3. The scale is used to identify the risk factors for PU (Cho & Noh, 2009).

Tescher et al. (2012) found that friction and shear scores have a stronger association with PU development than any other factors. They explained that friction and shear were underestimated by nurses due to the lack of an objective tool to quantify the friction and shear. Furthermore, nurses underestimated the role of shearing and friction in patients suffering from mobility limitations. The implication of this study on clinical practice was that the Braden subscales might provide more individualized plan of care for patients at risk for PU than the total Braden scale.

The findings in the Tescher study were different from the findings of a study conducted by Bergquist and Frantz (2001). They conducted a secondary data analysis of 107 adult patients admitted to an acute care facility and found that total Braden scale score was more predictive than the scores on the subscales of the tool. The limitation of the study was that the number of participants was small. To study the effect of using Braden scale on reducing the incidence of PU, Saleh et al. (2009) performed a study on 719 patients at risk for PU. The main purpose of the study was to examine if the incidence of PU is different in a group of patients for whom the risk for PU was assessed by the clinical judgment of the nurse from another group of patients assessed by Braden scale. They found no difference in the incidence of PU in both groups.

The main bias in the scales is that the RATs are not adjusted for preventive measures to identify which measures are the best at mitigating risk of developing a PU. Depriving patients at risk for PU from preventive measures to test the validity of a RAT

would be unethical, making it difficult to confirm the tool's validity (Anthony, Parboteeah, Saleh, & Papanikolau, 2008). There are other risk factors in acute care hospitals that are not included in the risk assessment scales such as advanced age, specific medical conditions, oxygenation and physiological status changes (Cowan, Stechmiller, Rowe, & Kairalla, 2012). Further studies are needed to compare the risk factors of PU in acute health care settings versus long-term care settings, to appropriately evaluate the use of risk assessment tools in both settings.

In conclusion, there are several limitations found in the RATs. The tools are used for both acute and long-term health care facilities. The risk factors may differ in patients found in acute care facilities from patients residing in long-term care facilities. The incidence of PU remains the same before and after implementing the RATs. The overall usefulness of such tools must be based on the reduction of the incidence of PU. Another limitation of these tools is that the risk factors comprising each of the subscale categories have equal weights, adding a statistical limitation to these tools. Causation and correlation are not equal; the risk factors found in the tools are just correlated with PU, not necessarily causative of PU. Despite the previous limitations, the risk assessment scales are more beneficial than the clinical judgment by nurses because they provide a way to quantify the risk and help nurses use resources wisely.

Summary

The review reveals two major gaps in the current literature. The first of these is the lack of risk assessment tools that identify persons at risk for PUs in the community. The Braden and Bergstrom (1989) tool has been used in acute and chronic clinical

settings at the national and international levels does not include the risk factors discussed in this review that fall under the social system. However, the gap related to assessment tools will not be addressed in this study.

The second gap is that researchers have investigated the risk factors and the characteristics of patients with either hospital acquired or community acquired PU but not both categories in the same study focusing on the personal and interpersonal system factors but not the social system. Any PU prevention program must consider the personal, interpersonal, and social systems. PU programs should be started prior to admission, and follow-up visits to patients at home and early management of at-risk patients are keys to reducing the incidence of PUs. A more thorough social assessment is also needed to identify the patient's support systems to help nurses plan for discharge and reduce recurrent admissions for PU development or complications. This study may increase health care providers' understanding of CAPU and provide a basis for future interventions.

Chapter 3

Methodology

Introduction

The purpose of the study was to describe patients' characteristics associated with CAPU and HAPU. A descriptive correlational design utilizing retrospective chart review was performed. The data collection included a medical chart review and a review of the existing records that included nursing admission assessment, daily nursing assessment and albumin and pre albumin levels, wound care consultation report if available, patient's history and admission report.

Design

A descriptive correlational design utilizing retrospective chart review was performed. The chart review included patients who were admitted with a diagnosis of PU (CAPU), or patients who developed PU in the acute health care facilities (HAPU). The advantages of descriptive correlational design utilizing retrospective chart review include the availability of data, less time consuming, and lower risk of potential harms to human subjects as long as the confidentiality and privacy of patient's information is being maintained throughout the study. The correlational design utilizing retrospective chart review has disadvantages. The selection of population, the quality of data, the data to be collected, and measuring variables are predetermined (Hulley, Cummings, Browner, Grady, & Newman, 2007). The variables selected for inclusion in this study were categorized according to the King's (1991) personal, interpersonal and social systems.

Setting

The patients included in the study were admitted into two not-for-profit hospitals. The two hospitals were a part of one of the largest healthcare systems in the North Texas area. One hospital had 515 beds while the other hospital had 269 beds. The vast majority of the population of the Southwest Dallas area was Hispanic. The percentage of Hispanic in this area was 38%, 34% Caucasians, and 22% African American. The Southwest Dallas Area was considered one of the most economically disadvantaged communities in the U.S (U.S Census Bureau, 2010).

Sample

To determine the sample size, the effect sizes in similar studies were reviewed and the decision was made to use the effect of malnutrition of patients with PU. Suttipong and Sindhu (2012) identified malnutrition as a risk factor for PU. The odds ratio (OR) in their study findings was 2.4. In another study, malnutrition was identified as a risk factor for PU; the OR was 2.29 (Iizaka, Okuwa, Sugama, & Sanada, 2010). Vliegen (2004) focused on the importance of early recognition of a depleted nutritional status and provision of adequate supervised intake of energy and protein. Patients admitted from the community with an existing pressure ulcer were more likely admitted with signs of dehydration and malnutrition, according to the Agency for Healthcare, Research, and Quality (2008). Based on this information, a medium effect size was used for the calculation of the sample size. The estimated sample size using G Power software

(Erdfelder, Faul, and Buchner (1996) with a medium effect size was a minimum of 152 patients for each group.

The medical records department had software which allowed running reports including admission diagnoses and their corresponding ICD codes. The software allowed extracting records of patients with PU, including some variables of interest to the study. HAPU cases were identified from incident reports and totaled only 94 cases. All of them were included for the review. For CAPU cases, more than 2000 patients were in the list who met the inclusion criteria . Using a feature in Microsoft Excel (2010), 206 CAPU charts were randomly selected for inclusions in the sample.

Inclusion and Exclusion Criteria

The study sample included patients who were 18 years old and older discharged from January 1, 2012 to December 31, 2012. The CAPU cases were extracted using the International Classification of Diseases, Ninth Revision- Clinical Modification (ICD-9-CM). The Clinical Classification System (CCS) categorizes ICD-9-CM diagnoses into a manageable number of clinically meaningful categories. The CCS makes it easier to quickly understand patterns of diagnoses and procedures. The ICD-9-CM codes defining pressure ulcers include diagnosis codes in the following range: 707.00-707.9. For HAPU cases, the incident reports of all cases were included in the study.

Patients who had a primary or secondary admission diagnosis of PU (ICD code 707-707.9) were included in the CAPU group. Patients who developed PU during the hospitalization were included in the HAPU group. Patients whose charts contained incomplete PU documentation or lacked the variables selected for the logistic regression

analysis were excluded. Patients who were admitted with PUs or developed PUs during the hospitalization that were not coded as ICD 707-707.9 were also excluded. The latter criterion excluded patients with ulcers that are coded as ICD 250.7 (diabetic ulcers) or ICD 459.81 (venous ulcers). The data were collected from the first admission, if repeated admissions occurred during the study period, to ensure that the sample included unique cases with no duplication.

Data Collection Procedure

Data were collected from the patient's electronic medical records (EMR) which were saved in software known as Meditech. Data in the Meditech software included admission assessment, shift assessment, nurses' notes, diagnostic procedures, the total Braden scale score, and Braden scale subscores. The Meditech software did not include the physician's orders and the progress notes written by physicians and other health care providers. The physicians' orders and progress notes were available in the patients' paper chart which had been scanned and saved electronically following discharge.

The researcher received special training from the manager of the medical records on how to view the data from the scanned charts and in Meditech. The goal of the training was to accurately and effectively extract the data. The researcher hired three data collectors to collect data. All data collectors were RNs working in one of the hospitals where the study was conducted. Two of the nurses were serving as committee members of a wound care council. The goal of the council was to improve wound care and decrease the incidence of PU in the hospital. All three data collectors sought the research experience because participation in research was one of the criteria for promotion on the

clinical ladder. The RNs were given an orientation which included an overview of the study and Meditech training regarding how to access the charts of discharged patients. In addition, they received online human subjects' protection training offered by the National Institutes of Health (NIH).

To supplement and validate the data found through the electronic retrieval, the researcher and data collectors reviewed the electronic charts (scanned paper charts). The chart review included the progress notes, physician orders, patient's admission history, wound care consult if available, and admission report. To ensure the accuracy of data, the researcher collected data from at least two charts and completed the data collection form for these two patients with each data collector. The variables were collected for each patient on a separate paper form designed for the study. The researcher or data collectors recorded the data that were related to the research questions from the medical records of patients on the forms.

All paper forms were kept in a locked private office in the hospital. The data in the forms were entered in a Microsoft Excel (2010) spreadsheet. From the spread sheet, data were transferred into the SPSS version 20 (SPSS IBM, New York, U.S.A) for analysis.

Operational Definitions of the Variables

The National Database of Nursing Quality Indicators (NDNQI, 2013) definitions of CAPU and HAPU were utilized as operational definitions. CAPU was defined as pressure ulcers present on admission to the facility as documented on admission assessment and HAPU as pressure ulcers that develop while the patient in the facility.

Table 3-1 displays the operational definition for each variable included in this study. The hospital’s policy was to record the Braden score every shift. For the purpose of the study, the Braden scores upon admission were recorded and included in the logistic regression model. For the nutritional status variable, the nutritional score in the Braden scale was used. For the albumen variable, the patient’s albumin level as reported by the laboratory was collected.

