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TITLE PAGE DISSERTATION

UNIVERSITY OF SAN DIEGO

Hahn School of Nursing and Health Science

DOCTOR OF PHILOSOPHY IN NURSING

PRESSURE ULCER RISK FACTORS FOR PATIENTS WITH HOSPITAL
VERSUS COMMUNITY ACQUIRED PRESSURE ULCERS

By

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HAHN SCHOOL OF NURSING AND HEALTH SCIENCE

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Abstract

Purpose: Pressure ulcers are a major health problem in the United States. Patients who develop pressure ulcers have longer hospital stays, significant increase in morbidity and mortality, added pain and suffering. The purpose of this study was to examine community versus hospital specific pressure ulcer risk factors to identify whether the most severe pressure ulcer stages can be predicted from the knowledge of an individual's risk factors as has been reported in the literature. **Methodology:** The sample of patients with stageable III-IV and unstageable pressure ulcer patients included in the analysis was extracted from a Microsoft Access database developed by a WOCN Certified Advanced Practice wound care nurse. **Results:** The sample was predominantly Caucasian, having community acquired and unstageable pressure ulcers. The risk factors examined in the Chi-square model Pearson's correlation calculated for predictor variables length of stay, age, and Braden scale score (which was analyzed as a continuous variable) showed significant positive relationships between hospital acquired pressure ulcer and length of stay. There were statistically significant differences in the incidence of patients admitted from the community with a pressure ulcer (stageable or unstageable) and those with hospital acquired ulcers. Ninety-five percent of patients had unstageable hospital acquired pressure ulcers compared to 72% of community acquired pressure ulcers. Twenty-seven percent of community acquired pressure ulcers were stageable (27.2%) compared to hospitalized acquired PUs (4.9%).

Conclusions: This study demonstrated that a wound care practice and quality database can be used to conduct exploratory descriptive research on a patient population with severe pressure ulcers. Findings indicate that most patients have community

acquired pressure ulcers and that these ulcers are unstageable, occur in Caucasian patients, and occur equally in men and women. Although the mean age of patients with these severe pressure ulcers is 74.24 years, patients with longer length of stays were associated with a higher risk for hospital acquired pressure ulcers. Diagnostic groups most common in these patients included patients with sepsis, cardiac and circulatory problems and pulmonary diseases. Hospital acquired pressure ulcers were significantly more likely to be unstageable with slough or eschar in the wound bed.

DEDICATION

This dissertation is dedicated to my Skin Team at Palomar Pomerado Health System:

My Co Chair Donna Rositani who steadfastly held down the fort while I engaged in my scholarly pursuit, Ann Moore who advised me to develop and keep a wound care database, and the staff nurses who are the heart of the Skin Team and contributed to all aspects of this work.

My husband, Ken Guther, who is my very best friend and source of support.

Acknowledgement

I would like to express my heartfelt appreciation and gratitude to the people who made this opportunity possible and contributed to my success.

To my dissertation committee:

Dr. Cynthia Connelly, my chair, who has guided me through the maze of data and helped me around obstacles great and small. I was blessed to have your generous time and expertise.

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Chapter 1

INTRODUCTION

The topic of quality of health care in the United States reached national prominence with the publications of the Institute of Medicine series of reports on medical errors (IOM, 1999). Hospital acquired pressure ulcers are often cited as an example of poor healthcare quality with a high cost burden for our society (IOM, 2001). Severe pressure ulcers are associated with higher mortality, longer hospital stays, and costly treatment (Maklebust & Sieggreen, 2001). In the United States, hospital acquired pressure ulcers cost our healthcare system an estimated 2.2 to 3.6 billion dollars a year (Garza, Okere, Igbinoba, Novosad, & Pexton, 2006). A 1994 conservative estimate for the direct cost of healing one pressure ulcer was estimated to range from \$5000-\$40,000 (Bergstrom, Bennett, & Carlson, et al., 1994). Pressure ulcers develop quickly, heal slowly, and occur as a result of a combination of forces (friction, shear, pressure, and moisture) exceeding the ability of the patient's tissues to tolerate these forces (Bergstrom et al., 1994). Stage III, IV, and unstageable pressure ulcers tend to be the most severe adverse hospital outcome, adding significant burden to the healthcare community and

individuals. Mean adjusted hospital costs for all hospital acquired pressure ulcers are reported to range from \$10,845-\$14,260 per patient (Allman,1998; Zhan, 2003).

Although pressure ulcers have occurred since recorded history, the evolution of pressure ulcer knowledge has exploded in the last 30 years. Pressure ulcers have been gaining increased professional and public concern since the 1980s as a high cost, possibly preventable healthcare phenomenon (Langemo, Black, Maklebust, & Posthauer, 2007).

Modern advancements in healthcare have not eradicated the pressure ulcer problem. Pressure ulcers continue to plague the healthcare industry worldwide. Unfortunately, most recently pressure ulcer prevention research has lost momentum. Because of the aging of our population and an increased interest in chronic healthcare conditions in concert with advancements in pressure ulcer care and prevention PU have not “captivated the focus of medicine” (Armstrong et al, 2008). The result is that there are few studies in this area as compared to other evidence based medical or healthcare topics.

Notably, pressure ulcer prevention and practice clinical guidelines published by the Agency for Healthcare Research and Quality (AHRQ, formerly the AHCPR) remain on that website when almost all of the other guidelines published near the same time (1992-1994) have become obsolete due to advances in evidence-based care. Possible explanations include a) the practice guidelines are timeless and remain current or b) there remains insufficient empirical evidence to inform the development of revised or new guidelines.

Pressure Ulcers Prevalence (Outcome)

Determining incidence and prevalence of pressure ulcers in acute-care hospitals, long-term care, and home health is an ongoing challenge for healthcare. Incidence refers to new cases of pressure ulcers that occur during a specified period and prevalence is a cross sectional count of the number of pressure ulcers at a specific point in time.

There are multiple ways to assess the pressure ulcer rate within institutions the most common of which is by performing pressure ulcer prevalence. This consists of a one day snapshot where all patients hospitalized on the study day are examined for the presence of a pressure ulcer. The medical record is examined to determine if the pressure ulcer was present on admission as documented usually by nursing staff or hospital acquired (documented more than 24 hours after admission). The National Database of Nursing Quality Indicators (NDNQI) benchmarks pressure ulcer rates for a large number of hospitals nationwide and reports these rates by similar hospital size.

Historically, pressure ulcer prevalence studies may have been sponsored by durable equipment companies or other vendors with a vested interest in the outcome (Bliss, 2000). Methodological problems do not address how the study addresses reliability and validity and interpreting reports of pressure ulcer incidence and prevalence are difficult. In order to interpret, replicate, or benchmark against any of these studies, one needs to compare and contrast various populations and look at variations in the sources of data. In addition, some study methods confuse incidence and prevalence and include or exclude stages or segments of the population.

Pressure Ulcer Assessment and Staging (Process)

Consistent, valid and reliable pressure ulcer staging is vital in determining prevalence of pressure ulcers and has been an ongoing challenge for practitioners and researchers. In 1987 a small group of healthcare professionals established a national organization to address pressure ulcer prevention, care, education, and advocacy. The National Pressure Ulcers Advisory Panel is an independent, non-profit organization that has become the U.S. organization that develops research, public policy, and education to improve patient outcomes in pressure ulcer prevention and management (Langemo et al., 2007). This organization's efforts resulted in the landmark AHCPR guidelines for pressure ulcer prevention and pressure ulcer treatment. In 1999, van Rijswijk reevaluated the evidence and provided an update that confirmed the strength or weakness of evidence presented in the original publications. One of the most important outcomes of the NPUAP is the pressure ulcer staging consensus that resulted in a classification system for pressure ulcers setting the standard for determining a reliable and valid nationwide pressure ulcer assessment for data collection (NPUAP, 2007).

Current Pressure Ulcer Trends

Pressure ulcers are frequently associated with poor nursing care in long term settings. In 2004, US Centers for Medicare and Medicaid services (CMS) implemented changes in long term care surveyor guidelines adding Tag F-314 that describes whether a pressure ulcer that developed in the facility was avoidable or unavoidable. As a result, skilled nursing facilities have been held to the higher standards for pressure ulcer

prevention that spell out specific aims for care of patients who are at risk of developing pressure ulcer and appropriate documentation (483.25c/TagF314). Historical changes in Medicare reimbursement and newly mandated reporting of all hospital acquired stage III and IV pressure ulcers in California (SB 1301) challenge healthcare providers to capture and manage pressure ulcer occurrences or suffer the consequences of denied reimbursement (<http://www.cms.hhs.gov/HospitalAcqCond/> accessed Aug 1, 2009). As part of the 2006 Deficit Reduction Act, the Center for Medicare & Medicaid Services (CMS) enacted Present on Admission (POA) Indicator Reporting for stage III & IV hospital acquired pressure ulcers. In the deficit reduction act of 2006, CMS identified high cost, high volume secondary diagnosis that was considered potentially preventable for non-payment. As of October 2008, stage III and IV hospital acquired pressure ulcer claims would no longer be reimbursed.

Complete and accurate documentation of any pressure ulcer that is present on admission has become critical. Magnan and Maklebust (2008) have observed that “Policy has an interesting way of shaping both science and practice” as they referred to their hope that recent changes in Center for Medicare and Medicaid Services (CMS) reimbursement for acute care pressure ulcer reimbursement might improve pressure ulcer prevention research. Lia van Rijswijk (2008) argues there is disconnect between policy maker’s decisions and the citizens (patients and providers) affected by those decisions. She makes a point that at the very least, regulation should reinforce accountability. This

CMS regulation is a step toward compelling acute care facilities to be more accountability for pressure ulcer prevention.

