REGISTERED DIETITIANS' KNOWLEDGE OF PRESSURE ULCERS AND THE ROLE OF NUTRITION IN WOUND CARE

A thesis submitted to the
Kent State University College
of Education, Health, and Human Services
in partial fulfillment of the requirements
for the degree of Master of Science

By

Kate Ellen Sample

December 2012

A thesis written by

Kate Ellen Sample

B.S., Kent State University, 2010

M.S., Kent State University, 2012

Approved by

_____, Director, Master's Thesis Committee
Eun-Jeong Ha

_____, Member, Master's Thesis Committee
Nancy Burzminski

_____, Member, Master's Thesis Committee
Natalie Caine-Bish

Accepted by

_____, Director, School of Health Sciences
Lynne Rowan

_____, Dean, College of Education, Health, and Human Services
Daniel Mahony

SAMPLE, KATE E., M.S., December 2012 Nutrition and Dietetics

REGISTERED DIETITIANS' KNOWLEDGE OF PRESSURE ULCERS AND THE ROLE OF NUTRITION IN WOUND CARE (129 pp.)

Director of Thesis: Eun-Jeong Ha, Ph.D.

The purpose of this study was to measure the general knowledge and the nutrition knowledge of pressure ulcer care of RDs in practice with regards to education, years of experience, age, different work settings, recency of exposure to educational material, and interest level towards working with older adults. Participants that were included in the study were 760 Ohio licensed RDs. The survey included demographics and 40 multiple-choice questions. Multiple-choice questions were divided into two parts: nutrition and treatment. Independent sample t-tests, ANOVAs, and Pearson's correlations were used to compare the scores of the nutrition and the treatment section with the data collected. Significance was set a priori at $p \leq 0.05$. Results of this study showed that there were no differences in pressure ulcer test scores with regards to the level of education; however, significance was found in years of experience, age, different work settings, recency of exposure to educational material, and interest level towards working with older adults. Study findings suggest that continuous exposure of updated pressure ulcer educational material throughout the RDs' career, particularly RDs who work in hospitals or long-term care facilitates, is important for maintaining or increasing knowledge of pressure ulcers.

ACKNOWLEDGMENTS

First and foremost, I would like to thank my thesis advisor, Dr. Eun-Jeong Ha, for all of her time, patience, comments, and advice. Her endless support and patience has helped me stay focused and motivated during this entire research process. I would also like to acknowledge the contribution of the other members of my thesis committee, Dr. Nancy Burzminski and Dr. Natalie Caine-Bish. Their professional knowledge and expertise have strengthened my paper and were much appreciated. In addition, I would like to express my appreciation to the registered dietitians who took the time to participate in my research study.

TABLE OF CONTENTS

TABLE OF CONTENTS continued

TABLE OF CONTENTS continued

LIST OF TABLES

Table Page

CHAPTER I

INTRODUCTION

"A pressure ulcer is localized injury to the skin and/or underlying tissue usually over a bony prominence, as a result of pressure, or pressure in combination with shear and/or friction (National Pressure Ulcer Advisory Panel [NPUAP], 2007, Pressure Ulcer Definition section)." About 2.5 million people in the United States develop pressure ulcers and 60,000 hospital patients will die from complications of these painful, chronic skin wounds every year (Joint Commission, 2008; Lyder, 2011). Healthy, mobile individuals do not develop pressure ulcers; however, occurrence of these lesions most likely occur in the elderly population, critically ill patients in intensive care units, diabetics, stroke victims, and those with impaired mobility and/or those who have inadequate nutrition status, occurring usually at the sacrum, coccyx, heels, elbows, and scapulae (Baranoski & Ayello, 2008; Baumgarten et al., 2008; Margolis, Bilker, Knauss, Baumgarten, & Strom, 2002; Margolis, Knauss, Bilker, & Baumgarten, 2003; Russo, Steiner, & Spector, 2008; Scemons & Elston, 2009). The elderly are more susceptible to the development of pressure ulcers due to decreased mobility and sensation, along with multiple disease states, loss of muscle mass, and poor nutrition (Baranoski & Ayello, 2008; Baumgarten et al., 2008).

Those who do develop pressure ulcers contribute to higher healthcare costs due to the extension of their hospital stay, increased staffing cost, and the amount of supplies

required for their treatment (Baranoski & Ayello, 2008; Graves, Birrell, & Whitby, 2005; Sendelbach, Zink, & Peterson, 2011). The occurrence of a pressure ulcer increases the cost of care from $10,000 to $86,000 per pressure ulcer, depending on the severity of the wound (Sendelbach et al., 2011). The financial, physical, social, emotional, and mental impact of having a pressure ulcer can result in decreased quality of life and increased dependence on others (Baranoski & Ayello, 2008; Hopkins, Dealey, Bale, Defloor, & Worboys, 2006; Spilsbury et al., 2007).