Table 3-1 Operational Definitions of Independent Variables Organized by Systems

System	Level of measurement	Coding / Operational definitions of the variables	Source
Personal			
Age	Ratio	Age in years upon admission	Meditech
Gender	Nominal	Male = 1 Female = 2	Meditech
Race	Nominal	Caucasian = 1 African American = 2 Hispanic = 3	Meditech
PU Site	Nominal	Elbow = 1 Back = 2 Heel = 3 Hip = 4	Meditech
Medical diagnosis (ICD code)	Nominal	Primary and Secondary Medical diagnoses derived from ICD codes and categorized according to body systems.	Meditech
Prealbumin / Albumin levels	Ratio	Value in mg/dl	Meditech – lab section

Table 3-1 - continued

System	Level of measurement	Coding / Operational definitions of the variables	Source
BMI	Ratio	<18.50 underweight 18.50 - 24.99 normal ≥25.00 obese	Meditech / admission assessment or first recorded in Meditech
Interpersonal system			
Interventions provided, turning, special equipment.	Nominal	Specialty bed = 1 Standard bed = 2	Meditech and Progress notes
Braden total score	Ordinal	Mild Risk: Total Score 15-18 = 1 Moderate Risk: Total Score 13-14 = 2 High Risk: Total Score 10-12 = 3 Very High Risk: Total Score 9 or less = 4	Meditech – Admission assessment
Braden item sub scores	Ordinal	Nutrition 1-4 Moisture 1-4 Sensory 1-4 Friction and Shear 1-3 Activity 1-4 Mobility 1-4	Meditech – Admission assessment
Social system			
Type of insurance	Nominal	Medicare = 1 Private = 2 Not insured = 3	Meditech
Length of stay	Ratio	Measured in days upon admission to the designated unit.	Meditech
Source of admission	Nominal	Emergency = 1 Non-Emergency = 2	Meditech
Time of admission / weekend or week day	Nominal	Week day = 1 Weekend (Saturday, Sunday) = 2	Meditech

Statistical Analysis

The following statistical procedures were used to address the research questions.

Research Question # 1

What are the characteristics of patients with community acquired pressure ulcer and patients with hospital acquired pressure ulcer?

Categorical variables were described as frequencies and percentages. Pearson Chi square analyses were computed for the categorical variables of gender, ethnicity, PU site, bed type, insurance, and admission type for CAPU and HAPU patients. Descriptive statistics for the continuous variables included the mean and standard deviation for serum albumin level, body mass index, length of stay, and age. The Mann-Whitney U was computed for the continuous dependent variables because the Shapiro-Wilk normality test was found to be statistically significant, indicating violation of the parametric assumptions of normality. The findings were summarized for each group and for the entire sample in tables. The results for research question 1 are presented according to King's (1991) model, categorized as the personal system, the interpersonal system, or the social system. The statistical significance was set at $\alpha < .05$.

Research Question # 2

What are the other admission medical diagnoses of adult patients with CAPU and HAPU?

Medical diagnoses other than PU were included in the data collection tool. The Frequency and percentage of each primary admission medical diagnosis were reported for each group and for the entire sample.

Research Question # 3

What are the patient characteristics are associated with an increased likelihood of developing a HAPU as compared to developing a CAPU?

A Mann-Whitney U test was computed for the total Braden score and for each Braden sub-scale because Shapiro–Wilk test was found to be significant indicating a violation of the parametric assumptions. Logistic regression was performed to identify which characteristics increased the likelihood of developing a CAPU as compared to developing a HAPU. Logistic regression, unlike discriminant function analysis, does not assume linearity of predictor variables (Agresti, 1996; Spicer, 2004). The dependent variable for logistic regression was group (CAPU or HAPU), with CAPU coded as “0” and HAPU coded as “1”. The predictor variables for logistic regression were the Braden scales and the three statistically significant demographics, weight, BMI, and length of Stay. The statistical significance level was set at $\alpha < .05$.

Human Subjects Protection

The medical records of patients admitted with a PU diagnosis or patients who developed a PU in the hospital were reviewed. Each patient’s name and the medical record number were removed when the data were recorded on the designed form. The researcher assigned a unique study identifying number and linked this number to the

patient's identifiers in a file saved to a desktop computer. The desktop computer was protected by a password and kept in a locked office within the hospital premises. The saved documents were protected by a password as well. The researcher obtained approvals from the Institutional Review Boards (IRBs) of the University of Texas at Arlington and the hospitals in which the study was performed. The researcher and data collectors received an online human subject protection training offered by the National Institute of Health (NIH) to fulfill the requirements of the UTA's IRB approval and the two hospitals.

Risks and Benefits of the Study

No physical, psychological, or social harm to the subjects in the study was anticipated. The greatest risk was loss of confidentiality and unauthorized release of individually-identifiable health information. This was minimized by separating the collected data from the medical record number and having the link between the data and the medical recorded number saved in a separate electronic file. Because of the minimal risks, a waiver of informed consent was approved by the IRBs.

The benefits of the study were that healthcare providers may use to the findings to identify the specific patient characteristics for patients with CAPU and HAPU. Describing the characteristics of patients in each PU category may help healthcare providers individualize the PU care and implement the proper prevention measures. Because the study utilized the retrospective chart review method for data collection, patients did not receive direct benefits from the findings.

Applying the King's (1991) model as a framework added to the nursing knowledge regarding the usefulness of the model in clinical practice. The application of the model as a framework for the study may encourage future nursing researchers to use nursing models as a framework in clinical research. The results of the study will be disseminated by publishing the findings in a nursing journal specializing in wound care. The results will also be communicated to the clinicians and the administrators in the facilities where the study was conducted.

Threats to Validity of the Findings

The retrospective use of previously collected data increased the risk for inconsistent, inaccurate, or missing information. Another threat to the validity of the findings was the inability of the investigator to identify the origin of the PU of patients with CAPU. Some patients who had CAPU may initially have developed the PU in an acute health care facility during a previous hospitalization. For the purpose of the study, patients admitted with a PU were categorized as CAPU. Another threat was that not all PU cases were assessed by specialized wound care nurses. Nurses without special training may have documented ulcers not related to pressure as PU. To minimize these threats, the researcher and data collectors reviewed patient's chart including the progress notes documented by the physician or other health care team members whenever necessary. Table 3-2 provides a summary of the limitations related to data collection and the actions taken to promote accuracy of the data.

Table 3-2 Summary of threats to validity and actions taken to minimize them

Problem	Solution
Inconsistent or missing data from the database	Reviewed the progress notes in the chart. Reviewed nurses notes Reviewed past medical history
Origin of PU for CAPU	Considered a CAPU if present on admission.
PU documented by non-wound care nurses.	Reviewed the progress notes written by the wound care consult if present. Reviewed wound assessment documented on Meditech written by all nurses assigned to the patient. If inconsistencies were present in charting, the patient was excluded from the study.

Delimitations

The study was delimited to patients admitted into hospitals that were selected for the study in the North Texas area. The sample was comprised of patients who were 18 years old and above who were discharged in a one-year period with PU or developed PU in the hospital. Diagnoses of CAPU or HAPU were confined to the ICD 9 codes of 707.0–707.9.

Summary

Data to describe the characteristics of patients with CAPU and HAPU were collected. Better understanding of patient characteristics for each type of PU may prompt health care providers to provide early interventions. Early interventions may reduce the overall incidence of PU. Despite the shortcomings of the descriptive correlational design utilizing the retrospective chart review, it was considered a feasible and appropriate design.

Chapter 4

Results

The purpose of the study was to describe patients' characteristics associated with CAPU and HAPU. Data were collected from the electronic medical records of patients discharged from two hospitals from January 1, 2012 to December 31, 2012. The records of CAPU cases were randomly selected from the list of patients who had a CAPU upon admission ($n = 206$). All patients with a HAPU who met the inclusion criteria were included in the study ($n = 94$).

This chapter begins with a description of the sample. The results from null hypotheses testing follow, including the differences between CAPU and HAPU in total Braden scores and in Braden component scores. Results from logistic regression are then presented. This chapter ends with a summary of major findings.

Research Question 1

What are the characteristics of patients with CAPU and patients with HAPU?

This section describes the characteristics of patients with CAPU and HAPU. The variables include gender, age, ethnicity, PU site, and albumin, weight, BMI, insurance, length of stay, type of bed, type of admission, and admission day. The results are organized by the systems in King's framework.

Personal System Factors

No statistical significant difference existed between groups in terms of gender (Table 4-1). HAPU patients were significantly older than CAPU patients, a difference of 2.8 years (Table 4-1). Race/ethnic groups included African Americans, Caucasians,

Hispanics, Asians, Native Americans and others. Race/ethnicity did not significantly differ for CAPU and HAPU groups (Table 4-1). Because Pearson's Chi Square assumes an expected minimum of five cases per cell, and because there were very few Asians, Native Americans, and others, the analysis was replicated using only data for African Americans, Caucasians, and Hispanics. The result confirmed no significant differences between groups in race/ethnicity, $\chi^2 (2, N=290) = 0.80; p = .68$.

PU sites were categorized as back, heel, or hip. One HAPU was located on the elbow. Pressure ulcer sites were contrasted by group to determine whether to include pressure ulcer site in the logistic regression analysis. PU site differences were not significant by Pearson's Chi Square analysis. The back was the most common site of PUs, as shown in Table 4-1.

Table 4-1 Categorical Characteristics by CAPU and HAPU

Characteristic	Statistic	HAPU	CAPU	Total	Difference
Gender	Male	46 (49%)	91 (44%)	137 (46%)	$\chi^2 (1) = 0.59;$ $p = .44$
	Female	48 (51%)	115 (56%)	163 (54%)	
Race/ Ethnicity	African Americans	50 (53%)	115 (56%)	165 (55%)	$\chi^2 (5) = 1.25;$ $p = .94$
	Asians	2 (2%)	4 (2%)	6 (2%)	
	Caucasians	33 (35%)	72 (35%)	105 (35%)	
	Hispanics	8 (9%)	12 (6%)	20 (7%)	
	Native Americans	0 (1%)	1 (1%)	1 (1%)	
	Others	1 (1%)	2 (1%)	3 (1%)	
Site	Back	70 (75%)	164 (80%)	234 (78%)	$\chi^2 (2) = 0.78;$ $p = .68$
	Heel	18 (19%)	34 (17%)	52 (17%)	
	Hip	5 (5%)	8 (4%)	13 (4%)	
Bed Type	Low Air loss	7 (7%)	25 (12%)	32 (11%)	$\chi^2 (1) = 1.49;$ $p = .22$

Table 4-1 – continued

Characteristic	Statistic	HAPU	CAPU	Total	Difference
	Standard	87 (93%)	181 (88%)	268 (89%)	
Admission Type	Not Emergency	12 (13%)	42 (20%)	54 (18%)	$\chi^2 (1) = 2.54;$ $p = .11$
	Emergency	82 (87%)	164 (80%)	246 (82%)	
Weekend Admission	No	73 (78%)	145 (70%)	218 (73%)	$\chi^2 (1) = 1.72;$ $p = .19$
	Yes	21 (22%)	61 (30%)	82 (27%)	
Insurance	Medicare	83 (88%)	186 (90%)	269 (90%)	$\chi^2 (2) = 0.48;$ $p = .79$
	None	2 (2%)	5 (2%)	7 (2%)	
	Private	9 (10%)	15 (7%)	24 (8%)	

Albumin levels were significantly lower in patients with CAPU than those with HAPU (Table 4-2) were. Both weight and BMI were significantly lower in CAPU patients than in HAPU patients, as shown in Table 4-2.