Skin Team

The healthcare district in which this study was performed has had an active Skin Team dedicated to improving wound and pressure ulcer care utilizing the QHOM model's Plan-Do-Check-Act format. The composition of the skin team is multidisciplinary and includes the Wound Care Center Medical Director and Administrator, the District Wound Care Clinical Nurse Specialist (CNS) as Chair, a Certified Wound Ostomy and Continence Nurse (CWOCN), a dietitian, physical therapist, and rotating nursing division directors. The core working team consists of staff and charge nurses from each of the adult inpatient units as well as nurses from the two district skilled nursing facilities, the home health agency, the acute rehabilitation unit, and both emergency rooms. The CALNOC pressure ulcer prevalence data collection activities are performed by these nurses who have been mentored in process improvement and evidence based practice quality improvement by the Wound CNS and CWOCN. Pressure ulcer rates are compared (benchmarked) against the CALNOC mean for like hospital and like units. The nurses on the units where these pressure ulcer data collection audits are performed post the results (outcomes) on their units and devise PDCA action plans to improve system or process problems that were found during the audit that led to any hospital acquired pressure ulcer on any patient.

Since the Skin Teams inception, continuous process improvement projects have been undertaken by the Team that including a project to improve incontinence care (Talley & Moore, 2005) and a system-wide quality improvement process that improved early assessment, care, and documentation of pressure ulcers (Talley, Moore, & Krall, 2007). The Skin Team revised the Integumentary Standard of Care for adult inpatients so that Braden Scores of 18 or less required pressure ulcer prevention plans of care. When implementing this process, it became important for the Skin Team to be able to monitor low Braden Scale patients on their units and guide staff on implementation options. The electronic medical record was modified to tag any adult inpatient with a Braden Scale of less than 18 every 7 days so that these patients could be monitored for changes in skin integrity.

Purpose of Study

The purpose of this study was to examine community versus hospital specific pressure ulcer risk factors as they relate to development of the most severe pressure ulcers and to provide a benchmark to measure future progress in pressure ulcer prevention. In other words, to identify whether pressure ulcer staging can be predicted from an individual's risk factors age, gender, race/ethnicity, PU origin (community or hospital), Braden Risk Score, and length of hospital stay.

Specific Aims

Aim # 1: Characterize a sample of pressure ulcer patients receiving care at two acute care hospitals.

Aim #2: Examine the relationship between demographic, (age, gender, ethnicity), system characteristics (hospital acquired or community acquired, Braden risk score, length of stay) and staging of pressure ulcer.

Aim #3: Explore factors that increase the probability of being classified with stagable pressure ulcers.

Conceptual Framework

A hybrid of Avedis Donabedian's original (1973) Quality Structure-Process-Outcome Model combined with the National Association of Clinical Nurse Specialists (NACNS) 3 Spheres of Influence was used to inform this study. The Quality Health Outcomes Model (QHOM) provides a healthcare system theoretical framework while the NACNS spheres of influence provide a framework for exploring nurse sensitive outcomes such as hospital acquired pressure ulcers. As Donabedian notes, "(these elements) are not attributes of quality, they are only kinds of information one can obtain, based on which one can infer whether quality is good or not" (Donabedian, 1973).

The QHOM model fits with the efforts of a wound care Clinical Nurse Specialist's (CNS) system Skin Team. This team is led by a healthcare system Clinical Nurse Specialist who operates within three spheres of influence: Nursing and nursing standards, systems, and patient. The CNS uses influence within all 3 spheres and within each of the QHOM domains in order to change and develop the organization toward optimal pressure ulcer prevention and care outcomes.

Mitchell (1998) argues a bidirectional model frames the following questions: Do we have a workable structure (equipment, qualified personnel, and products), process (early prevention, effective assessment, appropriate technical care), and do these achieve the desired outcome (reduced pressure ulcer rates). Outcome results must be achievable by good care. The spheres of influence frame the process within each of the Donnanbedian model elements and the Donnanbedian model can also frame process within the 3 spheres of influence (see figure 1).

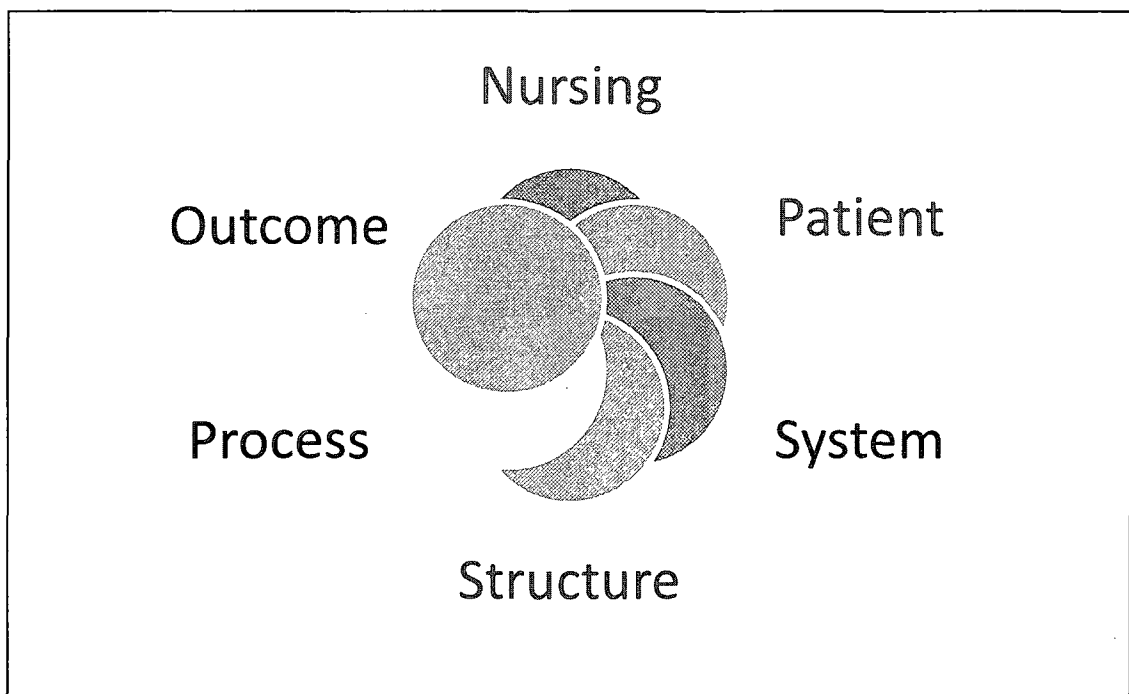


Figure 1

For the purposes of this study, the QHOM model informs the activities of the healthcare organizations' Skin Team to improve Pressure Ulcer prevention and treatment structure and processes. According to Mitchell & Lang (2004), Donabedian's original linear structure process-outcomes-model was limited and that model needed to be more robust by positing a dynamic (bidirectional) relationship between structure, process, and outcome. This study adds one more dynamic relationship: The CNS three spheres of influence as the Clinical Nurse Specialist influences nursing standards and care, changes and reporting of pressure outcomes to the system, and direct or/direction of the care provided to patients at risk or with pressure ulcers.

Significance of Study

This research was an initial step in the process of examining the most severe pressure ulcers that occur in a large healthcare system's two acute care hospitals. Using a quality data base, the study quantified the number of severe (Stage III-IV& unstageable) pressure ulcers in the study population from a two year time period. The research questions were framed to indirectly inquire about the frequency of documentation of pressure ulcers on admission and what would be most instructive all staff nurses to accurately assess and document pressure ulcers within twenty-four hours of admission. Other research questions sought to determine relationships between pressure ulcer risk factors and severe pressure ulcer outcomes that informed future Skin Team quality improvement activities and targeted specific prevention and care programs.

Data was collected on pressure ulcer coding in medical records to address the new CMS guidelines for reimbursement of community versus hospital acquired pressure ulcers. This information may be important to feedback mechanisms regarding medical record charting for medical staff about the success of their quality improvement efforts to correctly document and code for reimbursement all patients who have pressure ulcers. In addition, data including risk variables such as Braden Pressure Ulcer Risk, diagnosis, length of stay, gender and age, and anatomical location of pressure ulcer may guide prevention efforts and influences caregivers about the patient who may be at higher risk for pressure ulcer development.

The Skin Team, guided by the CNS and the 3 spheres of influence, utilized a plan-do-check-act to operationalize the non-linear QHOM/ CQI process and implemented improvement strategies from the (1992, 1994) Evidence Based Practice Guidelines over a 5 year period from 2004-2009. Change projects led by the skin team improved assessment education for nurses, resulted in changed products and care processes, improved documentation accuracy via the electronic health record, and system wide feedback about pressure ulcer prevalence rates (Talley et al., 2007). Despite these efforts, certain patient populations develop severe pressure ulcers.

The current study aims to see if there are gaps in our risk knowledge. Are we missing some of our more relevant patient population risk factors? How are these related to what is reported in the literature? Findings may guide more targeted prevention for

those identified at risk as well as stimulate similar research in other geographical locations to see if the findings can be replicated.

Nursing Implications

Leaders within the healthcare organizations struggle with allocation of limited resources and pressure ulcers consume hours of nursing time and supplies and equipment dollars. Pressure ulcer prevention and education for the area's own populations known to be high risk is not only cost effective but sensitive to the community's unique healthcare needs. Describing and defining attributes of patients who develop the most severe pressure ulcers historically within the systems patient population can guide future prevention efforts and identify pressure ulcer care priorities.