It has been reported that poor knowledge in the treatment and prevention of pressure ulcers can contribute to higher healthcare costs, impede wound healing, and increase the risk of mortality associated with malnutrition (Ayello, Thomas, & Litchford, 1999; Baranoski & Ayello, 2008). In addition, there may be an improvement in patient outcomes if there is an increase in the knowledge of pressure ulcer care (Maylor & Torrance, 1999; Pieper & Mattern, 1997; Pieper & Mott, 1995). Effective treatment from a multidisciplinary team approach, which includes physicians, physical, occupational, and speech therapists, nurses, and registered dietitians (RDs), should be involved in the treatment of a patient's pressure ulcer (Baranoski & Ayello, 2008; Brown, 2009). RDs are competent in performing nutrition assessments, monitoring the patients' food and fluid intake, and watching the patient's weight status ("Caring for Pressure Ulcers," n.d.). Nutrition especially plays an important role in the wound healing process; adequate calories, protein, fluid, zinc, vitamin A, and vitamin C help heal and repair tissue while keeping the body in positive nitrogen balance, whereas vitamin, mineral, and protein

deficiencies delay wound healing (Ayello et al., 1999; Baranoski & Ayello, 2008; Fonder et al., 2008; Lyder, 2003; Posthauer, 2005; Scemons & Elston, 2009). Nutrition status can also play a role in the prevention of pressure ulcers as inadequate nutrition, unintentional weight loss, underweight, and those with Braden scores ≤ 13 are associated as risk factors of pressure ulcers (Baranoski & Ayello, 2008; Fife et al., 2001; Scemons & Elston, 2009). Even though there are many treatments available for those suffering from pressure ulcers, the ultimate goal of the wound care team is the prevention of pressure ulcers, as most pressure ulcers are preventable according to the NPUAP (1992) (with exceptions in the critically ill patients in which patient comfort is the main goal).

Problem Statement

Poor knowledge in the treatment and prevention of pressure ulcers can significantly contribute to high healthcare costs, reduce patients' quality of life, impede wound healing, and increase the risk of mortality associated with malnutrition (Ayello, Thomas, & Litchford, 1999; Baranoski & Ayello, 2008). Moreover, patient outcomes may be improved when there is an increase in knowledge of pressure ulcer care (Maylor & Torrance, 1999; Pieper & Mattern, 1997; Pieper & Mott, 1995). Previous research with nurses studying their knowledge level of pressure ulcers has shown knowledge deficits in prevention such as repositioning, turning, and heel protection (Pieper & Mattern, 1997; Pieper & Mott, 1995; Smith & Waugh, 2009; Zulkowski et al., 2007), yet there has been very little, if any, improvement in nurses' knowledge of pressure ulcers since the original study performed in 1995 by Pieper and Mott (Smith & Waugh, 2009).

While there has been knowledge deficits present among nurses, wound care knowledge among RDs is not well-known. It is especially important to have knowledgeable RDs on the topic of wound care not only because nutrition plays a crucial role in the treatment and prevention of pressure ulcers (Ayello et al., 1999; Baranoski & Ayello, 2008), but due to the growing older adult population with whom these sores commonly occur (Baranoski & Ayello, 2008; Baumgarten et al., 2008; Lu et al., 2010). Therefore, due to an increased need of knowledgeable RDs on wound care, studying pressure ulcer knowledge among RDs may help determine whether there is a need to improve educational interventions to help reduce healthcare costs and enhance patient outcomes.

Purpose Statement

The purpose of this study was to measure the general knowledge and the nutrition knowledge of pressure ulcer care of RDs in practice with regards to education, years of experience, age, different work settings, recency of exposure to educational material, and interest level towards working with older adults.

Research Hypotheses

1. There will be differences in test scores for the general knowledge and the nutrition knowledge of pressure ulcer care between the levels of education of RDs in practice.

2. There will be differences in test scores for the general knowledge and the nutrition knowledge of pressure ulcer care between the years of experience of RDs in practice.
3. There will be differences in test scores for the general knowledge and the nutrition knowledge of pressure ulcer care between ages of RDs in practice.
4. There will be differences in test scores for the general knowledge and the nutrition knowledge of pressure ulcer care between the different work settings of RDs in practice.
5. There will be differences in test scores for the general knowledge and the nutrition knowledge of pressure ulcer care between the recency of exposure to educational material of RDs in practice.
6. There will be differences in test scores for the general knowledge and the nutrition knowledge of pressure ulcer care between the interest levels towards working with older adults of RDs in practice.

CHAPTER II

REVIEW OF THE LITERATURE

Pressure Ulcers

Pressure ulcers are painful skin lesions caused by unrelieved pressure that vary in size, depth, and location on the body (Baranoski & Ayello, 2008; Brown, 2009; Scemons & Elston, 2009). Pressure ulcers are also called decubitus ulcers, bedsores, pressure sores, and dermal ulcers, but "pressure ulcer" is the preferred terminology (Baranoski & Ayello, 2008; NPUAP, 1992). Capillaries provide blood to tissues; however, when this blood supply is cut off, skin integrity is affected and the tissue begins to deteriorate (Lyder & Ayello, 2008). This effect will result in the development of a pressure ulcer. Pressure ulcers commonly occur over body prominences, such as the sacrum, coccyx, heels, elbows, scapulae, iliac crest, trochanters, ischial tuberosities, and lateral malleolus (Baranoski & Ayello, 2008; Scemons & Elston, 2009). Sites that are often forgotten about are the occiput, ears, and the great toe region (Baranoski & Ayello, 2008).