Table 4-2 Characteristics by CAPU and HAPU

Characteristic	HAPU	CAPU	Total	Difference
Age (years)	70.4 (13.8)	73.2 (16.6)	72.3 (15.8)	$z = 2.2, p = .03$
Albumin (mg/dl)	2.9 (0.6)	2.7 (0.6)	2.8 (0.6)	$z = 2.7, p = .01$
Weight (kg)	84.2 (29.5)	75.1 (23.5)	77.9 (25.8)	$z = 2.5, p = .02$
BMI	28.5 (8.9)	26.1 (8.1)	26.9 (8.4)	$z = 2.4, p = .02$
Length of Stay (days)	22.3 (16.2)	8.7 (6.7)	13.2 (12.5)	$z = 8.4, p < .001$

Interpersonal System Factors

Most patients were placed on a standard bed (Table 4-1), and there was no significance between the groups on type of bed.

Social System Factor

Most participants in both CAPU and HAPU groups admitted from the emergency room. Emergency room admission was not significantly different for CAPU and HAPU patients (Table 4-1). Most participants admitted on a non-weekend day for both CAPU and HAPU patients and the groups were not significantly different. Most patients in CAPU and HAPU groups were insured by Medicare (Table 4-1). The average length of stay for HAPU patients was three times longer than for CAPU patients, which was statistically significant difference (Table 4-2).

Summary of Research Question 1

CAPU and HAPU groups were similar on the patient characteristics of gender, ethnicity, PU site, insurance, type of bed, type of admission, and weekend admission. Albumin, weight, BMI, and length of stay were higher in the HAPU group than in the CAPU group. CAPU patients averaged three years older than HAPU patients did. HAPU patients had longer lengths of hospital stay than CAPU.

Research Question 2

What are the other medical diagnoses of adult patients with CAPU and HAPU?

The most common medical diagnoses for CAPU were sepsis, followed by malnutrition and acute renal failure. The most common medical diagnoses for HAPU were respiratory problems, followed by sepsis, congestive heart failure, and trauma (Table 4-3).

Table 4-3 Medical Diagnosis at Admission by CAPU and HAPU

Diagnosis	CAPU		HAPU		Total	
	Count	%	Count	%	Count	%
Anemia	1	0.50%	0	0.00%	1	0.30%
ARF	27	13.10%	7	7.40%	34	11.30%
Bleeding	3	1.50%	0	0.00%	3	1.00%
Cancer	3	1.50%	1	1.10%	4	1.30%
Cardiac	2	1.00%	0	0.00%	2	0.70%
CHF	17	8.30%	12	12.80%	29	9.70%
CRF	7	3.40%	8	8.50%	15	5.00%
DM	7	3.40%	0	0.00%	7	2.30%
Infection	3	1.50%	1	1.10%	4	1.30%
Liver Disease	10	4.90%	9	9.60%	19	6.30%
Malnutrition	29	14.10%	7	7.40%	36	12.00%
Drug Toxicity	0	0.00%	1	1.10%	1	0.30%
Neurological problems	13	6.30%	4	4.30%	17	5.70%
Pressure Ulcer	2	1.00%	0	0.00%	2	0.70%
Respiratory	6	2.90%	17	18.10%	23	7.70%
Sepsis	65	31.60%	12	12.80%	77	25.70%
Trauma	6	2.90%	10	10.60%	16	5.30%
Vascular	5	2.40%	5	5.30%	10	3.30%
Total	206	100%	94	100%	300	100%

Note: ARF = Acute Renal Failure; CHF = Congestive Heart Failure; CRF = Chronic Renal Failure; DM = Diabetes Mellitus

Research Question 3

What are the patient characteristics associated with an increased likelihood of developing a CAPU as compared to developing a HAPU?

The Braden scale is a risk assessment tool that identifies patient's risk of PU development, for patients with and without PU. The Braden total score is composed of

six components: moisture, nutrition, activity, friction, sensory, and mobility. For this study, the Shapiro-Wilk test for the total Braden score and each Braden component (moisture, nutrition, activity, friction, sensory, and mobility) were significant ($p < .05$). Therefore, the parametric assumption of normality was violated and the hypotheses of differences in CAPU and HAPU for Total Braden score and for each Braden component were tested by the Mann-Whitney test. The statistical level of significance of α was set at $<.05$.

Total Braden Score

The total Braden score was significantly lower in CAPU than in HAPU patients. Table 4-4 shows the total Braden scores for patients in each group.

Table 4-4 Braden Score Descriptives by Group

Group	Statistic	Braden	Moist	Activity	Nutrition	Friction	Sensory	Mobility
CAPU(n=206)	<i>Mean(S.D)</i>	12.8(3.1)	3.1(0.8)	1.3(0.7)	2.3(0.8)	1.5(0.6)	2.6(0.9)	2(0.8)
HAPU(n=94)	<i>Mean(S.D)</i>	15.6(3.2)	3.5(0.6)	1.6(0.9)	2.7(0.8)	2.2(0.7)	3.1(0.9)	2.5(0.8)
	<i>Z value</i>	6.7	4.7	3.6	3.6	7.3	4.4	5.1
	<i>p-value</i>	<.001	<.001	<.001	<.001	<.001	<.001	<.001

Braden Subscale Scores

All Braden item subscale scores of moisture, activity, nutrition, friction, sensory and mobility were significantly lower in CAPU than in HAPU patients. The interpretation of these results indicated that CAPU patients were at higher risk for PU

development than HAPU patients were according to the Braden scores. The results are displayed in Table 4-4 and in Figure 2.

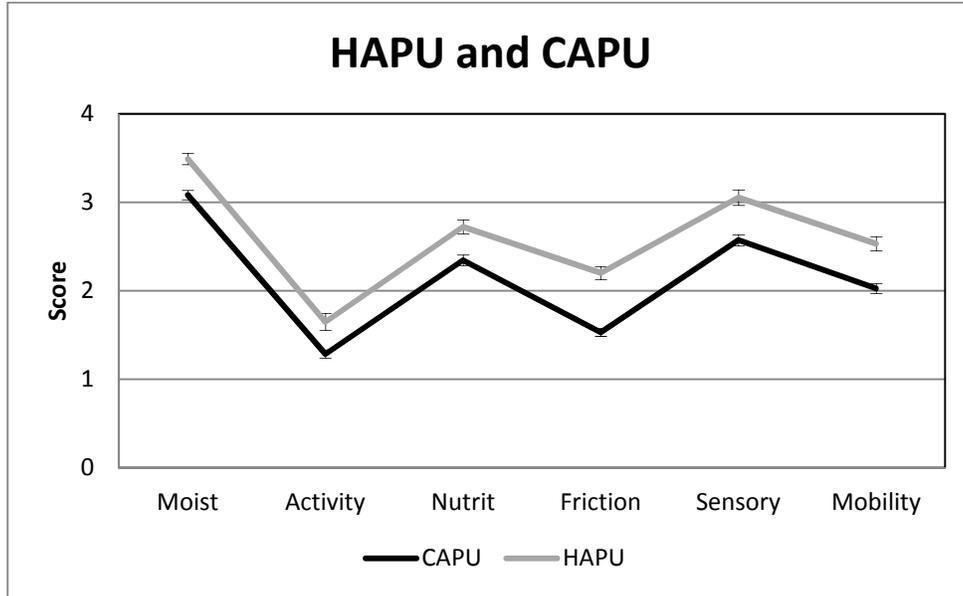


Figure 2. Braden subscale score by group.

Summary of Braden Scale

The total Braden scores were significantly lower for CAPU than for HAPU patients. CAPU scores for the Braden components of moisture, activity, nutrition, friction, sensory, and mobility were significantly lower than HAPU.

Hypotheses Testing Logistic Regression

Logistic regression was conducted to determine whether specific Braden scores and demographic variables were more likely to be associated with CAPU over HAPU. The outcome variable was group (CAPU or HAPU), and the predictor variables included the Braden scores and the demographics that were identified as statistically significant

between groups (i.e., albumin, weight, BMI, and length of stay). CAPU was coded as “0” and HAPU was coded as “1” for regression analyses.

Two logistic regression analyses were conducted. The first logistic regression used the total Braden score as a predictor, along with albumin, weight, BMI, and length of stay. A second logistic regression used the Braden components, as predictors, along with albumin, weight, BMI, and length of stay. These steps avoided the multicollinearity that would occur if both the total Braden and components of the Braden were included together.

The first logistic regression revealed that the model including total Braden, albumin, weight, BMI, and length of stay was statistically significant (Nagelkerke $R^2 = .48, p < .001$). The odds ratio (OR) for the Braden total score of 1.27 in Table 4-5 indicated that, for every unit increase in the total Braden score, a patient was 27% more likely to be in HAPU group ($p < .001$). Each additional length of stay day was associated with a 13% greater risk of being HAPU ($OR = 1.13$). No other predictors were statistically significant.

Table 4-5 Regression Coefficients for Braden Total Score and Demographics

<i>Predictor</i>	<i>p-value</i>	<i>OR</i>	<i>OR Lower 95% CI</i>	<i>OR Upper 95% CI</i>
Braden	<.001	1.27	1.15	1.41
Age	.15	1.02	.99	1.04
Albumin	.25	1.42	.79	2.55
Weight	.59	1.01	.98	1.03
BMI	.74	1.01	.94	1.09
Length of Stay	<.001	1.13	1.09	1.18
Constant	<.001	.001		

The second logistic regression revealed that the combination of Braden components (moisture, nutrition, activity, friction, sensory, and mobility), along with albumin, weight, BMI, and length of stay was statistically significant (Nagelkerke $R^2 = .51, p < .001$).