Chapter 2

Review of Literature

Historical Perspective Pressure Ulcer Care

Pressure ulcers have been historically recorded since the 17th century BC (Levine, 2000). These disturbing wounds were thought to be a sign of impending death. Pressure ulcers are mentioned in historical documents as early as 159 AD with Galen's description of "laudable pus" that described the evolution of wounds (Baxter, 2002). As early as 1585 Ambrose Pare described using a down cushion in combination with nutrition, hygiene and pain control for pressure ulcer relief (Levine, 2000). Jean-Martin Charcot, a neurologist and contemporary of Florence Nightingale, described the pressure ulcer in the 19th century but attributed it to neurotrophic causes and inevitably heralded impending death (Levine, 2000). A vignette published in the London Lancet in 1850 described the use of a water bed or cushion for prevention of sacral ulcerations.

Pressure ulcers have historically been considered negative nursing outcomes related to poor care and negligence with million dollar litigation awards in many cases (Goebel & Goebel, 1999). One of the earliest and most specific mention of the nurses'

role in pressure ulcer care and prevention was reflected by Florence Nightingale's statement in *Notes on Nursing* "If a patient ... has a bedsore, it is generally the fault not of the disease, but of the nursing." (Nightingale, 1860).

Today, pressure ulcer prevalence studies conducted quarterly provide information about how many patients in the hospital at one time have a pressure ulcer. Chart audits reveal which pressure ulcers were present on admission (community acquired) and which pressure ulcers occurred while the patient was in the hospital (hospital acquired). The results of these studies are compared to other institutions pressure ulcer rates (benchmarked) as a measure of the quality of healthcare provided by nurses at each institution.

The results of each pressure ulcer prevalence study guide caregivers in directing pressure ulcers prevention efforts and provide information about the population specific risks. For example, if a high number of heel pressure ulcers are found on patients with fractured hips, nursing staff can implement care processes for this orthopedic population such as floating heels, providing pain control in order to minimize the time that a patient is immobilized. Pressure ulcers that are discovered on admission give nurses a chance to provide enhanced and targeted prevention to their patients in the same manner. When a patient has difficulty breathing due to a respiratory disease and is discovered to have a sacral pressure ulcer, efforts to remove the pressure from the area while maintaining head

elevation to facilitate ventilation need to be individualized and creative and can even evolve into an art form.

In 1994, the American Nurses Association (ANA) launched the Safety & Quality Initiative to explore and identify the empirical linkages between nursing care and patient outcomes and this work resulted in the development of the National Database of Nursing Quality Indicators (NDNQI). The California Nursing Outcomes Coalition (CalNOC) was established in 1996 and is a major contributor of data to NDNQI. The CalNOC project is the largest ongoing nursing quality measurement repository development project in progress in the US. One of the aims of the project is to provide data to inform public policy and clinical decisions regarding the cost and efficacy of patient care delivery, nurse staffing and quality (Brown, 2007). The CalNOC repository contains over 11 years of data with over 338,000 patient pressure ulcers evaluations (www.calnoc.org. Accessed Aug. 8, 2009). These state and national databases allow concurrent benchmarking of pressure ulcer rates between like size hospitals utilizing standard assessment and data collection methods and foster the development of best practices for prevention (Aydin et al., 2004).

Quality Healthcare Outcomes Model and Pressure Ulcer Prevention and Treatment

The Quality Healthcare Outcomes Model (QHOM) an adaptation of Donabedian's (1973) Structure, Process, Outcomes Model provides a framework to link

the structure and process efforts of the Skin Team with the desired outcome of a lower hospital acquired pressure ulcer rate.

Quality Health Outcomes Model

Components of the QHOM include the structure, or system, which included the facility, organization characteristics, state mandates, and methods for payment or payment limitations. Process includes pressure ulcer prevention activities, and outcome includes the presence or absence of a severe pressure ulcer. See figure 2.

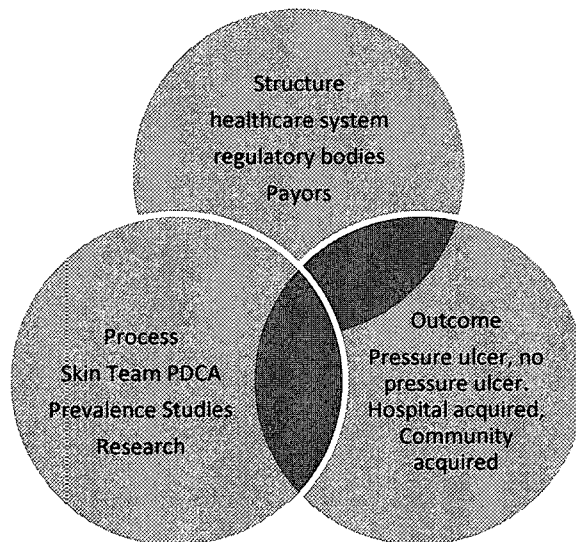


Figure 2

In an editorial on the shifting mission of healthcare delivery organizations, Bohmer and Thomas (2009) describe a transition in payment for healthcare delivery that focuses on producing outcomes. They observe that “physicians and nurses are best placed

to define exactly which processes are essential for generating good clinical outcomes and how these processes can be deployed most effectively” (pg 553).

Berwick (1989) described the quality improvement component of the model as a tool for improving pay-for-performance in which desired outcomes (lower pressure ulcer rates) is linked to continuous quality improvement (CQI). He asserts that the opportunity for improvement exists in every process on every occasion (Berwick, 1989). The PDCA process involves a “trial-and-learning” approach in which suggested solutions for improvement are made and tested on a small scale before changes are made to the whole system (Berwick, 1998).

As Struck and Wright (2007) note in a thoughtful article on the link between pressure ulcers and endothelial dysfunction, “researchers and clinicians spend significant time and money developing prevention and treatment strategies for pressure ulcers yet they (pressure ulcers) are still problematic.”

**Evidence Based Practice as Structure: Agency for Healthcare Research and Quality
(1992&1994 AHCPR/AHRQ)**

The Agency for Healthcare Research and Quality, formerly Agency for Healthcare Practice and Research published pressure ulcer prevention (1992) and pressure ulcer treatment (1994) guidelines that were informed by the best research, evidence and expert opinion at that time. Since then, only three guidelines, Pressure Ulcer Prevention, Pressure Ulcer Treatment, and Cardiac Rehabilitation remain posted on the

AHRQ Clinical Practice Guideline website while other guidelines have been removed as their evidence has become obsolete.

The content items in both AHRQ's web posted Pressure Ulcer Clinical Practice Guidelines (www.ahrq.gov/CLINIC/cpgsix.htm, accessed Aug 23 2009) include the following topics: Prevalence and incidence, risk assessment tools and risk factors, skin care and early treatment, nutrition, friction/shear injury, moisture control, mobility and activity, mechanical loading and support surfaces including pressure reduction beds and devices, positioning and offloading, and education of patient, family, caregivers and healthcare providers. The treatment guidelines (1994) added ulcer care, managing bacterial/infection, and operative repair. Both guidelines discuss future research agenda and include recommendations that research focus on cost effective ethical outcomes as refinement of risk assessment with an emphasis on methodological quality. Newer Pressure Ulcer and Prevention & Treatment Clinical Practice Guidelines are being developed jointly by the European Pressure Ulcer Advisory Panel and National Pressure Ulcer Advisory Panel but were not available as of this writing.

The Braden Risk assessment scale has been the most studied scale for widespread systematic nursing assessment of pressure ulcer risk. The Braden Risk Assessment scale is recommended as a risk screen in the original AHCPR, now AHRQ 1992 Pressure Ulcer Prevention Guidelines and remains one of the most recommended and used screening tools.

Pressure Ulcer Prevention Risk Assessment Scales

Risk assessment tools were introduced to the healthcare community as early as the 1950's. Several risk scales have been developed and tested to assess pressure ulcer risk. One of the pioneers of risk assessment was Doreen Norton who developed one of the first pressure ulcer risk assessment tools the Norton Scale (Norton, 1996). In the 1950s pressure ulcers were commonly called bedsores and were most often associated with a spinal cord injury patient. Norton succeeded in securing sponsorship for many of the first pressure ulcer studies. Norton looked for a method of systematically monitor patient's health and relevant pressure ulcer risk. Norton and colleagues (1962) also conducted epidemiological studies of pressure ulcers in elderly patients and found that many pressure ulcers were found to occur within two weeks of admission to a nursing facility.

In 1985, British nurse educator, Judith Waterlow was looking to create a risk assessment tool that would take into account new evidence about pressure ulcer risk that included nutritional status and factors such as time on an OR table. She built on Norton's scale and developed and tested the Waterlow Card (Waterlow, 2005). Waterlow cautions that with the Waterlow assessment tool, the hospital setting, professional skill and education, and judgment would all have a major influence on the reliability of the assessment and actions that needed to be taken. These themes run throughout the pressure ulcer assessment literature and are a current challenge for the pressure ulcer research community.

The Braden Risk (Bergstrom & Braden, 1992) assessment scale has a long history of reliability and validity testing in the literature. Developed by Barbara Braden, PhD, and Nancy Bergstrom, PhD, the scale is the most commonly used in the United States (Armstrong et al., 2008). The high acceptance of the Braden Scale has been linked to its tested clinical validity, ease of training for staff use, and close fit with issues identified that affect pressure ulcer risk (Armstrong et al., 2008). Braden and Bergstrom (1992) identified two etiology factors in pressure ulcer development: intensity and duration of pressure and tissue tolerance. The scale consists of 6 subscales: sensory perception, moisture, activity, mobility, nutrition, and friction and shear. Nancy Bergstrom described early studies during the tool development. Interrater reliability testing included the Pearson product moment correlation (a very generous assessment), percent agreement (a more stringent assessment), and interclass correlation (for greater precision) (Bergstrom, 2008). The Braden Risk assessment has become the standard for pressure ulcer risk assessment and will be examined in this study to determine how it relates to pressure ulcer severity.