Prevalence and Incidence

The prevalence and incidence rate of pressure ulcers is not well understood due to the confusion and inconsistency with pressure ulcer definitions and formulas for calculations (Baranoski & Ayello, 2008; NPUAP Board of Directors, 2001). The NPUAP Board of Directors (2001) examined 300 studies over the span of ten years

(1990-2000) to determine the prevalence and incidence of pressure ulcers in the United States. Prevalence of Stages I through IV pressure ulcers in general acute care settings ranged from 10 to 18%, 2.3 to 28% in long term care, and 0 to 29% in home care. Some studies excluded Stage I pressure ulcers, while others included it in their study (NPUAP Board of Directors, 2001).

Incidence of pressure ulcers was also examined by the NPUAP Board of Directors (2001) from 1990-2000. In this study, incidence of Stages I through IV pressure ulcers in general acute care settings ranged from 0.4 to 38%, 2.2 to 23.9% in long term care, and 0 to 17% in home care. A reduction in pressure ulcer incidence is not evident in the United States, even though knowledge of pressure ulcer development reduction is available (NPUAP Board of Directors, 2001).

Margolis et al. (2002) performed a large cohort design in the United Kingdom to determine the incidence and prevalence of pressure ulcers among elderly patients in the general practice setting. Out of over 200,000 medical records studied, it was determined that pressure ulcers were more likely to develop with increasing age. Incidence of pressure ulcers was much higher for those who were 85 years of age or older. Results from this study also showed that incidence did not differ between males of females or the time of year.

Another study performed in New York State from June 2006-July 2007 studied the racial differences and quality of care among African Americans and Caucasians in nursing home facilities (Cai, Mukamel, & Temkin-Greener, 2010). The results showed

that the quality of care and pressure ulcer risk did not differ between races in New York State. The higher proportion of pressure ulcers among African Americans was discovered in poorer communities with lower quality nursing home facilities with Medicaid residents; these facilities tend to be not-for-profit and have fewer resources than "better" quality nursing homes.

Costs

Although the average cost for pressure ulcers differs among health facilities, it is known that pressure ulcers create a financial burden for patients, families, and the facility due to the amount of supplies and staffing hours (Baranoski & Ayello, 2008; Dorner, Posthauer, & Thomas, 2009; Fife et al., 2001). Sendelbach et al. (2011) noted that treatment costs vary by the stage of the pressure ulcer and can range anywhere from $10,000 to $86,000 per pressure ulcer. The estimated annual costs are between $5 billion and $8.5 billion for the treatment of pressure ulcers (Beckrich & Aronovitch, 1999).

Excessive length of hospital stays due to pressure ulcers can be influenced by many factors (Grave et al., 2005). Graves et al. (2005) reported results from 1,747 randomly selected patients to assess the effect of pressure ulcers on length of stay in the hospital. The authors found that patients with pressure ulcers had an excessive hospital stay by a median of 4.31 days. These authors noted that this estimate is lower in other literature because other studies may overstate the independent effects of pressure ulcers on extended length of hospital stay.

According to the National Quality Forum (NQF) consensus report (2006), one of the 28 “serious reportable events” (“never-events”) is listed as“Stage 3 or 4 pressure ulcers acquired after admission to a healthcare facility” (Lembitz & Clarke, 2009). Consistent with NQF’s “never events,” is a “no pay” policy classified by the Centers for Medicare and Medicaid Services (CMS). The CMS determined that pressure ulcers are "non-reimbursable serious hospital-acquired conditions" as they are “reasonably preventable” through implementation of evidence-based practices (Lembitz & Clarke, 2009). According to the Deficit Reduction Act of 2005, Section 5001 (c), discharges on or after October 1, 2008 that include certain medical conditions, such as the development of a Stage III or IV pressure ulcer, that occurred during the patient’s hospital stay not present upon admission, will no longer be reimbursed (Miller, 2009). This policy is meant to encourage clinicians to screen patients who are at risk of pressure ulcer development when they are admitted to the hospital. Hospitals can only be paid for pressure ulcers if the patient has a documented pressure ulcer upon admission (Cunningham, 2009). However, if a pressure ulcer progresses to a Stage III or IV from a Stage I or II, hospitals will not be reimbursed, although there are facilities that are exempt from this policy, such as Cancer Hospitals, Long-term Care Hospitals, Inpatient Psychiatric Hospitals, etc. (Miller, 2009).

The cost of pressure ulcers can be reduced by preventative measures. For example, Sendelbach et al. (2011) developed and implemented a successful pressure ulcer prevention program across a large healthcare system (10 hospitals) in Minnesota.

The program consisted of multiple interventions: education for healthcare workers and patient/families, resources for healthcare workers, timely nutrition assessments, and a "Skin Day" to raise awareness of pressure ulcers. With the implementation of this program using an interprofessional, evidenced-based approaches to prevention, the incidence of pressure ulcers decreased 33%, with potential cost savings of up to $430,000.

Stages

There are different stages to define the depth of tissue injury of these pressure ulcers. The staging system was originally created in 1975 by Shea; however, the definitions were unclear and confusing, which led to inaccurate staging (NPUAP, 2007). Table 1 is the staging system for pressure ulcers describing the depth of the tissue injury involvement to improve consistency and quality of care among clinicians, which was created by the NPUAP (2007).