Table 4-6 Regression Coefficients for Braden Components and Demographics

Predictor	<i>p-value</i>	<i>OR</i>	<i>OR Lower 95% CI</i>	<i>OR Upper 95% CI</i>
Moist	.29	1.35	.77	2.37
Activity	.19	.71	.43	1.18
Nutrit	.34	1.25	.79	1.98
Friction	.002	2.44	1.39	4.27
Sensory	.68	1.10	.69	1.75
Mobility	.14	1.54	.87	2.74
Age	.32	1.01	.99	1.04
Albumin	.37	1.31	.72	2.39
Weight	.46	1.01	.98	1.03
BMI	.77	1.01	.94	1.09
Length of Stay	<.001	1.13	1.09	1.18
Constant	<.001	.0003		

Table 4-6 shows that the OR for the Braden friction subscore was 2.44, indicating that each unit (scaled from 1 to 3) increase in Braden friction sub-score was associated with a 2.44 times greater risk of having a HAPU ($p < .001$). Each day increase in length of stay was associated with a 13% greater risk of being HAPU ($OR = 1.13$) ($p < .001$). No other predictors were statistically significant.

Summary

Patients in both groups were similar in demographic characteristics except for age. CAPU patients were in poorer nutritional condition and had lower score in friction and shear. The logistic regression results demonstrated that higher total Braden scores were associated with HAPU. Furthermore, among the Braden components, only higher Braden friction scale scores were associated with HAPU when controlling for demographics and other Braden components. Greater length of stay was associated with HAPU. These findings indicated that longer lengths of stay, Total Braden scores, and Braden friction scores were more likely to be associated with HAPU.

Chapter 5

Discussion

Introduction

This study was designed to identify patient characteristics of CAPU and HAPU. In this chapter, The results of the study are summarized and compared with the current literature. In addition, the chapter also presents the implications of the findings in nursing practice and education and identifies gaps in nursing literature.

King's open system model, the framework for the study, categorizes the patient characteristics; demographic factors in the personal system, the patient's pressure ulcer assessment in the interpersonal system, and characteristics related to the available social resources via type of insurance and type of admission in the social system.

Discussion of Results

The discussion is organized using the study's framework. Because demographics were explored in the analyses for the research question, the comparison of this sample's demographic characteristics to the demographic characteristics reported in other studies will not occur in a separate section

Research Question 1

What are the characteristics of patients with CAPU and patients with HAPU?

Personal System Factors

Gender

No statistical difference appeared between the two groups in terms of gender. Almost half of the total sample was male. The groups had a similar proportion of men and women. The results related to gender were consistent with the findings from other studies (Fogerty et al., 2008; Saladin & Krause, 2009).

Age

The findings of the study indicated that PU was a problem for older patients. The mean age of groups was 73 years for CAPU and 70 years for HAPU, higher than the age of the sample in some studies. In two studies, the average age of patients with PU was 65 years of age (Russo et al., 2006; VanGilder, MacFarlane, & Meyer, 2012). The sample in the study conducted by Sookyung et al. (2013) was an average of 57.5 years old. The findings in this study were consistent with findings from the Theisen et al., (2012) study, in which the mean age of the subjects was 83 years old.

Race/Ethnicity

Most participants in the study were African American (55%) or Caucasian (35%). In the study's geographic area, African Americans represented 23.4% of the population, Caucasians represented 29%, and Hispanics represented 44%. (Office of Economic Development, 2014). Based on the area's demographic structure, Hispanics were underrepresented in the sample of the present study (only 7%). The reason for this difference is not clear, but may be related to cultural differences in the care of older adults. The role of race/ethnicity in PU remains controversial (Aday, 2001; Anthony et al., 2002; Saladin & Krause, 2009). Fogerty et al. (2008) found that African American patients were at higher risk for PU than Caucasian patients. In an older study, however,

Bergstrom and Braden (1996) found that Caucasian patients were at higher risk for PU than African American patients. Further studies are needed to clarify the effect of race/ethnicity on PU.

Nutrition

Patients with CAPU were in poorer nutritional condition with lower nutrition scores than HAPU patients. The lower the score, the more severely the patient is malnourished. Researchers have reported causal links between wound healing and poor nutritional intake (Wojcik, Atkins, & Mager, 2011). Patients need not only proteins, calories, and zinc, but vitamins A, E, and C are essential nutrients as well (Crowe & Brockbank, 2009). Patients with existing pressure ulcers were more likely to have poorer nutritional status. Despite nutritional management in hospitals, malnourished patients with existing pressure ulcers require a longer time, beyond the expected length of stay, to regain their nutritional balance. Similar to the study findings, Wann-Hansson et al. (2008) found the nutrition score in CAPU patients was lower than the nutritional score in HAPU patients.

Albumin

Several studies in the extant literature have reported the significance of low albumin level as a contributing factor for PU (Crowe & Brockbank, 2009; EPUAP, 2009). The albumin levels were low in both groups. Albumin level in patients with CAPU was 2.7 and 2.9 for HAPU patients. The normal albumin level is 3.4 g/dl to 5.4 g/dl (National Institutes of Health, 2014). The NPUAP (2009) recommended albumin as a nutritional indicator for nutritional assessment. Due to albumin's long half-life, low

albumin levels indicate that patients have been malnourished for a long time. An albumin level less than 3 mg/dl has been identified as a contributing factor of PU (Jenkins & O'Neal, 2010). The finding in the study that patients with CAPU have lower albumin levels was similar to the findings in a multicenter study that identified the risk factors for PU of patients in nursing homes (Horn et al., 2002).

BMI

The average BMI for patients with CAPU was 26.1 and for patients with HAPU 28.5. The patients with CAPU had a lower BMI than patients with HAPU. The BMI value means that CAPU patients were categorized as overweight according to the Centers for Disease Control (CDC, 2014). Although CAPU and HAPU cases were categorized as overweight, some were malnourished. Poor nutrition was reported more among CAPU patients with 14.7% admitted with a malnutrition diagnosis, double the percentage of HAPU patients with a diagnosis of malnutrition (7%).

These results were similar to the findings of another study in which the average BMI of patients with HAPU was 29.5 (Tescher et al., 2012). The association between BMI and the incidence of PU is controversial. Although moderate obesity provides a protective effect and reduces the incidence of PU, morbidly obese patients were at high risk for PU development (Drake et al., 2010). Defloor and Grypdonck (2005) found that patients with obesity were at lower risk for PU development; however, if obese patients did develop PU, the stage of the ulcer was advanced. They suggested that the severity of PU among obese patients depended on the presence of shearing and friction forces that were higher in those patients. In another study in which obesity and overweight were

associated with poor PU healing, the causative mechanism was explained as being poor vascularization (Thompson & Fuhrman, 2005).

Sensory Perception

In this study, the mean sensory score for patients with HAPU was above 3, indicating slight limitation in sensory perception. In patients with CAPU, the mean score was lower than 3, indicating more sensory impairment. In contrast, Wann-Hansson et al. (2008) found no statistical difference in sensory sub-scores between CAPU and HAPU patients. A possible explanation of this finding was that the percentage of patients with diabetes and neurological diseases may have been higher in the CAPU group than the HAPU group. Sensory impairment may be due either to nerve damage in case of stroke and diabetes or to pain medications that may alter sensation (Baumgarten et al., 2008). Another possible explanation was that nurses subjectively recorded the sensory score. In a study, the reliability of Braden scores was examined. It was found that sensory measurement has the lowest reliability among all Braden sub-scores (Baratz et al., 2012). In contrast, Brunet and Kurcgant (2012) found the strong agreement in sub-scores of sensory perception, indicating high inter-rater reliability in the clinical evaluation of patients.

Moisture

Moisture scores were significantly lower (worse) in CAPU than in HAPU patients. Moisture as a risk factor is due either to fecal or urinary incontinence or to

sweating. In both cases, the back is more likely to retain moisture than the other bony prominences at risk for PU (Sae-Sia et al., 2005). The lower the moisture score in the Braden scale, the higher the risk for PU (Bergstrom & Braden, 1992). The findings were consistent with the theorized relationship of moisture to the incidence of PU, in which moisture increases the friction and shearing forces and damages the skin (NPUAP, 2009). Urine and stool increase the moisture present, contain lytic enzymes that damage the skin, and promote skin breakdown by altering acidity (Beldon, 2008). Sweating is another form of moisture that increases the risk of PU. Sacral and coccygeal areas retain moisture more than the other areas, thus increasing friction and shearing forces (Sae-Sia et al., 2005). In this study, although patients with CAPU were scored lower in moisture level than patients with HAPU, both patient groups were categorized as occasionally moist according to the scale. The results differ from the findings of Wann-Hansson et al. (2008) who found no statistical difference in moisture scores between CAPU and HAPU patients. The moisture score in patients with HAPU was consistent with the current literature (Baratz, Amãilia, Gabriela, & Fiore, 2012).

Activity

Patients with CAPU scored lower in activity than the HAPU group. Both groups were at high risk for PU because activity scores averaged lower than 2 on the 1-to-4 scale. NPUAP (2009) considered individuals who are bed-fast (score 1) or chair-fast (score 2) to be at higher risk of PU development. The results were inconsistent with the results of a study by Baratz et al. (2012), who found that 83% of patients with HAPU scored one in the activity category. In another study, researchers compared the risk

factors for CAPU and HAPU, wherein HAPU patients scored statistically significant lower activity sub-scores, (Wann-Hansson et al., 2008).

Mobility

The average mobility item sub-score for the CAPU group was 2, indicating the CAPU patients had very limited mobility. For HAPU patients, the score was higher and the mobility status was better than for the CAPU group. The results in the study were inconsistent from other studies in that 84% of patients with HAPU scored 1 on the mobility item sub-score indicating complete immobility (Baratz et al., 2012; Wann-Hansson et al., 2008).

PU Site

The sacral and coccygeal areas were the most common sites for PU in both HAPU and CAPU patients. In the study, 78% of PU sites were in the coccygeal and sacral areas. The finding was consistent with the findings from previous studies. The overall percentage of sacral PUs was found to be 73.1% in acute and chronic healthcare settings in the United States (Moro, Maurici, Do Valle, Zacliffevis, & Kleinubing, 2007). In a classic survey conducted by Amlung, Miller, and Bosley (1999), the most common site affected by PUs was the sacrum at 37% of the total PUs. These results were consistent with data from the NPUAP (2007).