Several state of the science reviews report the strength of the process of performing a Braden assessment. In a study of 843 randomly selected individuals from a variety of healthcare settings, Bergstrom and Braden (1998) found that a Braden Scale of 18 or lower was the cutoff point for risk of pressure ulcer development. They also found

that low Braden Scale scores on admission were predictive of pressure ulcer development but not as predictive as the Braden score 24-48 hours after admission.

In a 2005 European study of 120 inpatients, Gunningberg found that a majority of patients who were identified at risk by Braden risk assessment did not receive prevention activities. This finding was supported by a meta-analysis of 33 studies that concluded that there was no evidence that use of a risk scale decreased pressure ulcer incidence (Pancorbo-Hidalgo et al., 2006). Brown (2004) concluded that risk scales may not be optimally predictive of pressure ulcer development due to the confounding effect of prevention activities which the risk assessment is intended to instigate. In fact, in a randomized control study to validate 2 risk assessment scales in 1772 older patients, Vanderwee et al., (2005) concluded that use of effective pressure ulcer prevention decreased the predictiveness of any risk scale.

Populations identified at risk

Many studies have identified patient populations that have a high risk of developing pressure ulcers. Allman, Goode, Patrick, Burst, & Bartolucci (1995) performed a prospective cohort study of orthopedic patients in a teaching hospital and found age over 75, stage I pressure ulcer, history of previous pressure ulcer and fecal incontinence were all associated with pressure ulcer incidence. In a prospective epidemiological study in Germany of 689 Intensive Care patients, Compton et al., (2008) had a 17% incidence rate

and found that organ dysfunction, circulatory impairment, and sepsis were significantly associated with pressure ulcer incidence ($p < .05$).

Capon, Pavoni, Mastromattei, and DiLallo (2006) used a retrospective cross sectional study to explore main factors associated with risk of pressure ulcer development in 571 long term care residents in Italy. They found that a history of previous cerebrovascular accident (CVA) (OR = 1.96; 95% CI 1.13-2.85), previous trauma (OR = 1.83; 95% CI 1.12-2.99) and cognitive decline (OR associated with a 1 point Short Portable Mental State Questionnaire increase = 1.26; 95% CI 1.05-1.50) were significantly positively associated with high risk conditions of developing a pressure ulcer. In a clinical classification study of 94,758 patients discharged with a diagnosis of pressure ulcer, Fogerty et al., (2005) performed multiple regression analysis on a large Nationwide Inpatient Sample (NIS) dataset using the discharge ICD-9 code for pressure ulcer and demonstrated that African American race, advanced age, organ system failure, and sepsis/infection were all risk factors associated with pressure ulcer (OR > 2.0). In their two skilled nursing facility cohort study, Bergstrom and Braden (1998) found that medical diagnosis was not predictive of pressure ulcer development.

In the United Kingdom, Margolis et al. (2003), using a proportional hazards model and Oxford Medical Information System (OXMIS) codes, examined 75,168 records from an outpatient clinic, 121 who had pressure ulcers. Results indicated that a diagnosis of Alzheimer's disease, congestive heart failure, CVA, diabetes, hip fracture, malignancy,

malnutrition, Parkinson's disease, rheumatoid arthritis, and urinary tract infection were all associated with pressure ulcer development in the community.

Many studies examine pressure ulcer risk as it relates to patient characteristics other than disease state or medical diagnosis. Gender was not found to be predictive of pressure ulcer development in Anthony et al's. (2003) 5 year study of the Waterlow Risk scale of 82691 patient records, nor in Kayser-Jones et al. (2005) study of 117 terminally ill skilled nursing patients with pressure ulcers; yet in Fisher's et al. (2004) male gender was associated with pressure ulcer incidence.

A significantly higher pressure ulcer rate in black versus white skin was reported in a study by Baumgarten et al. (2004) of 1938 skilled nursing residents. Fogerty et al. (2005) also found that African American race was significantly associated with higher pressure ulcer rates whereas Bergstrom and Braden (1998) found that white race was more predictive of pressure ulcer development.

Many studies are more specifically examining pressure ulcer risk factors in known risk patient populations. One European study examined extrinsic and intrinsic risk factors for pressure ulcer development in hip fracture patients in Northern versus Southern European hospitals. Waiting time and duration of surgery were significantly longer in the Southern European hospitals but were not statistically significantly related to pressure ulcer development (Lindholm et al., 2008). Shoonhoven et al. (2002) in a cohort study of 1229 patient records demonstrated that patients who developed a stage II or greater

pressure ulcer during their hospital stay were more likely to have had more frequent and prolonged surgery times.

There is a plethora of studies reporting quality improvement and quasi-experimental processes that measure the outcomes of pressure ulcer prevention interventions. Maklebust et al. (2009) report on the effects of technology-assisted training of pressure ulcer interventions. The module taught nurses to correctly assess using the Braden Scale Pressure Ulcer Risk Assessment Tool and to plan risk based interventions. They found that the web-based training improved accuracy of prevention interventions but for new users only. More troubling is a meta-analysis of 33 pressure ulcer risk scale studies conducted by Pancorbo et al. (2006). Findings indicated no evidence that use of a risk scale decreased pressure ulcer incidence. Defloor & Grypdonck (2003) validated two risk scales in 1772 older patients and concluded that the use of effective prevention actually decreased the predictiveness of the risk scales.

In Whitman et al.'s (2002) study of 95 patient care units there was no significant relationship between staffing and pressure ulcer outcome. Additionally, Aydin et al. (2004) examined nurse staffing and pressure ulcer outcomes in a California (CalNOC) acute care hospital database of 134 hospitals over 20 quarters with prevalence data on 41,982 patient observations and found no statistically significant relationship between staffing level and pressure ulcer incidence although there was a clinical trend that showed lower pressure ulcers with higher RN staff ratios. In a cross sectional study of 120

European inpatients, Gunningberg (2005) found that for a majority of patients who were assessed at risk, that majority did not receive pressure ulcer prevention.

The literature provides a robust list of extrinsic risk factors associated with pressure ulcer development and patient characteristics that place a patient at risk for developing a pressure ulcer. There is sparse literature describing risk factors for hospital versus community acquired pressure ulcers and few studies that specifically focused on risks associated with the most severe stage III, IV and unstageable pressure ulcers. Therefore this study will be informed by the findings in the literature in order to develop research questions that examine risk factors in a population of acute care patients who have developed the most severe pressure ulcers.

Chapter 3

Methodology

The purpose of this study was to identify whether pressure ulcer staging can be predicted from the knowledge of an individual's risk factors (age, gender, race/ethnicity, PU origin (community or hospital), Braden Risk Score, and length of hospital stay). The Quality Health Outcomes Model informs the examination of the relationship between the predominant patient characteristics (diagnosis, age, gender, skin color), system characteristics (hospital acquired or community acquired ulcer, Braden risk score, length of stay) and the outcome (stageable or unstageable) pressure ulcer.

Specific Aims

The specific aims of the study include:

Aim # 1: Characterize a sample of pressure ulcer patients receiving care at two acute care hospitals in a large Magnet designated public healthcare district.

Aim # 2: Examine the relationship between demographic (age, gender, ethnicity), system characteristics (hospital acquired or community acquired, Braden risk score, length of stay) and staging of pressure ulcer.

Aim #3: Explore factors that increase the probability of being classified with stageable pressure ulcers.

Design

A descriptive design using precollected retrospective data was used to identify relationships between independent risk variables and pressure ulcer severity in a subset of acute care hospital patients who are identified with stageable III-IV, and unstageable pressure ulcers. Descriptive designs facilitate examination of information not previously explored (Kerlinger & Lee, 2000) as was intended with this population. The dependent variable of interest was pressure ulcer severity (stageable versus unstageable) with a focus on the difference between hospital acquired and community acquired source to determine if there are any differences in reported risk factors.

Subjects and Setting

The sample of severe pressure ulcer patients was extracted from a database of over 4000 records from patients seen by wound care nurses from the time period of January 1 2008 through February 28, 2010. The wound care and pressure ulcer database is kept for the purpose of reporting wound care nurse productivity for two acute care hospitals in a large public hospital district in North San Diego County. This is a non-teaching hospital system that includes two acute care hospitals, one 319 bed level 2 trauma center and a smaller 107 bed hospital. Wound and pressure ulcer data has been collected five days a week by two certified wound care nurses on patients since 2005 and

recorded in an Access database located on a secured computer drive. The database included patient records that include diagnosis of pressure ulcer as well as medical record number that allowed a query of the electronic medical record for the information needed to access data required for the independent variables.

Inclusion and Exclusion Criteria

The population of stageable III-IV and unstageable pressure ulcer patients included in the analysis was extracted from a Microsoft Access database developed by a WOCN Certified Advanced Practice wound care nurse. Data was then extracted from the electronic records of adults greater than 18 years of age who had been hospitalized within the two year period from 2008 to 2010. The initial staging of the pressure ulcers as either stage III-IV or unstageable in the database was diagnosed by either one of the two certified wound nurses.

Records in the database of patients with wounds other than pressure ulcers or other types of consults where data is incorrect or incomplete were excluded from analysis. When etiology of heel ulcers is uncertain (Neuropathic or severe peripheral vascular disease), and not clearly identified as resulting from pressure injury, these were excluded from the sample.