Table 1 *NPUAP Pressure Ulcer Staging Definitions*

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. 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. 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. 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 is a sign that suspected deep tissue injury is present
Stage III	Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle is not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunneling. 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. 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. 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.

To determine the stage of the pressure ulcer, a physical wound assessment can determine the depth of tissue involvement. The physical wound assessment can also identify the characteristics of the wound, for example, the color, slough, eschar, fibrous tissue or slough, or gangrene (Brown, 2009). There may be different types of secretions leaking from the pressure ulcer in varying amounts, which can be pus, seropurulent, serous, seroguineous, and bloody (Brown, 2009; Scemons & Elston, 2007). Pus may be accompanied with odor and will appear in thick, opaque yellow, tan, or green colors, which may indicate an infection. Odor or absence of odor should be documented; if odor exists, the intensity and characteristics of it should be described. The caregiver should inspect the skin surrounding the pressure ulcer, and assess the temperature and condition, such as signs of scarring or inflammation. If there is redness around the wound, it could indicate a reaction to the dressing, or indicate irritation from feces or urine incontinence (Brown, 2009).

If these assessments are not performed correctly by the caregivers, the patient may not receive the appropriate treatment needed for wound healing and may suffer from other complications, such as osteomyelitis. The patient should be evaluated for osteomyelitis if the bone is exposed or can be touched with an instrument (Fonder et al., 2008). Osteomyelitis is a bone infection that can lead to serious complications, such as bone damage, reduced limb or joint function, spread of infection to other body parts, and amputation (PubMed Health, 2010). It is very important that the caregiver is aware of the

signs any symptoms (e.g. bone pain, fever, and local inflammation) and treats the infection quickly (PubMed Health, 2010).

Physical wound assessment should be performed correctly on a regular basis to assess the effectiveness of the treatment plan and determine if healing is present (Brown, 2009). To encourage consistency, the same clinician should examine the patient in the same position during every wound assessment (Brown, 2009). A disposable tape measure can also be used to measure the greatest width, length, and depth of the pressure ulcer (Brown, 2009; Fonder et al., 2008). Depth of the pressure ulcer can be measured by using a sterile, cotton-tipped applicator. It can be inserted into the deepest part of the wound and measured at the surface (Brown, 2009). The caregiver can also identify whether or not undermining (the destruction that occurs under the skin) is present (Brown, 2009).

Documentation through photographs and translucent tracings can be used to evaluate the healing process (Baranoski & Ayello, 2008; Brown, 2009). The distance of which the photograph was taken from the pressure ulcer site should also be documented for consistency and prevention of image distortion (Lyder, 2003). If the tissue appears "pink and plump" in the assessments, then it is a sign that healing is occurring (Fonder et al., 2008). If healing and improvement is present, staging cannot go in reverse order (Baranoski & Ayello, 2008; Brown, 2009). Pressure ulcer staging is only used to measure the depth of the damaged tissue. It is oftentimes recorded in reverse order by many clinicians to show improvement in pressure ulcer. For example, if a patient has a

Stage III pressure ulcer and has shown wound healing, his or her pressure ulcer cannot be classified as a Stage II or Stage I. When that Stage III pressure ulcer is healed, it can be described as a healed Stage III pressure ulcer (it cannot be documented as a "Stage 0" pressure ulcer) (Baranoski & Ayello, 2008). When pressure ulcers heal, the wound will heal to a more shallow depth and fill with scar tissue; it does not replace the lost muscle, subcutaneous fat, or dermis (Baranoski & Ayello, 2008).

Patient Quality of Life

Quality of life is defined as "general sense of happiness and satisfaction with one's life and environment (Mahan & Escott-Stump, 2008, p. 286)." Studies have shown the health and financial burden of living with a pressure ulcer, but few have studied how living with a pressure ulcer affects quality of life (Hopkins et al., 2006; Spilsbury et al., 2007). The nonmonetary costs of having a pressure ulcer can be extremely painful, which can inhibit the healing process and waste a patient's time (Brown, 2009; Hopkins et al., 2006; Spilsbury et al., 2007). Identifying what is causing the pain, such as the treatments or other disease conditions, can help the caregiver provide interventions to help manage the pain level (Brown, 2009). Individuals who have a pressure ulcer can experience negative effects during their daily activities and social interactions. Hopkins et al. (2006) interviewed eight different participants who were over the age of 65 and had experienced at least one grade 3 or 4 pressure ulcer (European Pressure Ulcer Advisory Panel grading) that lasted for longer than a month. These participants shared their experiences with living with a pressure ulcer. Findings from these interviews have

shown three common themes: pressure ulcers cause endless pain, pressure ulcers produce a restricted life, and coping with a pressure ulcer (Hopkins et al., 2006). Participants described how the endless pain was not alleviated by analgesia or pressure relieving equipment and found remaining as still as possible a way to cope with the intense pain. The participants had an understanding of the importance of repositioning, but feared additional movement as they knew it would cause more pain. They experienced the following feelings: worry, depression, being burdensome, inadequacy and a sense of powerlessness (Hopkins et al., 2006). Living with a pressure ulcer has an impact on their daily activities, which also affects others around them.