Interpersonal System Factors

Type of Bed

Choice of bed type was categorized as part of King's interpersonal system (1991), because the nurse or other healthcare provider interacted with the patient and made a

decision about the appropriate bed. Most participants (89%) were placed on a standard bed, including 93% of HAPU patients and 88% of CAPU patients. In the current study, no adequate documentation was found regarding the type of mattress that was used. Possibly, nurses do not document the use of support mattresses if mattresses are placed on top of the mattress of a standard bed. Unlike support mattresses, specialty beds used for PU are motorized and are expensive (Rich et al., 2011).

The NPUAP (2009) recommended the use of pressure reducing mattresses for all patients at risk for PU regardless to the type of bed used. The positive effect of pressure reducing mattresses on decreasing the risk of PU has been reported in the literature (Agam & Gefen, 2007; Peterson et al., 2008).

Friction

CAPU patients were scored as having greater friction (lower score) at admission than patients with HAPU were. Friction *per se* is not a significant factor for PU development and was eliminated from the NPUAP wording of the definition of PU; however, friction can be a contributing factor and increases the shearing forces. Shearing forces are a significant factor in PU development and still in the current definition of PU (NPUAP, 2009). Shearing forces may decrease blood flow to high-risk areas and cause an advanced stage of PU (Defloor & Grypdonck, 2005).

The results of the study were inconsistent with the current literature. Wann-Hansson et al. (2008) found no difference in the friction score between CAPU and HAPU patients. In theory, the heavier the patient, the more the negative effect of friction and shearing forces on PU (NPUAP, 2009). Shearing and friction increase the potential

incidence of PU, particularly for obese patients. In the present study, patients with CAPU were overweight and scored lower on friction, indicating more friction and shearing risk among patients with CAPU. Previous research indicated that patients with a friction and shearing score of 1 had 126 times the risk of having a PU as compared to patients with score of 3 on that item subscale (Tescher et al., 2012).

Total Braden Score

Lower Braden scores indicate higher risk of developing a PU. Total Braden scores were lower (worse) for CAPU patients than for HAPU patients. CAPU patients averaged ~12.5, indicating moderate to high risk, while HAPU patients averaged ~15.5, indicating mild risk (Baratz et al., 2012; Braden, 1987; Brunet & Kurcgant 2012). This finding was expected given that at admission, the CAPU patients had a PU and HAPU did not. This finding was not consistent with the finding of Wann-Hansson et al. (2008), who found no significant difference between CAPU and HAPU patients on total Braden score who were admitted to an acute care hospital. It was unknown why the results were inconsistent between Wann-Hansson's study and the current one. One possible reason for the inconsistency may be differences in the settings where the studies were conducted.

A possible explanation for lower Total Braden score in CAPU patients is that the presence of PU upon admission may influence nurses to subjectively underscore these patients. Another explanation is that the low score reflects the actual risk condition of these patients as evidenced by having PU. The purpose of the Braden scale is to identify patients at risk for PU. However, if patients already have CAPU, there may be limited

clinical benefit of using the scale. Patients admitted with an existing PU should begin wound care management and treatment immediately (Baumgarten et al., 2008).

Social System Factors

The social system can have an influence on pressure ulcer prevention. King (1991) identified the concepts of organization, power, authority status, decision making, and control in the social system. The role of patients in the community and the level of social support are considered to be part of the social system, which would include insurance type, admission type, admission diagnosis, and length of hospital stay.

Insurance

Most patients in this study were insured by Medicare, 88% of HAPU and 90% of CAPU patients. This study finding was consistent with the finding of the AHRQ (2006) report. In the report, most patients were insured by Medicare (90%), including 88% of HAPU and 90% of CAPU. Patients with Medicare insurance may have higher risk for PU than patients with private insurance due to lack of money for out-of-pocket expenses, and lack of reimbursement for products (Jones & Fennie, 2011).

Admission Type

The vast majority of participants were admitted via the emergency department. CAPU and HAPU patients presented similar in rates of admission by the emergency room. Most participants were admitted from the emergency room, including 87% of HAPU and 80% of CAPU. Consequently, reducing the incidence of PU in the community may reduce the load in the emergency departments. Although patients with HAPU were admitted due to emergency conditions not related to PU, CAPU patients were admitted

via emergency department due to conditions related to existing PU. For example, 25% of total CAPU admissions were diagnosed with sepsis upon admission. It was known that PU is a leading cause of sepsis (Fogerty et al., 2008).

PU should be treated in wound care clinics following scheduled appointments, not via the emergency department. Excessive use of the emergency department by patients with CAPU is a possible implicit indicator of the lack of social support for these patients. Because the majority of the patients had Medicare, paying for care was not a reason for underuse of wound care clinics. Rather a lack of transportation, including not having someone to accompany or drive them to the hospital, may contribute to admission through the emergency department on an emergent basis. Patients admitted via the emergency department may stay on stretcher for long hours without turning. Lack of turning may increase the risk of PU prior to their admission to the designated unit (Baumgarten et al., 2008).

Weekend Admission

Patients with CAPU and HAPU had similar rates of weekend admission. Most participants (73%) were admitted on a weekday, not on a weekend, including 78% of HAPU patients and 70% of CAPU patients. Whether there was a relationship between the day of the week for admission and PU development is unknown. Very little is known regarding the association between weekend admission and the risk for PU. Patient's repositioning depends on the availability of nurses and the adequate staffing. The staffing level is reduced in weekends; reduced staffing levels increase the risk for PU (Baumgarten et al., 2008). In general, the complication rates were higher on weekend

admissions than non-weekend admissions. Complications associated with surgical procedures were higher on weekend than non-weekend admission (Bendavid et al., 2008).

Length of Stay

Length of hospital stay was considered part of the social system because many variables combine to determine a patient's length of stay, including insurance status and social support. The average length of stay of patients with HAPU was three times longer than the average length of stay for patients with CAPU. In logistic regression, the length of stay was associated with HAPU patients. Prolonged length of stay of patients with HAPU group was consistent with the findings from other studies that identified the risk factors of PU in acute health care setting; the length of stay has been identified as a risk factor (Bours, Laat, Halfens, & Lubbers, 2003; Lydar, Wang, & Metersky, 2012). Longer stays may be directly associated with HAPU development because continued bed rest may have contributed to the development of the PU. However the difference in length of stay between the groups may have been due to the severity of HAPU patients' illnesses or other factors not directly related to the development of the PU. Another possibility is that the treatment of the newly-developed PU extended their stay.

Research Question 2

What are the other medical diagnoses of adult patients with CAPU and HAPU?

Sepsis and malnutrition were the most frequent medical diagnoses for patients with CAPU. For HAPU patients, the most frequent medical diagnoses were respiratory problems and CHF, observations different from what Compton et al. (2008) had found

wherein circulatory impairment and sepsis showed associations with the occurrence of pressure ulcers. The high number of sepsis admission diagnoses for CAPU patients was consistent with previous studies (e.g., Fogerty et al., 2008). A possible reason for the high rate of sepsis diagnoses was that infected chronic wounds were more likely to cause sepsis (Fogerty et al., 2008). Sepsis is the 10th leading cause of death in the United States, and 200,000 patients die annually from sepsis (Wang, Devereaux, Yealy, Stafford, & Howard, 2010).

The percentage of malnutrition diagnoses upon admission for CAPU patients was double the percentage of malnutrition diagnosis for patients with HAPU. Patients with malnutrition may have been admitted with complications related to malnutrition, such as acute renal failure (ARF) due to dehydration. Acute dehydration increases the risk of kidney damage causing ARF. The percentage of ARF diagnoses for CAPU patients was (13%) and it was almost the same as the percentage admitted with malnutrition (14%) and doubled the percentage of ARF and malnutrition among the HAPU patients. Relationships among sepsis, dehydration, ARF, malnourishment, and PU development need further study. Analysis of case studies of patients with CAPU and HAPU over time may be a method of increasing healthcare providers' understanding of factors and medical diagnoses associated with PU.

Research Question 3

What are the patient characteristics associated with an increased likelihood of developing a CAPU as compared to developing a HAPU?

As variables, the total Braden score, friction, and length of stay were significantly associated with HAPU in logistic regression analyses. The Braden score represented multiple factors related to PU development that were assessed. Higher Braden scores for HAPU patients at admission and the fact that they later developed a PU supported the hospital policy of assessing PU risk and recording a Braden score each shift. Frequent assessment is congruent with the NPUAP's (2009) recommendations. As noted previously, scores on the Braden scale may be less valid for CAPU patients at admission because they already have a pressure ulcer.

Friction as a subscale of the Braden scale was of particular importance. The importance of friction was similar to findings from a prevalence study in which friction was found to be the most important predictor of CAPU (Lahmann, Tannen, Dassen, & Kottner, 2011). The extent of friction present is an important risk factor that characterizes the development of PU in the community and the hospital. Reasons for the differences in length of stay for the two groups were discussed earlier in the chapter.

Limitations

Because this study was conducted in two hospitals in one county in Texas, the findings of the present study may not be representative of what would be found in other hospitals in other locations. The hospitals were in a county with a population that was 24% Hispanic, but the sample was only 7% Hispanic. Future researchers will need to explore whether the smaller proportion of Hispanic patients with pressure ulcers reflected reality or was unique to this particular sample.

The present study was limited by decisions that were made about selecting the sample. The present study utilized an existing database, so, in the process of chart review, it was unclear where and when the PU of patients with CAPU had developed. Data from the hospitalization that resulted in the first discharge during 2012 were the only data included for each patient. Patients with CAPU may have had more than one admission in their history, making it unclear if the PU was initially developed during a previous hospitalization or if it was developed in the community. Some patients were transferred from other facilities and it was not known the length of stay in the facilities where they were previously. Hence, data collected may not have accurately reflected the actual length of stay if a previous hospitalization was included and, consequently, obscured the relationship between length of stay and development of PU. The present study was limited by the measures. The present study did not include body temperature or temperature of skin in contact with other surfaces. Temperature would be an important measure to include in future studies of PU because heat has been shown to increase the likelihood of developing a PU (Kokate et al., 1995; Sae-Sia et al., 2005). Furthermore, this study included only one measure of each construct. Inclusion of multiple measures of constructs would have provided convergent validity to the findings (Waltz, Strickland & Lenz, 2005, p.158).