Power, Effect and Sample Size

There is no consensus on the approach to compute the power and sample size with logistic regression; although as pointed out by Katz (2006), ten outcomes for each

independent variable is appropriate. In logistic regression an estimate of the probability of a certain event occurring is made, rather than detecting the difference or relationship that may be present, such as in linear regression. No assumptions are made about the dependent variable (stage), the relationship is non-linear, and is not normally distributed (Munro, 2005). Some authors use the likelihood ratio test; some use a test of proportions; some suggest various approximations to handle the multivariate case. Some advocate the use of the Wald test since the Z-score is routinely used for statistical significance testing of regression coefficients (Demidenko, 2007). Since this is a descriptive study and not focused on hypothesis testing, the Final Logistic Regression Model, which includes significance defined by $p < 0.05$, where p is from the Wald test for Confidence Interval for the Odds Ratio and overall statistical significance is tested by the likelihood ratio test $p < 0.1$, is used to demonstrate logistic regression model fit.

Measurements and Data Collection Procedures

Dependent variable = Pressure Ulcer

The dependent variable of interest was pressure ulcers stages III-IV(stageable), and unstageable which included deep tissue injuries that have evolved into unstageable or stage III, IV pressure ulcer. Pressure ulcers are classified according to the amount of visible tissue loss (NPUAP, 2007). Stage III and stage IV ulcers have known depth while unstageable ulcers are covered with either slough or eschar which obscures the true depth of the ulcer. The unstageable ulcer is considered a full thickness ulcer so the unstageable

ulcer will be either a stage III or Stage IV once the dead tissue is removed. Distinguishing the difference between these variables is an interest in this study since healing of pressure ulcers is delayed in unstageable ulcers with eschar and slough (Bergstrom et al. 1994 pg 47).

The ulcers were categorized into either of the following 2 options: 1, Community acquired (CAPU), or Hospital acquired (HAPU), and 2, Stageable or Unstageable. The National Pressure Ulcer Advisory Panel definitions was used to determine pressure ulcer stage (2007, NPUAP, see appendix 1) with full thickness pressure ulcers divided into a dichotomous outcome variable Stageable or Unstageable. The National Database of Nursing Quality Indicators (NDNQI, 2009) definition was used to define Community acquired (pressure ulcers present on admission to the facility as documented on the admission assessment), verses Hospital acquired pressure ulcer (ulcers that develop while the patient is in the facility) category. Pressure ulcer site data was also collected and grouped into categories based on anatomical location of pressure ulcer or ulcers for descriptive purposes (see table 1). Pressure ulcer coding for re-imburement in the electronic medical will also be recorded as yes or no.

Independent Variables

The Braden Risk (Bergstrom & Braden, 1992) assessment scale. Braden interrater reliability is reported in the literature both as a research tool and a screening tool for clinical practice. For researchers, achievement of interclass correlations to assess

consistent reliable data collection is typically set at $r = 0.95$. For the purposes of this study, the utility of the Braden as a screening tool was not evaluated for clinical practice since secondary data extraction was from inactive clinical records. A second rater would need to perform the Braden Risk assessment on the same patient at the same point in time in order to be precise.

The Braden risk assessment scale, usually a ratio level of measurement, was recorded as a categorical independent (control) variable for this study. The scores ranged from 6-23 where there is no true zero. For the purposes of analysis, risk categories were developed and stratified into 5 levels as described in the Wound Ostomy and Continence Guideline for Prevention and Management of Pressure Ulcers (2006): 19-23 = no risk (0), 16-18 = mild risk (1), 13-15 = moderate risk (2), 10-12 = high risk (3), ≤ 9 = very high risk (4).

Table 1 Variables

Length of Stay (LOS)	Numerical	Number of days in Hospital for patient with Pressure Ulcer during which stay pressure ulcer was discovered
Age	Numerical	Number of years old at time of pressure ulcer
Race/ethnicity	Categorical	0= Caucasian 1= Hispanic 3= Asian/Pacific Island 4 =African American 5 =Other/Non-Hispanic 6=Native American
Gender	Categorical	0=M 1=F
Pressure Ulcer Severity (Outcome)	Categorical	0=Stage III-IV 1= Unstageable
Pressure Ulcer Coded for Reimbursement	Categorical	0=No 1=Yes
Braden Pressure Ulcer Risk assessment Scale	Numerical	19-23 = no risk (0), 16-18 = mild risk (1) 13-15 = moderate risk (2) 10-12 = high risk (3) 6- 9 = very high risk (4)
Skin Color	Categorical	0=Light 1=Dark 2=Unknown
Ulcer Site	Categorical	0= ear, nose, head, elbow 1= leg, heels, knee 2= back, hip, buttock, sacrum, or 2 sites 3= 3 or more sites
ICD 9 Major diagnostic group (Grouper) Diagnosis ICD-9 # condition responsible for admission to hospital	Categorical	See appendix C

Pilot Study

Evaluation and modification of Wound CNS Database for feasibility of data extraction for community versus hospital acquired pressure ulcer outcomes was completed. A one page data collection tool was developed and tested for use with the database's recorded information on patients with stage III-IV and unstageable ulcers. The formatting allowed faster extraction, collection and categorized of data from the electronic medical record by mutual agreement between researcher and statistician (see tables and appendix).

Instruments: See appendix

NPUAP Pressure Ulcer Staging (2007) Appendix A

Braden Risk Assessment Scale (1987, Bergstrom and Braden) Appendix B

Data tool. Appendix C

Database and chart extraction from identified dependent variable population (pressure ulcer patients) for Independent Variables as modeled above was recorded in an excel format for input into SPSS statistical program.

Statistical analysis

Initial descriptive statistics are presented in tables with mean, median, mode and standard deviations for numerical variables was completed in order to characterize the pressure ulcer patient sample for aim number one. Chi-Square analysis was completed for observed frequencies for categorical predictor variables: Braden Risk Score, gender, ethnicity, and skin color. Pearson's correlation was calculated for predictor variables length of stay, age, and Braden (which was analyzed as a continuous variable) to determine if there were any relationships. Stepwise Logistic regression analysis was used to determine relationship between independent variables and the two variables HAPU/CAPU, and stageable/unstageable pressure ulcers.

Logistic regression is a multivariate statistical analysis that can be used to predict membership in one dichotomous variable from a set of independent variables. Since the dependent variable is categorical and the explanatory variables are either categorical and or continuous, the logistic regression model can be used to predict membership in one of the outcome categories. The tolerance statistic in the SPSS software can examine multicollinearity among the independent variables to insure that they do not measure the same thing. Tolerance statistics less than 0.10 would suggest a collinearity problem within the identified independent variables (Mertler & Vannatta, p. 169, 2005) and would require re-examination of predictor variables for inclusion in the study.

The third variable, which determines if the pressure ulcer is coded in medical record, is reported as a percentage for the total sample.

Methodological assumptions

For this study, a logistic regression analysis was considered. This method is both more complex and flexible than a simple linear regression. The rationale for using this method is that the dependent or outcome variable was categorical/discrete and reduced to two values (Stageable and Unstageable). The data analysis examined the relationship between the independent variables (Hospital Acquired/Community Acquired) and independent risk variables in order 'predict' odds of membership in one of the two outcome categories.

Limitations

Limitation of the study is that it relies on data previously collected. Inconsistent, inaccurate or missing data was one of the main limitations of this study and resulted in a smaller sample size than originally attempted. Although every attempt was made to find the first documented incidence of severe ulcer, the community acquired pressure ulcers could have occurred from another healthcare system hospital admission that would not be apparent in this hospital's electronic medical record. Since there was no contact with patients or nursing staff, only the documented data in the electronic medical record was available for recording of variables. Although the wound care nurses have a record of diagnosing all severe pressure ulcers, there may be inconsistencies of severity as size of

ulcer was not included in the analysis. In addition, the categories for stage III and IV were collapsed into the stageable outcome category for analysis. Stage III can be considered in some cases much less severe than stage IV which causes major morbidity when bone is involved.

Since only severe pressure ulcers stage III and more severe are included in the data, knowledge about the progression of pressure ulcers in this vulnerable population was not be assessed in this study but offers an opportunity for future research. The study will not have the strength of a prospective randomized control trial since not all pressure ulcer risk factors will be included as would be in a more controlled study. There are issues when proposing a control study since it is not ethical to eliminate one vulnerable group from any pressure ulcer prevention activities in order to study pressure ulcer outcome.

There is always the risk of inconsistency in the staging of pressure ulcers; however, the staging was performed by two professionally certified wound care nurses with more than ten years of pressure ulcer assessment experience each.

Human Subjects Protection

To ensure protection of all subjects' freedom from intrinsic risk or injury, all human subject protection considerations were utilized. Approval for the study was obtained from the University of San Diego Investigational Review Board (Appendix B) and the Palomar Pomerado Health Investigational Review Committee (Appendix C).

Since this is a retrospective chart extraction with all patient identification removed, no informed consent was required. All patient data was stored on a secure password protected drive in the hospital information system. Only the Wound Clinical Nurse Specialist (principle investigator), the Certified Wound Ostomy and Continence Nurse and one administrative assistant had access to the drive. All patient identification was removed before the data was handed off to the statistician for the analysis. There was no perceived potential physical, psychological, or social risk to the subjects in the study. Findings will be used to enhance pressure ulcer prevention and care in this vulnerable population.

Chapter IV

RESULTS

The purpose of this study was to identify whether pressure ulcer staging could be predicted from the knowledge of an individual's risk factors (age, gender, race/ethnicity, PU origin (community or hospital), Braden Risk Score, and length of hospital stay). In this chapter results are presented including a profile of the sample followed by each research question and the results of the analysis.

Aim # 1: Characterize a sample of pressure ulcer patients receiving care at two acute care hospitals.