Another qualitative two-year study (Spilsbury et al., 2007) assessed the experiences and perceptions of the impact of pressure ulcers among 23 participants (five men and 18 women aged 33-92 years old (reason for pressure ulcer at age 33 due to spina bifida)). This study determined that 91% (n=21) of these participants agreed upon the idea that pressure ulcers negatively affect their physical, social, mental, and social life. The patients' responses to the medical care of the healthcare professionals indicated that patients' pain was not fully understood or treated properly. The health professionals did not address a timeframe for the healing time of the pressure ulcer for the patients. This study indicates the lack of communication of the treatment plan between the health professionals and the patient with pressure ulcers; Brown (2009) agrees.

Causes of Pressure Ulcers

Pressure. Low amounts of pressure for a long duration and high amounts of pressure for a short duration can both be detrimental to the skin (Baranoski & Ayello, 2008; Scemons & Elston, 2009). Pressure ulcers can develop in as little as two to six hours (Lyder & Ayello, 2008). Factors that affect the duration and intensity of pressure include: immobility, inactivity, and loss of sensory perception (Scemons & Elston, 2009). The types of body tissues differ with tolerance to pressure. For example, muscle is more sensitive to pressure damage than skin; therefore, muscle tissue will die first (Baranoski & Ayello, 2008).

Shear and friction. Shear and friction are both mechanical forces that can contribute to pressure ulcer formation; they often occur together and are rarely seen without the other (Baranoski & Ayello, 2008). Friction occurs when two surfaces move along each other; however it is not a primary cause for the development of pressure ulcers. Friction affects the epidermal and dermal layers. Shear occurs underneath the skin at the deep fascial level and bony prominences and results in blood flow disruption. Shear can cause stress by twisting and stretching deep tissue and blood vessels (Scemons & Elston, 2009). An example of deep tissue damage as a result of shear and friction: It can occur when a patient (along with the deep fascia) slides down a tilted bed while the superficial fascia remains attached to the bed sheet (Brown, 2009).

Moisture. Additional moisture to the skin can interact with friction and become more susceptible to pressure force, which puts a patient at risk of developing pressure

ulcers and infections (Brown, 2009; Scemons & Elston, 2009). Urinary and bowel incontinence can cause excess moisture and overhydrate the epidermis, while the enzymes and chemical damage can deteriorate the skin (Brown, 2009; Scemons & Elston, 2009). Determining the cause of the incontinence and implementing an intervention can reduce the patient's risk of developing a pressure ulcer. For example, a Foley catheter can be inserted to manage urinary incontinence and protect the skin from urine. A Foley catheter is a thin, flexible tube that is inserted into the urethra and leads to the bladder in order to drain urine into a collected bag, away from the skin (Vorvick, 2011).

Risk Factors of Pressure Ulcers

All healthcare settings should make it a priority to assess the patients for pressure ulcer risk to maintain skin integrity and prevent skin breakdown (Baranoski & Ayello, 2008). Braden and Norton Scales are appropriate for determining pressure ulcer risk due to the validity and reliability; they are the most widely used assessment tools (Baranoski & Ayello, 2008; Lyder, 2003). According to Baranoski & Ayello (2008), the most common pressure ulcer assessment scale in the United States is the Braden Scale. The Braden Scale is made up of six subscales that are scored from 1-4 (1 represents the lowest functional ability and 4 involves no problems). The six subscales include sensory perception, moisture, activity, mobility, nutrition, and friction and shear. The lower the score of the sum of the six subscales, the higher the patient is at risk for developing pressure ulcers. A score between 15-18 is considered at risk; a score of 13 or 14 is moderate risk; between 10 to 12 is high risk, and six to nine is considered very high risk

(Brown, 2009). Fife et al. (2001) performed a study to assess the risk factors of developing a pressure ulcer in the intensive care unit. Of the 186 participants, 23 (12.4%) developed at least one pressure ulcer during their hospital stay. Risk factors included those that were underweight and those with Braden scores ≤ 13. Results from this study showed that participants with Braden scores of at least 16 did not develop any pressure ulcers; therefore, preventative measures is impractical and not necessary for all critical care patients upon admission. Hospital staff should focus on pressure ulcer prevention for patients with Braden scores of ≤ 13 or and/or low body mass indexes. The Braden Score alone does not always address each patient's individual case; therefore, clinical judgment should also be used when assessing a patient for pressure ulcer risk (Baranoski & Ayello, 2008).

There are intrinsic and extrinsic factors that contribute to skin damage. The extrinsic factors include pressure, immobility, medication, heat, moisture, friction, shear, and irritants (Baranoski & Ayello, 2008; Brown, 2009; Scemons & Elston, 2009). The intrinsic factors affect the ability of the skin and supporting structures to prevent pressure and/or shear from damaging the tissue. The factors include: age, incontinence, cognitive impairments, paralysis, inadequate circulation, malnutrition, blood pressure, smoking, diabetes mellitus, dehydration, fractures, neuropathy, increases in body temperature, significant obesity or thinness, and history of previous pressure ulcer (Baranoski & Ayello, 2008; Scemons & Elston, 2009).