Implications

The primary implication for nursing practice is that nurses should be alert to friction between the patients' skin and the bed surface. In this study, CAPU patients had lower (worse) friction scores. In particular, home health nurses and other nurses

providing care in long-term care facilities must be alert to this factor and decrease friction to minimize the likelihood of a patient developing a PU. Although the mean friction score was lower (worse) in CAPU patients than in HAPU patients, some HAPU patients had low friction scores, pointing to the need for nurses to seek methods for reducing friction in all patients with and at risk for PU. In particular, nurses should be advocates for their patients and promote the use of specialized beds that can reduce friction and decrease the risk of developing a PU (Jones & Finnie, 2011).

To reduce PU ulcers, the nursing community must fully appreciate the role of malnutrition on PU development and therefore foster nutrition in patients, regardless of the primary diagnosis. Patients with low nutrition scores should be referred to a dietitian for further assessment and nutrition supplement (Baranski & Ayello, 2008; Jones & Fennie, 2011)

Nurses should be aware that the most common PU sites were similar for CAPU and HAPU patients. For example, the sacral and coccygeal area accounted for most PU in both the CAPU and HAPU groups. Failure to assess these body areas may result in PU not being prevented nor identified in a timely way. The fact that HAPU patients had higher Braden scale scores at admission and still developed a PU supports the necessity of thorough assessment of all patients every shift.

The implications for nursing education are that all students need to understand the factors associated with different types of PU and measures taken to prevent their development. This content is typically covered in nursing textbooks (Potter, & Perry,

2013; Lewis, Dirksen, Heitkemper, Bucher, & Camera, 2011) or in wound care seminars offered by specialized wound care nurse during post clinical conferences.

Gaps in Literature and Areas for Future Research

The purpose of this study was to describe patients' characteristics associated with CAPU and HAPU utilizing the standardized Braden scale and demographic variables relevant to PU. Informed by the conceptual framework of King (1991), with factors associated with the development of PU categorized under the personal system, the interpersonal system, and the social system, the results of the study indicated that CAPU patients were in poorer physical condition when compared to HAPU patients at admission. This study represented the first systematic comparison of CAPU and HAPU, using these measures and, thereby, fills an important gap in the literature.

To build on the foundation of this study, the characteristics associated with PU to be studied using larger, more diverse samples, including multiple hospital types (private, public) across regions and strata of urban, rural, and socioeconomic status. This study was relatively inexpensive, costing little more than the time it took to get approval, collect the data, and run the analyses. Although chart reviews can take extensive amounts of time if the data are not digitized, the steps to replicate this retrospective study are clear, inexpensive, and could potentially be fruitful towards reducing PU risk in patients across setting. The pattern seen in the present findings may or may not replicate in other hospital settings, an important area for future research.

Predictive designs utilizing prospective chart review including all patients with and without PU admitted during a given time frame in multiple sites would allow for

explication of the risk factors for such designs can be designed to include multiple measures of constructs and standardization of measurements. Moreover, given the important role skin temperature plays in PU development, including skin temperature in future studies would strength their explanatory power. It is also important to explore the inter-rater reliability of nurses who are scoring PU risk factor measures for clinical purposes, such as the Braden scale. For example, malnutrition was a common diagnosis in both CAPU and HAPU, but the nutrition sub-scale of the Braden scale was assessed subjectively by nurses. Careful study is thus needed to examine the reliability of this subjective nutrition item in comparison to objective measures of nutrition, such as albumin level and BMI.

Many PU patients have a history of recurrent admissions to acute care hospitals (Alderden, Whitney, Taylor, & Zaratkiewics, 2011), and it is possible that some CAPU patients in the study actually developed their PU during a previous hospital stay. If HAPU was not fully healed during a previous hospitalization, patients may have been discharged with PU, which subsequently worsened in the community. This possibility highlights the importance of PU in providing quality nursing care. Thus, case study analysis may be useful in determining the origin and the course of PU over time. Furthermore, for HAPU cases, there is a possibility that some patients may have had a stage one PU prior to their admission to the hospital which was not documented upon admission. Although first documented in the hospital, these HAPU cases began in the community because of the patients' prolonged exposure to conditions that promote skin

breakdown. This exposure was adequate to damage the skin prior to their admission and the actual skin breakdown occurred after their admission.

PU on the back (sacral and coccygeal) is a particular concern for nurses and an important area for future research. These sites were the locations for 78% of all PU cases in this study. This finding was consistent with the findings of others (Amlung, Miller, & Bosley, 1999; NPUAP, 2007). The back area may have increased localized temperature risk (Kokate et al., 1995; Lachenbruch, 2005) and moisture risk (Lachenbruch, 2005; Sae-Sia et al., 2005). As moisture level, local temperature, and anatomical structure of the sacral and coccygeal areas increase the risk of PU in the back, therapeutic interventions specific to the sacral and coccygeal areas are needed. To date, no existing studies have examined the positive effect of cooling mattresses on the incidence of PU of patients who are normothermic, an important area for future research.

Although the present study was focused on factors that characterize differences between CAPU and HAPU, wound assessment is also important. The Pressure Sore Status Tool (PSST) (Bates, 1990) and the Pressure Ulcer Scale of Healing (PUSH) (Thomas et al., 1997) have been validated as PU assessment tools (Pillen et al., 2009). Since monitoring the healing process over time is of great importance, by using these tools, the results of interventions must be recorded and tracked over time. For instance, the size, color, and amount of exudates present in the wound can be used to assess the healing or worsening of PU (Pompeo, 2003; Thomas et al., 1997). To supplement the Braden scale of PU risk, future scholars can use the PSST and the PUSH to evaluate therapy or to document progress in patients with PU.

Summary

Pressure ulcers present challenges for the nursing community and identifying the characteristics of patients with CAPU and HAPU from a broader aspect may help reduce the incidence of PU. The findings of this study were that patients with CAPU and HAPU had similar demographic characteristics and were admitted through the ER on a weekday. However, differences existed. HAPU patients have higher BMI than CAPU patients. The most common primary diagnosis for CAPU patients was sepsis, followed by malnutrition, and acute renal failure, while most common primary diagnoses for HAPU were respiratory problems, followed by sepsis, congestive heart failure, and trauma. CAPU patients already had a PU at admission and were significantly worse than HAPU patients on the factors associated with PU, such moisture, activity, nutrition, friction, sensory, mobility, and total Braden score. Sites of PU were similar for CAPU and HAPU patients. A low friction score was significantly predictive of CAPU patients, and length of stay was longer for HAPU than for CAPU. Combined, these results identified differences between CAPU and HAPU and highlight the important challenges pressure ulcers present for the nursing community.

References

- Aday, L., A. (2002). *The health and health care needs of vulnerable populations in the United States* (2nd ed.). CA: Jossey-Bass.
- Aday, L. A., Begley, C. E., Lairson, D. R., & Slater, C. H. (1998). *Evaluating the health care system: Effectiveness, efficiency, and equity*. Chicago, IL: Health Administration Press.
- Agam, L., & Gefen, A. (2007). Pressure ulcers and deep tissue injury: A bioengineering perspective. *Journal of Wound Care*, 16(8), 336–342.
- Agency for Healthcare Quality and Research (2012). Preventing pressure ulcers in hospitals: A toolkit for improving quality of care. Retrieved January 26, 2013 from <http://www.ahrq.gov/research/ltc/pressureulcertoolkit/putool3.htm>.
- Agency for Healthcare Quality and Research (n.d). *Hospitalizations related to pressure ulcers among adults 18 years and older*. Retrieved January 13, 2013, from; <http://www.hcup-us.ahrq.gov/reports/statbriefs/sb64.jsp>
- Agency for Healthcare Quality and Research (2005). *National healthcare disparities report*. Retrieved November 6, 2012 from <http://www.ahrq.gov/qual/nhdr05/nhdr05.htm>.
- Agresti, A. (1996). *Introduction to categorical data analysis*. (2nd ed.). N.J John Wiley.
- Alderden, J., Whitney, J., Taylor, S., & Zaratkiewicz, S. (2011). Risk profile characteristics associated with outcomes of hospital-acquired pressure ulcers: A retrospective review. *Critical Care Nurse*, 31(4), 30-42.

- Amlung, S., Miller., & Bosle, M. (1999). National Pressure Ulcer Prevalence Survey: A benchmarking approach. *Advances in Skin and Wound Care*, 14(6), 297–301.
- Anthony, D., Johnson, M., Reynolds, T., & Russell, L. (2002). Ethnicity in pressure ulcer risk assessment, with specific relation to the Pakistani ethnic minority in Burton, *England Journal of Advanced Nursing*, 38(6), 592-7.
- Anthony, D., Parboteeah, S., Saleh. M. & Papanikolau, P. (2008). Norton, Waterlow and Braden scores: A review of the literature and comparison between the scores and clinical judgment. *Journal of Clinical Nursing*, 17 (5), 646-653.
- Baranski, S. & Ayello, E. (2008). *Wound care essentials. Practice principles* (2nd Ed.). PA. Lippincott Williams & Wilkins.
- Bates-Jensen, B. (1998). A quantitative analysis of wound characteristics as early predictors of healing in pressure sores. (Doctoral dissertation, University of California, Los Angeles, 1998). Proquest. Abstract retrieved April 14, 2009, from <http://proquest.umi.com>
- Baumgarten, M., Margolis, D., Localio, A., Kagan, S., Lowe, R., Konsian, B., & ... Mehari, T. (2008). Extrinsic risk factors for pressure ulcers early in the hospital stay: a nested case control study. *Journals of Gerontology Series A: Biological Sciences & Medical Sciences*
- Baumgarten, M., Margolis, D., van Doorn, C., Gruber-Baldini, L., Hebel, R., Zimmerman S., & Magaziner, J. (2004). Black/White differences in pressure ulcer incidence in nursing home residents. *Journal of American Geriatric Society*, 52(8), 1293-8.