Aim #2: Examine the relationship between demographic, (age, gender, ethnicity), system characteristics (hospital acquired or community acquired, Braden risk score, length of stay) and staging of pressure ulcer.

Aim #3: Explore factors that increase the probability of being classified with stageable pressure ulcers.

Characteristics of the Sample (Aim # 1)

Data was collected through a retrospective audit of patient records obtained from a wound consult data base of a large healthcare system located in northern San Diego County. Specifically, pressure ulcer patients who received care between January 1, 2008 to February 1 2010. The wound consult data base contained a total of over 4000 patient visits. Initially 414 patient records met inclusion criteria of being 18 years of age or older; been hospitalized within the two year period from 2008 to 2010; and initial staging of the pressure ulcers as either stage III-IV or unstageable. Next the sample was further reduced to 300: eligible records contained all the data elements for the analysis. Ultimately, 299 records were included in final regression analysis as one of the 300 records was found to have missing data.

The demographic portion of the chart abstraction form (Appendix A) was designed to collect information from which a profile of the sample could be developed and was used to extrapolate subject demographic and personal data. These data included age, gender, ethnicity, skin color, diagnosis, etc.

As shown in Table 1, the sample was evenly distributed based on gender (149 males, 150 females), with a mean age of 74.24 (*SD* 16.45) years, range 20 - 103. More than three quarters of the sample were Caucasians 79.7 %(*n* = 293), with 9% (*n* = 27) Hispanics, 4% (*n* = 12) Asian/Pacific Islander, 2% (*n* = 6) Native American, and 2% (*n* = 6) other-non-Hispanic. Approximately 80% (239) classified skin color as light, 16.3%

(49) as dark, and 4% (12) were unknown. Since the sample was predominantly Caucasian, it was decided to collapse the categories for ethnicity to Caucasian and non-Caucasian for subsequent analysis.

Mean score for length of stay ($N = 300$) was 13.47 ($SD = 30.49$) days, range 1 to 340 days, median 7.00, mode 4. The decision was made to keep the outliers ($N = 5 > 250$ days) in the analysis since clinically, longer length of stays challenge nurses to be especially vigilant in pressure ulcer prevention and hospital acquired pressure ulcer are frequently unavoidable in this population.

Pressure ulcers in the sample were predominantly community acquired 259 (86.3%), rather than hospital acquired 41 (13.7%). For the Braden Risk Scale by category, 29 (9.7%) were classified as very high risk, 94 (31.3%) high risk, 126 (42%) moderate risk, 44 (14.7%) mild risk, and 7 (2.3%) no risk. The predominant ulcer sites were the back, hip, buttock, and sacrum, and 2 or more (including buttock and heel or hip and other) ulcer site category, totaling 192 (64%). The next most common sites were the heels or legs at 52 (17.3%), followed by ulcers on 3 or more areas 49 (16.3%). Seven (2.3%) of patients had ulcers on ears, nose, head, or elbow. The most prevalent pressure ulcer stage was the unstageable ulcer at 226 (75.3%), while stageable (III+IV) ulcers equaled 74 (24.7%); 39 (13%) and 35 (11.7%) respectively.

Table 2

Characteristic	
Gender	N (%)
Male	149 (49.6%)
Female	150 (50.0%)
Ethnicity	
Caucasian	239 (79.8%)
Hispanic/Latino	27 (9.0%)
Asian/Pacific Islander	12 (4.0%)
African American	10 (3.3%)
Non Hispanic/Other	6 (2.0%)
Native American	6 (2.0%)
Skin Color	
Light	239 (79.8%)
Dark	49 (16.3%)
Unknown	12 (4.0%)
Braden Risk Score	
No Risk (19-23)	7 (2.3%)
Mild Risk (16-18)	44 (14.7%)
Moderate Risk (13-15)	146 (42.0%)
High Risk (10-12)	94 (31.3%)
Very High Risk (6-9)	29 (9.7%)
Acquired PU	
Hospital	41 (13.7%)
Community	259 (86.3%)
Ulcer Site	
Ear, Nose, Head, Elbow	7 (23%)
Leg, Heels, Knee	52 (17.3%)
Back, Hip, Buttock, Scrum, or 2 sites	192 (64%)
3 or more sites	49 (16.3)
Stage	
Stageable	74 (24.7%)
Level III	39 (13.0%)
Level IV	35 (11.7%)
Unstageable	226 (75.3%)
Coded for Reimbursement	
Yes	211 (70.3%)
Length of Stay (<i>M, SD</i>) Range	
	13.47(30.49) 1-340
Age	
	74.24 (16.42) 20 -103

Diagnosis

In order to describe the comorbidities of the study patients, a decision was made to use the initial diagnosis or major diagnostic group (MSDRG) that was coded in the medical record upon discharge. The second code was the diagnosis (ICD-9) that was the illness or major health reason for the current hospitalization was also included to provide additional detail about the patient's health status. There were 127 coded major MSDRG groups and 150 different ICD-9 coding for this patient population (see appendix D). There were frequently many other ICD-9 codes recorded in the final discharge analysis but the decision to include only the first two was made by the researcher and statistician in order to limit the number of independent variables. Even with this limitation the number of codes was so large that statistical analysis was problematic. A decision was made to review the MSDRG and ICD-9 codes and collapse them into 10 major diagnoses by systems for descriptive purposes. Frequencies for the 10 groups for both the MSDRG group and ICD-9 group were examined to determine the top 3 areas that accounted for 50% of the diagnostic codes. Major diagnoses are summarized in table 3.

Table 3

Group 1	Infection, sepsis
Group 2	Cancers, oncology diagnosis
Group 3	Metabolic disorders, Diabetes, other diagnosis not categorized
Group 4	Cardiovascular, includes heart failure and vascular disease
Group 5	Neurological diagnosis, includes trauma, stroke, injury, mental problems
Group 6	Respiratory, includes pneumonia, failure, obstructive disease
Group 7	Gastrointestinal, includes perforation, hepatitis, bleeding
Group 8	Wounds, includes pressure ulcer, grafts
Group 9	Orthopedic, includes fractures, osteomyelitis, stenosis
Group 10	Renal disease, includes renal failure, urinary tract infection

MSDRG category	Frequency	Percent	ICD-9 category	Frequency	Percent
1	56	18.7	1	64	21.3
2	11	3.7	2	10	3.3
3	16	5.3	3	20	6.7
4	43	14.3	4	31	10.3
5	18	6	5	13	4.3
6	51	17	6	60	20.0
7	23	7.7	7	25	8.3
8	21	7.0	8	23	7.7
9	29	9.7	9	24	8
10	30	10	10	30	10
Total	298	99.3			
Missing	2	.7			

It is notable that the largest percent of patient diagnosis in both the MS-DRG category and the ICD-9 category involved infection or sepsis (18.7 and 21.3% respectively). The next two most frequent diagnostic groups were cardiovascular (14.3% and 10.3% respectively), and respiratory (17% and 20% respectively). The least represented of groups were the cancer group with 3.7% and 3.3% followed by metabolic disorders (diabetes and other diagnosis not categorized) category 5.3% and 6.7%, and neurological diagnosis, including trauma, stroke, injury, mental problems, 6% and 4.3%.

Research Aims and Questions

Aim #2: Examine the relationship between demographic, (age, gender, ethnicity), system characteristics (hospital acquired or community acquired, Braden risk score, length of stay) and staging of pressure ulcer.

Research Question 1.

Are there statistically significant differences in ulcer source (hospital versus community) by gender, Braden Risk score, ethnicity, or skin color?

As shown in table 4, there are no statistically significant differences in the above predictors and ulcer source.

Table 4

<i>Predictor Variable</i>	<i>Community Acquired n (%)</i>	<i>Hospital Acquired n (%)</i>	<i>Chi-square value</i>	<i>p</i>
Gender				
Male	125 (48.3%)	25 (61%)	2.288 (df=1)	.130
Female	134 (51.7%)	16 (39%)		
Braden Risk				
None	4 (1.5%)	3 (7.3%)	7.807(df=4)	.099
Mild	35 (13.5%)	9 (22%)		
Mod	112 (43.2%)	14(34.1%)		
High	82 (31.7%)	12 (29.3%)		
Very High	26(10%)	3 (7.3%)		
Ethnicity				
Caucasian	210 (81.1%)	29 (70.7%)	2.340 (df =1)	.126
Non Caucasian	21 (8.1%)	6 (14.6%)		
Skin				
Light	210 (81.1%)	29 (70.7%)	2.455 (df = 2)	.293
Dark	39 (15/1%)	10 (24.4%)		
Unknown	10 (3.9%)	2 (4.9%)		

Note: N = 299

Research Question 2

Are there statistically significant relationships between length of stay, age, ulcer source (hospital versus community), and Braden risk score?

There is a statistically significant positive relationship between length of stay (LOS) and hospital acquired pressure ulcer source ($r = .17, p < .05$). The longer the patient is in the hospital, the greater risk of developing a hospital acquired pressure ulcer. Curiously, there is a statistically significant inverse relationship between length of stay and age ($r = -$

.13, $p < .05$). The younger a patient is the more likely to be hospitalized with a longer length of stay. See table 5.

Table 5: Pearson's Correlations

	Length of Stay	Age	Hospital vs. Community Acquired PU	Braden Risk Score
Length of Stay	-			
Age	-.139(*)	-		
Hospital vs. Community Acquired PU	.171(**)	-.086	-	
Braden Risk Score	.033	.103	-.104	-

Research Question # 3

Are there statistically significant differences in staging by gender, Braden Risk score, ethnicity, skin color, or ulcer source (hospital versus community)?