Results from a large cohort study (over 200,000 person-years of available observation) found that pressure ulcer risk was four to 20 times more likely for individuals over the age of 80 (Margolis et al., 2002). Younger patients that develop pressure ulcers are patients with spinal cord injury or paralysis, whereas patients who are 65 years of age or older will have nutritional disorders, dementia, fluid and electrolyte disorders, and diabetes without complications (Russo et al., 2008). Elderly patients with certain medical conditions are more vulnerable to the development of a pressure ulcer, as shown by Margolis et al.'s (2003) observational study. According to this study it appeared that patients 65 years of age or older in an outpatient setting were at risk of developing a pressure ulcer from the following medical conditions such as Alzheimer's disease, congestive heart failure, chronic obstructive pulmonary disease, cerebral vascular accident, diabetes mellitus, deep venous thrombosis, hip fracture, hip surgery, limb paralysis, lower limb edema, malignancy, malnutrition, osteoporosis, Parkinson's disease, rheumatoid arthritis, and urinary tract infections. Theses medical conditions are also associated with the decreased ability to heal wounds. In addition, angina, hypertension, pneumonia, and a history of myocardial infarction were inversely associated with the development of a pressure ulcer. The authors were unsure why those medical conditions posed as a decreased risk of pressure ulcer development, but believed that beta-blocker use played a role.

Another study identified the risk factors of developing a pressure ulcer in the intensive care units among the elderly population. A nested case-control study that

assessed the risk factors for developing pressure ulcers of elderly patients in the hospital showed that length of intensive care units stay is significantly associated with increased pressure ulcer risk (Baumgarten et al., 2008). Reasons for elderly patients in the intensive care units having a higher risk may be due to immobility, coma, prolonged low blood pressure, or malnutrition. Results of this study demonstrated the importance of developing preventative methods for pressure ulcers among intensive care unit patients.

Treatment and Prevention of Pressure Ulcers

Managing skin care. Keeping the skin healthy is an important part of pressure ulcer prevention. Caregivers should help patients maintain clean, dry, and soft skin through proper bathing (Brown, 2009). Soaps should be mild and used with warm (not hot) water and use non-alcohol based moisturizers to prevent skin from drying out (Baranoski & Ayello, 2008; Brown, 2009; NPUAP, 1992; Scemons & Elston, 2009). It is also important to examine the body every day for spots of redness or signs of sores, especially over the boney prominences of the body. If a patient is incontinent of urine or feces, skin should be cleansed and moisturized immediately after the accident to protect the skin from breaking down (Baranoski & Ayello, 2008; Brown, 2009). Diapers should be minimized; bedpans can be used in place of diapers to help minimize moisture build up in the skin (Brown, 2009; Scemons & Elston, 2009).

Pressure relief. The development of a pressure ulcer can occur within hours, but the healing process can take months. Living with a pressure ulcer decreases the patient's quality of live, while contributing to higher health care costs and mortality rate; therefore,

effective treatment is absolutely essential (Dorner et al., 2009). Taking pressure off of the wound is one of the first steps to the healing process (Brown, 2009). It is important to have the person avoid sitting or lying on the pressure ulcer site ("Caring for Pressure Ulcers," n.d.). Frequent repositioning and using special support devices can help relieve or reduce the pressure (Brown, 2009; "Caring for Pressure Ulcers," n.d.; Scemons & Elston, 2009). There are different types of pressure-relieving devices that a patient can use. There are seat cushions, pillows, foam cushions, special beds, mattresses, medically approved sheepskin, and mattress coverings available to help heal current pressure ulcer and prevent new wounds from forming (Brown, 2009; "Caring for Pressure Ulcers," n.d.; Scemons & Elston, 2009).

Communication between the caregiver and the patient can help determine where the patient spends the majority of his or her time and recommend the appropriate support surface based on the patient's general health (Brown, 2009). A donut-shaped cushion should never be used because it restricts the blood flow through the capillaries ("Caring for Pressure Ulcers," n.d.; NPUAP, 1992; Scemons & Elston, 2009). Adequate blood flow is important for the treatment and prevention of pressure ulcers.

Because incidence of pressure ulcers is increasing, there is a need for preventative measures for those that are at risk for pressure ulcers (Lyder, 2003). Keep the patient's heels off of the mattress to prevent heel pressure. For example, the HEELS mnemonic can be used to prevent pressure ulcers on the heels (Baranoski & Ayello, 2008).

- Have the foot or leg movement?
- Evaluate sensation.
- Eliminate friction and foot drop risk.
- Look at heels!
- Suspend heels with devices as needed.

Other areas of the body can develop pressure ulcers; therefore, developing a turning or repositioning schedule for patients' needs and care goals can help prevent pressure ulcers from forming (Lyder, 2003; NPUAP, 1992; Scemons & Elston, 2009). There are also support surfaces that can be used for prevention, such as air or foam coverings or mattress replacements (Brown, 2009; Scemons & Elston, 2009). For patients that are in wheel chairs, cushions may be useful.