- Beldon, P. (2008). Problems encountered managing pressure ulceration of the sacrum. *British Journal of Community Nursing, Wound Care Supplement, 13*(12), s6–s12.
- Bendavid, E., Kaganova, Y., Needleman, J., Gruenberg, L., & Weissman, J. (2007). Complication rates on weekends and weekdays in US hospitals. *American Journal of medicine, 120*(5), 422-428
- Benoit, R., Mion, L. (2012). Risk factors for pressure ulcer development in critically ill patients: A conceptual model to guide research. *Research in Nursing & Health, 35*(4): 340-62.
- Bergstrom, N., Braden, B., Laguzza, A., & Holman, V. (1987). The Braden scale for predicting pressure sore risk. *Nursing Research, 36*(4), 205-210.
- Bergstrom, N., & Braden, N. (1992). A prospective study of pressure sore risk among institutionalized elderly. *Journal of the American Geriatrics Society, 40*(8), 747-758]
- Bergstrom, N., Braden, B., Kemp, M., Champagne, M., & Ruby, E. (1996). Multi-site study of incidence of pressure ulcers and the relationship between risk level, demographic characteristics, diagnoses, and prescription of preventive interventions. *Journal of the American Geriatric Society, 44*(3). 22-30
- Bergquist, S., & Frantz, R. (2001). Braden scale: validity in community-based older adults receiving home health care. *Journal of Applied Nursing Research, 14*(1), 36-43.
- Bianchi, J., & Cameron, J. (2008). Assessment of skin integrity in the elderly. *British Journal of Community Nursing, 13*(3), S26.

- Braden, B., & Bergstrom, N. (1987). A conceptual schema for the study of the etiology of pressure sores. *Rehabilitation Nursing, 12*(1), 8-15
- Breslow, R. A., Halfrisch, J., & Goldberg, A. P. (1991). Malnutrition in tube fed nursing patients with pressure ulcers. *Journal of Parenteral Enteral Nutrition, 15*, 663-668.
- Bry, K.E., Buescher D, Sandrik M. (2012). Never say never: A descriptive study of hospital-acquired pressure ulcers in a hospital setting. *Journal of Wound Ostomy Continence nursing, 39*(3), 274-81
- Cambinha-Bacote, J. (2003). "Many faces: Addressing diversity in health care". *Online Journal of Issues in Nursing, 8*(1). Retrieved November 8, 2012 from:
<http://www.nursingworld.org/MainMenuCategories/ANAMarketplace/ANAPeriodicals/OJIN.aspx>
- Casey, G. (2011). Chronic wound healing: Leg ulcers. *Kai Tiaki Nursing New Zealand, 17*(11), 24-29.
- Chapman, B. R., Mills, K. J., Pearce, L. M., & Crowe, T. C. (2011). Use of an arginine-enriched oral nutrition supplement in the healing of pressure ulcers in patients with spinal cord injuries: An observational study. *Nutrition & Dietetics, 68*(3), 208-213
- Cho, I., & Noh, M. (2009). Braden scale: Evaluation of clinical usefulness in an intensive care unit. *Journal of Advanced Nursing, 66*(2), 293-302.

- Cowan, L., Stechmiller, J., Rowe, M. & Kairalla, J. (2012) Enhancing Braden pressure ulcer risk assessment in acutely ill adult veterans. *Wound Repair and Regeneration*, 20, 137-147.
- Cox, J. (2011). Predictors of pressure ulcers in adult critical care patients. *American Journal of Critical Care*, 20(5), 364-375.
- Crowe, T., & Brockbank, C. (2009). Nutrition therapy in the prevention and treatment of pressure ulcers. *Wound Practice and Research*, 17(2), 90-99.
- Defloor, T. (2000). The effect of position and mattress on interface pressure. *Applied Nursing Research*, 13(1), 2-11
- Defloor, T., & Grypdonck, M. (2005). Pressure ulcers: validation of two risk assessment scales. *Journal of Clinical Nursing*, 14(3), 373-382
- Demidova-Rice, T., Hamblin, M., & Herman, I. (2012). Acute and impaired wound healing: Pathophysiology and current methods for drug delivery: Part 2: Role of growth factors in normal and pathological wound healing: therapeutic potential and methods of delivery. *Advances in Skin & Wound Care*, 25(8), 349-370.
- Department of Health and Human Services (n.d). *Healthy People 2020*. Retrieved November 12, 2012 from <http://www.healthypeople.gov/2020/about/default.aspx>
- Doley, J. (2010). Nutrition in the management of pressure ulcers. *Nutrition in Clinical Practice Journal*, 2(1), 50-60.
- Erdfelder, E., Faul, F., & Buchner, A. (1996). G power: A general power analysis program. *Behavior Research Methods, Instruments and Computers*, 28(1), 1-11.

- Elsner, J., & Gefen, A. (2008). Is obesity a risk factor for deep tissue injury in patients with spinal cord injury? *Journal of Biomechanics*, 41(16), 3322–3331.
- European Pressure Ulcer Advisory Panel and National Pressure Ulcer Advisory Panel (2009). Pressure ulcer prevention: Quick reference guide. Retrieved January 13, 2013 from www.EPUAP.org
- Falabella, A. F., & Kirsner, S. R. (2005). *Wound healing*. FL. Taylor and Francis Publishers.
- Field, L., Smith, B. (2008) *Nursing care: An essential guide*. Prentice Hall, Harlow
- Flaskerud, J. H., & Winslow, B. J. (1998). Conceptualizing populations' health-related research. *Nursing Research*, 47(2), 69-78.
- Fogerty, M., Abumrad, N., Nanney, L., Arbogast, P., Poulouse, B. & Barbul, A. (2008). Risk factors for pressure ulcers in acute care hospitals. *Wound Repair and Regeneration*, 16(1), 11-18.
- Frey, M. A. (1989). Social support and health: A theoretical formulation derived from King's conceptual framework. *Nursing Science Quarterly*, 2. 138-148
- Garza, S., Okere, V., Igbino, J., Novasad, K., & Pexton, C. (2006). *Reducing hospital acquired pressure ulcers. Patient safety and quality healthcare*. Orlando, FL: Lionheart Publishing
- Gefen, A., & Levine, J. (2007). The false premise in measuring body-support interface Pressures for preventing serious pressure ulcers. *Journal of Medical Engineering and Technology*. 3(5), 375-380.
- Gordis, L. (2004). *Epidemiology* (3rd ed.). PA: Elsevier Saunders.

- Hamdan, A. (2008). Characteristics of patients admitted with PU to acute care hospitals. Unpublished raw data.
- Horn, S., Bender, S., Bergstrom, N., Cook, A., Ferguson, M., Rimmasch, L., ... Voss, A. (2002). Description of the national pressure ulcer long-term care study. *Journal of the American Geriatrics Society*, 50, (11), 1816–1825.
- Hulley, S., Cummings, S., Browner, W., Grady, D. & Newman, T. (2007). *Designing clinical research* (3rd ed.). PA: LWW.207-211.
- Jaul, E. (2011). A prospective pilot study of atypical pressure ulcer presentation in a skilled geriatric nursing unit. *Ostomy Wound Management*, 57(2), 45-49.
- Joan, J., & Lerner, S. (2007). Prevalence of incontinence and associated skin injury in the acute care inpatient unit. *Journal of Wound, Ostomy, and Continence Nursing*, 34(3), 260-269
- Jones, K., & Fennie, K. (2007). Factors influencing pressure ulcer healing in adults over 50: An exploratory study. *Journal of the American Medical Directors Association*, 8(6) (2007), pp. 378–387
- Jones, J. (2003). Stress responses, pressure ulcer development and adaptation. *British Journal of Nursing*, 12(11), S17-S24.
- Kaitani, T., Tokunaga, K., Matsui, N., & Hiromi, S. (2010). Risk factors related to the development of pressure ulcers in the critical care setting. *Journal of Clinical Nursing*, 19 (3), 414-421.

- Kiecolt-Glaser, J.K., Marucha, P.T., Malarkey, W.B., Mercado, A.M., & Glaser, R. (1995). Slowing of wound healing by psychological stress. *Lancet*, 346, 1194-1196.
- Kokate, J.Y., Leland, K. J., Held, A.M., Hansen, G., L., Kveen, G., L., Johnson, B. E. et al. (1995). Temperature modulated pressure ulcers: A porcine model. *Archive of Physical Medicine and Rehabilitation*, 76(7), 666-673.
- King, I. M. (1991). *A theory for nursing, systems, concepts, process*. NY: Wiley Medical.
- Kuszajewski, M., & Clontz, A. (2005). Eye on diagnostics, Prealbumin is best for nutritional monitoring. *Nursing*, 35(5), 70-71.
- Laat, E., Shoonhoven, L., Grypdonk, M., Verbeek, A., Graaf, R., Pickkers, P., & Achterberg, T. (2007). Early postoperative 30 degrees lateral positioning after coronary surgery: Influence on cardiac output. *Journal of Clinical Nursing*, 16(4), 654-661.
- Lachenbruch, C. (2005). Skin cooling surfaces: Estimating the importance of limiting skin temperature. *Ostomy, Wound Management*, 51(2), 70-79.
- Lahmann, A., Tannen, A., Dassen, T., & Kottner, J. (2011). Friction and shear highly associated with pressure ulcers of residents in long-term care – Classification Tree Analysis (CHAID) of Braden items. *Journal of Evaluation in Clinical Practice* 17(1):168-173
- Lee, T., Lin, C., Mills, M., & Kuo, H. (2012). Factors related to the prevention and management of pressure ulcers. *Computer Informatics Nursing*, 30(9), 489-95.

- Lewis, S., Dirksen, S., Heitkemper M., Bucher L., & Camera, I. (2011). *Medical surgery nursing assessment and management of clinical problems*. (8th ed.). Elsevier-Mosby. Saint Louis: Elsevier Mosby.
- Lewis, S.M., Heitkemper, M.M., & Dirksen, S.R. (2004). Pharmacokinetics of tobramycin in cystic fibrosis. *Journal of Pediatrics*, *100*(2), 318-321.
- Iizaka S., Okuwa M., Sugama J., & Sanada, H. (2010). The impact of malnutrition and nutrition-related factors on the development and severity of pressure ulcers in older patients receiving home care. *Clinical Nutrition*, *29*(1), 47-53.
- Marchionni, C., & Ritchie, J. (2008). Organizational factors that support the implementation of a nursing best practice guidelines. *Journal of Nursing Management*, *16*(3), 266-274.
- Maylor, M. (2006). Complications of adapting pressure ulcer risk assessment scales. *British Journal of Nursing*, *15*(6), S26–S31.
- McDonagh, D. (2008). Moisture lesion or pressure ulcer? A review of the literature. *Journal of Wound Care*, *17*(11), 461–466.
- Microsoft. (2010). Microsoft Excel [computer software]. Redmond, Washington: Microsoft.
- Moody, P., Gonzales, I., & Cureton, V. (2004). The effect of body position and mattress type on interface pressure in quadriplegic adults: A pilot study. *Dermatology Nursing*, *16*(6), 507-512.