Levene's test was conducted for each ANOVA; where there was indication of violation of the homogeneity of variance assumption, Welch's F is reported. For the ANOVA for Braden Risk Score by stage and age by stage, Levene's test ($p = .035$) and $p = .011$ respectively, indicated a violation of the homogeneity of variance assumption. Therefore, Welch's test is reported for Braden Risk by stage, $F(1, 277.42) = 1.67$, $p = .198$ and for age $F(1, 104.25) = 3.16$, $p = .078$.

Crosstabulations revealed a statically significant difference in staging by source (hospital or community) $\chi^2(1) = 10.08$, $p = .002$. No statistically significant difference

in staging by gender, $\chi^2 (1) = 1.79$, $p = .18$, or ethnicity $\chi^2 (1) = .464$, $p = .496$ were found.

Research Question # 4

What is the relationship between where acquired PU and staging of ulcer?

Ninety-five percent of patients had unstageable hospital acquired pressure ulcers compared to 72% of community acquired pressure ulcers. Twenty-seven percent of community acquired pressure ulcers were stageable (27.2%) compared to hospitalized acquired PUs (4.9%) There were statistically significant differences in the incidence of patients admitted from the community with a pressure ulcer (stageable or unstageable) and those hospital acquired, $\chi^2 = 10.0$, $p = .002$.

Aim #3: To explore factors that increase the probability of being classified with stageable pressure ulcers.

Research Question 5

What independent variable(s) increase the risk for stageable (III-IV) versus unstageable ulcers?

A logistic regression with predictor variables: gender, age, length of stay, ethnicity, community or hospital origin (HAPU or CAPU), and Braden Risk Score was

computed. Prior to the analysis the independent variable race/ethnicity and the dependent variable ulcer stages were collapsed to (0 = Caucasian, 1 = non Caucasian) and 0= stageable (combined Stage III and Stage IV) respectively; or 1= unstageable .

A forward logistic regression was conducted to determine which of the six selected independent variables (gender, age, length of stay, ethnicity, community or hospital origin (HAPU or CAPU), Braden Risk score increased the odds for stageable ulcers.

Regression results indicate the overall model of six predictors was statistically reliable in distinguishing between the presence or absence of stageable ulcer, -2 Log Likelihood = 311.38; provides an index of model fit; $\chi^2 = 23.23 (6) p < .001$. The Hosmer and Lemeshow Chi-Square test of goodness of fit was used to test for overall fit of the binary logistic regression model. This test is considered more robust than the traditional chi-square test, particularly if continuous covariates are in the model or sample size is small. A finding of non-significance $p = .532$, signifies that the model adequately fits the data. The model correctly classified 75.3% of the cases. Regression coefficients are presented in Table 4. Wald statistics indicated that age, $B = 0.19, p = .026$ and source-Hospital acquired $B = -2.17 p = .004$ significantly increased the odds for unstageable ulcers. However, odds ratios (OR.114) for this variable are fairly small, indicating little change in the likelihood of predicting unstageable ulcers.

Table 6 Regression Coefficients

Predictor	<i>B</i>	<i>Wald</i>	<i>df</i>	<i>p</i>	<i>Odds Ratio</i>
LOS	-.004	.596	1	440	.996
Gender	.407	2.011	1	156	1.503
Braden	.240	2.342	1	126	1.272
H or C acquired	-2.168	8.333	1	004	.114
Ethnicity	-.185	.253	1	615	.831
Age	.019	4.980	1	026	1.019
Constant	1.203	1.370	1	.242	3.329

Chapter 5

DISCUSSION OF FINDINGS

The purpose of this research study was to examine risk factors associated with severe pressure ulcers. In this chapter the research design and method, data analysis and the overall results was summarized in the context of the literature and the Quality Health Outcomes /Spheres of Influence Model which provided the conceptual framework for this study. Those variables that are associated with severe pressure ulcer outcome, either hospital or community acquired, will be discussed and the non-significant variables will be addressed. In addition, implications for nursing practice, education and research are presented.

This study was conducted with data from two acute care hospitals that are part of the largest public health system in California. The sample of 300 eligible records of patients with severe pressure ulcer outcome was derived from a data set of 4000 patients in the wound care quality database receiving wound care consults between January 1, 2008 and February 18, 2010. Two hundred and ninety-nine patient records were included

in the final analysis and logistic regression model. The dependent variables included patients with a stage III-IV stageable, or unstageable pressure ulcers diagnosed by a certified wound care nurse. The majority of the patients were Caucasian and had community acquired unstageable pressure ulcers.

Specific Aim

The specific aim of this study was to determine if there were statistically significant differences in ulcer source (hospital versus community) by gender, Braden Risk score, ethnicity, or skin color. An additional aim was to explore any statistically significant relationships between length of stay, age, source, and Braden risk score, and determine which independent variable(s) increase the risk for stageable (III-IV) versus unstageable ulcers. Characteristics of the patients in the sample are also described.

The Quality Health Outcomes /Sphere of Influence Model was useful as a framework for conceptualizing the relationship between the healthcare organization, the patient at risk for pressure ulcer, and the staff responsible for care of the patient at risk and outcome of severe pressure ulcer. Pearson's correlation indicated that the longer the patient was hospitalized the more likely a hospital acquired severe pressure ulcer. The variables examined in the logistic regression model that demonstrated significance as predictors of stageable /unstageable pressure outcome were age and source. The study also found that a statistically significant number of hospital acquired pressure ulcers were in the unstageable category. There are several explanations for this finding and these will be discussed as they relate to nursing clinical practice. This is a finding that will require further study.

This study found that the mean age of patients in the sample was consistent with what was reported in the literature. With respect to age, an interesting finding in this study was that the

older had a significantly shorter length of stay. Older patients are frequently hospitalized when they develop an acute exacerbation on top of a chronic illness then are quickly managed and returned to the community. In addition, the multicollinearity violation between age and Braden risk in the logistic regression could be a reflection of nursing awareness. Age is a risk factor frequently reported in the literature, nurses may be more aware of an older patient's risk and therefore may unconsciously and automatically assess a low Braden and implement close assessment and prevention with this population.

Although Fogerty, et al.(2005) found African American race and Baumgarten, et al. (2004) found darker skin presented an increased risk for pressure ulcer, this study found no relationship between hospital or community acquired pressure ulcer risk related to ethnicity or skin color.

There was some indication that certain diagnostic groups represented a higher overall percentage of the study population. The first two of these diagnostic groups were consistent with what was reported by Compton et al. (2008). The first two broad categories of this study that encompassed 33.3% of the major diagnostic related groups were sepsis/ infection, and cardiovascular and/or heart failure/vascular disease. These are consistent with the Compton (2008) findings of circulatory impairment and sepsis association with pressure ulcer. The third major diagnostic category that contributed to the most represented diagnostic coding for this study was respiratory illness which included end stage chronic obstructive pulmonary disease, pneumonia and respiratory failure. The closest related diagnosis that was reported in the literature was also in the Compton (2008) study and was described as organ failure. There are several other high pressure ulcer risk populations reported in the literature that were not highly represented in this study but this may only indicate that these populations, i.e. spinal cord injury

patients, do not contribute to a very large segment of our acute hospitalization patient population in general.

Although the Braden Risk Assessment did not predict either stageable or unstageable pressure ulcer risk, it was notable that 249 out of 300 of the risk scores were moderate to very high risk. Only 7 (5.3%) of the risk scores were considered no risk. A majority (n = 6) of the no risk patients were in the unstageable pressure ulcer category. Patients who were scored as “not at risk” may have been scored inaccurately or have had other risk factors not captured by the Braden Risk assessment such as prolonged operation time.

Study findings indicating that pressure ulcers are predominantly community acquired are interpreted with caution. It is reassuring that nursing staff are “catching” pressure ulcer status on admission assessment since all hospital acquired stage III plus ulcer need to be reported to the California Department of Health Services (CDHS) within five days of discovery. Equally important, the additional cost of care for stage III+ pressure ulcers that are hospital acquired is not reimbursed by Medicare/Medicaid services (CMS) (<http://www.cms.hhs.gov/HospitalAcqCond/> accessed Aug 1, 2009). Alternately, these patients reside in our community and are considered by the public health system to be our healthcare responsibility. Pressure ulcer literacy for our vulnerable patient populations needs to be a priority.

Implications for Nursing

Practice

An important outcome of this work will be translation of the results of this study into practical application and practice utilizing the Skin Team and the structure- process- outcome model. Future work will include examining the variables prospectively for predictive significance that may be amenable to healthcare system changes, nursing pressure ulcer

prevention and care, and patient education both within the acute care hospitals and for the community of patients at risk. Examples of system issues that place patients who are already at risk in danger of pressure ulcer formation are crowded emergency rooms or diagnostic testing areas where patients wait on hard gurneys to be seen or pre-operative areas where pressure ulcer prevention is not the focus of care. Other system problems that contribute to high pressure ulcer incidence include outdated or broken support surfaces that do not function as designed, linen and supplies that may be inexpensive and inefficient for protecting vulnerable skin.

This study adds to a growing body of research that addresses challenges when interpreting which patients are at risk for hospital or community acquired severe pressure ulcers. It is important to note that unstageable pressure ulcers, which represented 75% of this study population's ulcer, are full thickness wounds where the actual depth of the ulcer is completely obscured by slough or eschar (dead adherent tissue) in the wound bed (NPUAP 2007). If and when these wounds are cleaned (debridement) of dead tissue, they will be either a stage III or IV ulcer.