Cleaning the site. A clean site promotes pressure ulcer healing, whereas high amounts of bacteria can inhibit wound healing. The cleaning process can remove any type of debris, dirt, dead tissue, and remove excess drainage (Brown, 2009). Cleansing the wound and removing the dead material can help minimize the bacteria growth and prevent infection (Brown, 2009). Using normal saline to cleanse the wound is recommended because it is noncytotoxic, safe, and will not damage the healing tissue (Brown, 2009; Scemons & Elston, 2009). The site should be cleaned every time the

dressings are changed (Brown, 2009). Caregivers should also note that using too much force or using too little force when cleaning the site can inhibit the healing process.

Debridement. Debridement is the process of removing dead tissue and foreign material overlaying a wound bed (Baranoski & Ayello, 2008). Debridement is an important and necessary part of treatment because it enhances cell movement, exposes the severity of the site, and enables the wound to begin healing. If this step is skipped, bacteria can damage tissue even further and result in the amputation of the limb, osteomyelitis, cellulitis, septicemia, and even death (Baranoski & Ayello, 2008). A pressure ulcer can only be staged after debridement and the depth of the wound is exposed. There are several debridement methods used in health facilities and include: surgical/sharp, autolytic, mechanical, maggot larvae, and enzymatic. The debridement method should be determined based on the patient's individual needs and methods available at the current facility (Baranoski & Ayello, 2008).

Mechanical debridement. Mechanical debridement is a nonselective method that removes the necrotic tissue and parts of the healthy tissue by force (Baranoski & Ayello, 2008; Brown, 2009; Fonder et al., 2008). In this process, wet-to-dry dressings, wound irrigation, whirlpool, and dextranomers are used (Brown, 2009). A common treatment, the wet-to-dry method involves wetting the gauze with saline and placing it over the pressure ulcer (Baranoski & Ayello, 2008; Fonder et al., 2008). Once the gauze has dried, the removal of the gauze will also remove the debris from the pressure ulcer site (Baranoski & Ayello, 2008; Fonder et al., 2008). This method is not used as often as

other methods since it is painful and there are safer methods available of removing necrotic tissue (Baranoski & Ayello, 2008; Brown, 2009; Fonder et al., 2008).

Enzymatic debridement. The topical ointments containing enzymes help remove the fibrin and collagen of the necrotic material (Brown, 2009; Fonder et al., 2008). This method may be suitable for those who are not good candidates for surgery (Baranoski & Ayello, 2008). Enzymatic debridement may create a burning sensation and caregivers should take special precaution not to get the ointment on healthy tissue surrounding the pressure ulcer (Baranoski & Ayello, 2008; Fonder et al., 2008).

Sharp debridement. Physically removing the necrotic material with sharp, surgical methods, such as a scalpel, forceps, and/or scissors is the fastest removal but can be painful (even with medication) and cause the site to bleed (Baranoski & Ayello, 2008; Brown, 2009; Fonder et al., 2008). This method removes the debris until vascular tissue is exposed (Fonder et al., 2008). After this type of process, dressings should be applied for eight to 24 hours on the site to stop the bleeding, and then the moist dressings can begin again (Brown, 2009). This method is not appropriate for patients who have bleeding issues (Fonder et al., 2008).

Autolytic debridement. This type of debridement involves using the patient's own wound fluids to remove the necrotic tissue, but should not be used on wounds that are infected (Baranoski & Ayello, 2008; Brown, 2009). Synthetic dressings cover the wound and the enzymes in the patient's own wound fluids breaks down the necrotic tissue (Brown, 2009). This method can take weeks to remove the nonviable tissue, but

may be a more appropriate debridement method over the sharp method for those who have problems with bleeding (Fonder et al., 2008).

Dressings. Dressings are materials that are applied to the surface of a wound for protection and absorbance of drainage (Brown, 2009). It is important to use moist wound therapy dressings to promote healing (Brown, 2009; Baranoski & Ayello, 2008; Fonder et al., 2008). There are thousands of different types of dressings used to treat pressure ulcers (Baranoski & Ayello, 2008). The different types of dressings include: gauze, films, foams, alginates, hydrogels, hydrocolloids, collagens, antimicrobials, composites, and combinations (Baranoski & Ayello, 2008; Brown, 2009; Fonder et al., 2008).

When choosing the dressing, it should help keep the wound bed moist and the surrounding skin dry (Brown, 2009; Fonder et al., 2008). The amount of moisture on the wound bed should not exceed appropriate wetness because it can lead to overhydrated skin, which makes the skin more susceptible to further breakdown (Fonder et al., 2008). The dressing should also protect the fragile healing tissue from damage (Brown, 2009). If a person experiences high amounts of drainage, dressings that are very absorptive are recommended. The dressing type can change as the pressure site heals ("Caring for Pressure Ulcers," n.d.).