- Moore, Z. Z., Johanssen, E. E., & van Etten, M. (2013). A review of PU prevalence and incidence across Scandinavia, Iceland and Ireland (Part I). *Journal of Wound Care*, 22(7), 361-368
- Moro, A., Maurici, A., Do Valle, J. B., Zacliffe, V. R., & Kleinubing, H. (2007). Assessment of patients with pressure sores admitted to a tertiary center. *Revista Da Associacao Medica Brasileira*, 53(4), 300–304.
- National Database of Nursing Quality Indicators (2009). Pressure Ulcer Training, Retrieved January 13, 2013 from <https://www.nursingquality.org/NDNQIPressureUlcerTraining/Default.aspx>
- National Pressure Advisory Panel (2010). Pressure ulcer staging revised. Retrieved November 16, 2012 from www.npuap.org
- Nixon, J., & McGough, A. (2001). *Principles of patient assessment: Screening for pressure ulcers potential risk in the prevention and treatment of pressure ulcers*. Edinburgh, Mosby. PP. 55-74.
- Norton, D., McLaren, R., & Exton-Smith, A. (1962). *An investigation of geriatric nursing problems in hospitals. National Corporation for the Care of Old People*, London
- Opatowsky, A.R., McWilliams, M., & Cannon, C.P. (2007). Cardiovascular disease and other chronic conditions in women. *Journal of General Internal Medicine*, 22(1), 55-61.

- Peterson, M. J., Schwab, W., McCutcheon, K., Oostrom, J. H., Gravenstein, N., & Caruso, L. (2008). Effects of elevating the head of bed on interface pressure in volunteers. *Critical Care Medicine*, 36(11), 3038–3042.
- Peterson, M. J., Schwab, W., Oostrom, J. H., Gravenstein, N., & Caruso, L. (2010). Effects of turning on skin-bed interface pressures in healthy adults. *Journal of Advanced Nursing*, 66(7), 1556-1564.
- Pompeo, M. (2003). Implementing the PUSH tool in clinical practice: Revisions and results. *Ostomy, Wound Management*, 49(8), 32–46
- Potter, P. A., & Perry, A. G. (2013). *Fundamentals of nursing* (13th ed.). Philadelphia, PA: F. A. Davis Company
- Raghavan, p., Raza, W. A., & Ahmad, Y. S. (2003). Prevalence of pressure sores in a community sample of spinal injury patients. *Clinical Rehabilitation*, 17, 879-884
- Rich, S. E., Shardell, M., Hawkes, W. G., Margolis, D. J., Amr, S., Miller, R., & Baumgarten, M. (2011). Pressure-redistributing support Surface use and pressure ulcer Incidence in elderly hip fracture patients. *Journal of the American Geriatrics Society*, 59(6), 1052-1059.
- Rondorf-Klym, L., & Langemo, D. (1993). Relationship between body weight, body position, support surface, and tissue interface pressure. *Decubitus*, 6(1), 22–30.
- Roubenoff, R.(1999). The pathophysiology of wasting in the elderly. *The Journal of Nutrition*, 129(1), 2565-2595.

- Russo, A., Steiner, A., & Spector, W. (2006). Hospitalizations related to pressure ulcers among Adults 18 years and older. Retrieved July 24, 2012 from:
<http://www.hcup-us.ahrq.gov/reports/statbriefs/sb64.jsp>.
- Sae-Sia, W., Wipke-Tevis, D. D., & Williams, D. A. (2005). Elevated sacral skin temperature (Ts): A risk factor for pressure ulcer development in hospitalized neurologically impaired Thai patients. *Applied Nursing Research, 18*(1), 29-35.
- Sakai, K., Sanada, H., Matsui, N., Nakagami, G., Sugama, J., Komiyama, C., & Yahagi, N. (2009). Continuous monitoring of interface pressure distribution in intensive care patients. *Journal of Advanced Nursing, 64*(4), 809-817.
- Saladin, L., & Krause, J. (2009). Pressure ulcer prevalence and barriers to treatment after spinal cord injury: Comparisons of four groups based on race-ethnicity. *Neuro rehabilitation, 24*(1), 57-66.
- Sayar, S., Turgut, S., Doğan, H., Taşdelen, B. (2009), Incidence of pressure ulcers in intensive care unit patients at risk according to the Waterlow scale and factors influencing the development of pressure ulcers. *Journal of Clinical Nursing, 18*(5) 765–774.
- Schoonhoven, L., Grobbee, D., Donders, A., Algra, A., Grypdonck, M., Bousema, M., ... Buskens, E. (2006). Prediction of pressure ulcer development in hospitalized patients: A tool for risk assessment. *Quality & Safety in Health Care, 15*(1), 65-70.

- Selye, H. (1956). *The stress of life*. New York, NY: McGraw-Hill. P. 151-170.
- Sener, G., Sert, G., Sehirli, O., Arbak, N., & Dulger, A. (2006). Melatonin protects against pressure ulcer-induced oxidative Injury of the skin and remote organs in rats. *Journal of Pineal Research*, 40(3), 280-287.
- Shahin, E., Meijers, J., Schols, J., Tannen, A., Halfens, R., & Dassen, T. (2010). The relationship between malnutrition parameters and pressure ulcers in hospitals and nursing homes. *Nutrition*, 26(9), 886–889.
- Sharp, C., & McLaw, M. (2005). A discourse on pressure ulcer physiology: The implications of repositioning and staging. *Worldwide Wounds*. Retrieved November 11, 2012 from:<http://www.worldwidewounds.com/2005/october/Sharp/Discourse-On-Pressure-Ulcer-Physiology.htm>
- Singer, P. (2002). Nutritional care to prevent and heal pressure ulcers. *Israel Medical Association Journal*, 4(5), 713-716.
- Spicer, J. (2004) *Making sense of multivariate data analysis*. CA. Sage Publications.
- Stechmiller, J., Cowan, L., Whitney, J., Philips, L., Aslam, R., Barbul, A., ... Stotts, N. (2008). Guidelines for prevention of pressure ulcers. *Wound Repair and Regeneration*, 16(2), 151-168.
- SPSS IBM Statistics for Windows, Version 20.0. Armonk, NY, IBM Corp
- Stinson, M., Gillan, C., & Porter-Armstrong, A. (2013). A literature review of pressure ulcer prevention: Weight shift activity, cost of pressure care and role of the occupational therapist. *British Journal of Occupational Therapy*, 76(4), 169-178.

- Suttipong, C., & Sindhu, S. (2012). Predicting factors of pressure ulcers in older Thai stroke patients living in urban communities. *Journal of Clinical Nursing, 21*(3/4), 372-379.
- Tescher, A., Branda, M., Byrne, T., & Naessens, M. (2012). All at risk patients are not created equal. *Journal of Wound, Ostomy and Continence Nurses, 39*(3), 382-291
- Theilla, M., Singer, P., J., & Dekeyser, F. (2007). A diet enriched in eicosapentanoic acid, gamma-linolenic acid and antioxidants in the prevention of new pressure ulcer formation in critically ill patients with acute lung injury: A randomized, prospective, controlled study. *Clinical Nutrition, 26*(6), 752-757.
- Theisen, S., Drabik, A., & Stock, S. (2012). Pressure ulcers in older hospitalized patients and its impact on length of stay: a retrospective observational study. *Journal of Clinical Nursing, 21*(3/4), 380-387
- Vanderwee, K., Grypdonck, H., De Bacquer, D., & Defloor, D. (2006). Effectiveness of turning with unequal time intervals on the incidence of pressure ulcer lesions. *Journal of Advanced Nursing, 5*(1), 59-68.
- VanGilder, C., MacFarlane, G., Meyer, S., & Lachenbruch, C. (2009). Body mass index, weight, and pressure ulcer prevalence: An analysis of the 2006–2007 international pressure ulcer prevalence surveys. *Journal of Nursing Care Quality, 24*(2), 127–135.
- Vega, A. (2011). A review of the efficacy of zinc, selenium, and vitamin C in the treatment of pressure ulcers. *Topics in Clinical Nutrition, 26*(2), 115-125
- Vliegen, E. (2004). Old age, malnutrition, and pressure sores: An ill-fated alliance

Journal of Gerontology, 59(4), M355-M360

- Waltz, C., Strickland, O., & Lenz, E. (2005). *Measurement in nursing and health research*. (3rd edition). NY. Springer publishing company.
- Wang, H., Devereaux, R., Yealy, D., Safford, M., & Howard, G. (2010). National variations in United States sepsis mortality: A descriptive study. *International Journal of Health Geographics*, 9(9). 10-17
- Wann-Hanson, C.W., Hagell, P. & Willman, A. (2008). Risk factors and prevention among patients with hospital acquired and preexisting pressure ulcers in an acute care hospital. *Journal of Clinical Nursing*, 17(13), 1718-1727.
- Woodbury, G. M., & Houghton, P. E. (2004). Prevalence of pressure ulcers in Canadian health care settings. *Ostomy Wound Management*, 50(10), 32-38
- Young. (2004). The 30° tilt position vs the 90° lateral and supine positions in reducing the incidence of non-blanching erythema in a hospital inpatient population: A randomized controlled trial. *Journal of Tissue Viability*, 14(3), 88–96.

Biographical Information

Ahmad A. Hamdan graduated from The University of Jordan located in Amman - Jordan in 1993; from the same university he earned his Master degree in Nursing Education in 1997. He worked in different countries including Jordan, United Arab Emirates, Saudi Arabia and the USA. He presented several papers in several international conferences. His background includes critical care and nursing education. During the PhD program, he received the Ferne C. Newman Kyba Endowed Fellowship. His research interest includes pressure ulcers and vulnerable populations. He currently works as a nurse educator in a non-for-profit hospital system located in Dallas.