Healing time for unstageable pressure ulcers is prolonged as the presence of slough in the wound bed increases the bacterial load and decreases the body's ability to heal the wound. The newly released Pressure Ulcer Prevention and Treatment Clinical Practice Guidelines (2009) were developed jointly by the European Pressure Ulcer Advisory Panel (EPUAP) and the National Pressure Ulcer Advisory Panel (NPUAP). Page seventy-seven of the guideline concludes that though there is very little direct evidence (randomized control trials posing ethical problems) supporting debridement of pressure ulcers, there is strong informed clinical consensus to support debridement of pressure ulcers when devitalized tissue is present.

There are times when debridement is not clinically or ethically advisable as when the patient has not ability to heal the wound and debridement would cause more harm than benefit to the patient. The CNS and CWOCN consult with physicians and nurses to implement these orders to ensure that debridement (or not) and care is appropriate for each patient's goals. Most patient length of stays are too short to see any significant change in the amount of slough or eschar in the wound and patients are discharged before the wound can be considered stageable as either a stage III or IV. This may explain why a greater number of community acquired pressure ulcers are stageable. In the home or the skilled nursing facility, the patient may be getting treatment that cleans the wound of slough and eschar and accurate staging has occurred. Frequently patients with clean stage III-IV ulcers are admitted for surgical closure of the wound.

The information gleaned by looking at the diagnosis of patients with severe pressure ulcers offers an opportunity to look at nursing practice related to the hemodynamic instability of many critically ill patients. There is an informal belief that these patients are "too ill to be moved or turned" and that turning the patient brings on cardiac arrest. The fact that these patients are not able to perfuse their vital organs seems to guarantee that there will be insufficient perfusion for any skin on any pressure point; a perfect set-up for a severe ischemic pressure ulcer. Although many of these patients do not survive their critical illness, those that do may find that they also have a severe pressure ulcer to overcome. Research into staff nurses beliefs about re-positioning the unstable patient will need to be explored in order to determine what beliefs and practices prevail with this population.

Education

Clinical expert consults at the bedside are still finding staff who stage an ulcer as a stage II when the ulcer is actually unstageable. It was for this reason that the decision was made to

use only CNS/CWCN and CWOCN validated pressure ulcers in this study. The NDNQI website has a pressure ulcer staging tutorial that has worked well for the system. It does not require a password and can be assigned to staff as a competency. Staff nurses who have completed the tutorial have verbalized enthusiasm and praise for the teaching process; however, no measurements have been completed to determine if staging accuracy has improved.

Strong nurse advocacy for appropriate debridement for unstageable pressure ulcers is a treatment intervention that will need to be developed. Staff nurses are not always confident or accurate in their staging abilities nor do they all have the necessary knowledge base to determine which ulcers should be debrided. Work within the Skin Team guided by evidence has led to wound treatment orders that have several options for debridement. Strong nurse advocacy for appropriate debridement for unstageable pressure ulcers is a treatment intervention that will need to be developed.

The diagnostic group that is present in over 50% of the stage III, IV and unstageable ulcers patients provides some interesting information about the severe illnesses that the patient is hospitalized. Sepsis can be a very complex and difficult condition to treat especially if it is associated with shock. Patients who have multiple comorbid conditions are especially vulnerable to infections. Deciding which coded diagnosis is most relevant to pressure ulcer risk proved to be daunting as there were too many variables and too many comorbid conditions for each patient. When looking at the diagnostic codes, it was decided to use only the major MSDRG umbrella code and the first coded ICD-9 which was the major reason for hospitalization. Most of the patients had a long list of other comorbid conditions. This study did not attempt to include the multiple coded comorbidities such as diabetes, Parkinson's, Alzheimer's, and compromised

organ function, such as cardiac or pulmonary disease, renal failure, also listed in the coding summaries. Analysis of this magnitude proved beyond the scope of this study.

Research

There are a number of system processes that increase risk for unstageable pressure ulcers. Following an acute care admission, hemodynamically unstable patients are frequently transported on gurneys for diagnostic examinations or emergent surgery. During the evolution of a pressure ulcer, sustained pressure to a vulnerable pressure point, coupled with friction and shearing forces (as with moving a patient from a bed to a gurney and vice versa) along with any intrinsic problems manifested as hypoxia, hypo-perfusion to skin tissue, cause severe tissue damage, ischemia and cell death (Aronovitch, (1998). Tissue damage may not be evident immediately but can show up as late as 7 days after the initial injury (Kosiak, 1961). Dead tissue is then seen in the wound bed when the ulcer matures. This is one explanation of how an unstageable pressure ulcer might be statistically more common in the hospital acquired pressure ulcer population and will require further study. Future studies that explore patient transport, diagnostics, and operating room risk factors and practices will need to be conducted in order to determine with more specificity if these procedures contribute to severe pressure ulcer development.

Conclusion

This study demonstrated that a wound care practice and quality database can be used to conduct exploratory descriptive research on a patient population with severe pressure ulcers. Findings indicate that most patients have community acquired pressure ulcers and that these ulcers are unstageable, occur in our Caucasian patients, and occur equally in men and women. Although the mean age of patients with these severe pressure ulcers is around 75 years, younger

patients with longer length of stays were associated with a higher risk for hospital acquired pressure ulcers. Diagnostic groups most common in this population included patients with sepsis, cardiac and circulatory problems and pulmonary diseases. Hospital acquired severe pressure ulcers were significantly more likely to be unstageable with slough or eschar in the wound bed.

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Appendix A: Measures

National Pressure Ulcer Advisory Panel Stages

Suspected Deep Tissue Injury:

Purple or maroon localized area of discolored intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear. The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer or cooler as compared to adjacent tissue.

Further description:

Deep tissue injury may be difficult to detect in individuals with dark skin tones. Evolution may include a thin blister over a dark wound bed. The wound may further evolve and become covered by thin eschar. Evolution may be rapid exposing additional layers of tissue even with optimal treatment.

Stage I:

Intact skin with non-blanchable redness of a localized area usually over a bony prominence. Darkly pigmented skin may not have visible blanching; its color may differ from the surrounding area.

Further description:

The area may be painful, firm, soft, warmer or cooler as compared to adjacent tissue. Stage I may be difficult to detect in individuals with dark skin tones. May indicate "at risk" persons (a heralding sign of risk)

Stage II:

Partial thickness loss of dermis presenting as a shallow open ulcer with a red pink wound bed, without slough. May also present as an intact or open/ruptured serum-filled blister.

Further description:

Presents as a shiny or dry shallow ulcer without slough or bruising.* This stage should not be used to describe skin tears, tape burns, perineal dermatitis, maceration or excoriation.

*Bruising indicates suspected deep tissue injury

Stage III:

Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle are not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunneling.

Further description:

The depth of a stage III pressure ulcer varies by anatomical location. The bridge of the nose, ear, occiput and malleolus do not have subcutaneous tissue and stage III ulcers can be shallow. In contrast, areas of significant adiposity can develop extremely deep stage III pressure ulcers. Bone/tendon is not visible or directly palpable.

Stage IV:

Full thickness tissue loss with exposed bone, tendon or muscle. Slough or eschar may be present on some parts of the wound bed. Often include undermining and tunneling.

Further description:

The depth of a stage IV pressure ulcer varies by anatomical location. The bridge of the nose, ear, occiput and malleolus do not have subcutaneous tissue and these ulcers can be shallow. Stage IV ulcers can extend into muscle and/or supporting structures (e.g., fascia, tendon or joint capsule) making osteomyelitis possible. Exposed bone/tendon is visible or directly palpable.

Unstageable:

Full thickness tissue loss in which the base of the ulcer is covered by slough (yellow, tan, gray, green or brown) and/or eschar (tan, brown or black) in the wound bed.

Further description:

Until enough slough and/or eschar is removed to expose the base of the wound, the true depth, and therefore stage, cannot be determined. Stable (dry, adherent, intact without erythema or fluctuance) eschar on the heels serves as "the body's natural (biological) cover" and should not be removed.

Data Collection Tool

Subject*	LOS	gender	age	Group	ICD-9 1	Braden 1	H or C	Coded for reimb.	skin color

*MRN removed prior to statistical analysis

The Braden Scale for Predicting Pressure Sore Risk (1987)
Jayne Ball
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Appendix C: Palomar Pomerado IRC Approval

MEDICAL STAFF SERVICES

PALOMAR
POMERADO
HEALTH

November 25, 2009

Margaret Talley, R.N.
10303 Lavender Pt Lane
Escondido, CA 92026**RE: Pressure Ulcer Risk Factors for Patients with Hospital- Versus Community-Acquired Pressure Ulcers**

Dear Ms. Talley:

The Palomar Pomerado Investigational Review Committee (PPH IRC), in its meeting of November 12, 2009, reviewed and approved the protocol for the above-mentioned study. The study was approved to be conducted at Palomar Medical Center and Pomerado Hospital. The study was also granted a waiver of informed consent requirements as it meets the criteria in 45CFR46.116(d).

Approval was affirmed by the Executive Committee of Palomar Medical Center at their meeting of November 23, 2009 and the Executive Committee of Pomerado Hospital at their meeting of November 24, 2009.

Prior to initiation of the study, approval must also be obtained from the Administration of the Hospital(s) involved. Studies approved by the Investigational Review Committee may not proceed until after administrative approval is obtained. Please contact Melissa Wallace at (760) 480-7988 for information on the administrative review process. Study specific laboratory and imaging studies that will be performed as part of the study are required to be ordered on the appropriate form.

The Palomar Pomerado Investigational Review Committee is in compliance with Federal Rules and Regulations and operates in accordance with Good Clinical Practices. Approval of this protocol and informed consent is effective for one (1) year from the initial approval and may not proceed past November 12, 2010 without reapproval by the Palomar Pomerado Investigational Review Committee.

Sincerely,

Richard G. Just, M.D.
Chairman, Investigational Review Committee

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