Infection control. Treating an infected pressure ulcer is crucial because as long as the wound is infected, it will not heal and can lead to other health issues (Spilsbury et al., 2008). Antibiotics are administered orally and topically to infected pressure ulcers (Baranoski & Ayello, 2008). Shallow infections that do not have a lot of redness around

the site may only need a topical antibacterial agent; however, more severe pressure ulcers that involve more tissue involvement may need antibiotic given orally or through injection, especially if the wound is not healing ("Caring for Pressure Ulcers," n.d.). A person is at risk of developing an infection when the body does not receive sufficient calories, nutrients, fluid, vitamins, and minerals for normal, healthy functioning of the body (Dorner et al., 2009; Posthauer, 2006). Typically, those affected by pressure ulcers will exhibit signs and symptoms such as increased site drainage (sometimes purulent - thick green or yellow), a foul odor, pain, fever, weakness, confusion, and/or redness or warmth around the wound; however, some pressure ulcers can be asymptomatic and appear as a non-healing wound (Baranoski & Ayello, 2008; Brown, 2009; "Caring for Pressure Ulcers," n.d.).

Pain management. Caregivers should also ask the patients to rate their pain scale from one through ten (Brown, 2009). The higher pain ratings can give clue that an infection or inflammation may be present (Brown, 2009). Pain can be caused by the pressure ulcer due to inflammation, infection, or from exposed or damaged nerve endings ("Caring for Pressure Ulcers," n.d.). When nerve endings are damaged (such as in a Stage III), the pain may decrease or the patient may not experience any type of discomfort (Zeller, Lynm, & Glass, 2006). Pain medication may also be needed by patients during dressing changes, debridement, repositioning, or during the wound cleansing step ("Caring for Pressure Ulcers," n.d.). Patients with pressure ulcers experience intense pain during dressing changes (even when there is evidence of

healing); one patient described the pain, "When they clean it, it is like a needle scraping my nails. It is very painful (Hopkins et al., 2006, p. 349)." Another study indicated that pressure ulcer treatment gave the patients increased comfort and felt that the infection was being "sucked out" (Spilsbury et al., 2008, p. 500). Nevertheless, caregivers changing the dressing should be careful and gentle to help control the pain and prevent further damage on the wound site.

Pruritus and odor control. Pruritus, or itching, is a common symptom for those suffering from pressure ulcers. Dry skin, allergies, medications, or different treatment methods can cause the wound site to itch. Topical medication can relief itching symptoms, or a cool, wet cloth applied to the skin and/or cool bath with baking soda can help. Avoid using harsh laundry detergents and opt for more gentle detergent to reduce any type of skin irritation ("Caring for Pressure Ulcers," n.d.).

Odor can be caused by infection or dead tissue, but it can be treated by properly cleansing the wound site and removing dead tissue or pus. Odor can be a sensitive issue for patients and the patients' family; therefore, entering a room with a mask should be avoided in order to avoid offense or embarrassment. Odor can also be controlled by making the room well-ventilated, using essential oils in diffusers, or placing kitty litter or activated charcoal under the patient's bed to absorb odor ("Caring for Pressure Ulcers," n.d.).

Nutrition care. Nutrition plays an important role for treatment and prevention of pressure ulcers, although there is minimal evidence-based research available (Ayello et

al., 1999; "Caring for Pressure Ulcers," n.d.; Dorner et al., 2009; Fleishman, 2005; Mahan & Escott-Stump, 2008). Preventing skin breakdown and maintaining skin integrity is achieved through adequate calories, carbohydrates, protein, fat, vitamins, minerals, and fluids (Brown, 2009; Dorner et al., 2009; NPUAP, 1992). For treatment of pressure ulcers, there are several nutrients in particular that contribute to the healing and tissue repair process, which includes calories, protein, zinc, copper, iron, vitamin C, vitamin A, and fluid. Maintaining adequate nutrition status is important as inadequate protein or energy can delay wound healing (Mahan & Escott-Stump, 2008). When nutritional deficiencies are present, the patient can experience delayed or worsened wound healing due to the reduction of the activity of cells responsible for wound healing, such as collagen synthesis and epithelization (Scemons & Elston, 2009). Although supplementation is crucial to correct any type of nutrient deficiency, supplementation far above the Recommended Dietary Allowance (RDA) when deficiency is not apparent does not speed the wound healing, and may even be harmful (Dorner et al., 2009; Tempest, Siesennop, Howard, & Hartoin, 2010).

Calories. Macronutrients, such as protein, fat, and carbohydrates provide energy (Dorner et al., 2009). A patient can have the appropriate topical treatment for a pressure ulcer to heal, but if the patients' energy intake is poor, their wound will not heal (Brown, 2009). Sufficient intake of energy is an important factor in the wound healing process to its role in anabolism, or tissue building through collagen and nitrogen synthesis (Dorner et al., 2009).

Patients who have pressure ulcers require additional calories to make up for the loss of energy since their bodies are in an inflammatory phase and increased metabolic rate (Dorner et al., 2009; Posthauer, 2006). This increase in metabolic rate is known as hypermetabolism (Dorner et al., 2009). The body first uses glycogen stores for energy use and major organ functions; however, when glycogen stores are depleted the body's protein and fat stores are converted into glucose and used for energy (Dorner et al., 2009).

The required amount of calories varies from individual cases and may be adjusted higher or lower depending on their health status, but the treatment goal should provide enough calories for weight maintenance or gradual weight gain (Dorner et al., 2009; Ayello et al., 1999). There are several ways of calculating energy needs for patients. The indirect calorimetry is one of the more accurate ways of measuring energy expenditure, but is costly (Dorner et al., 2009). Indirect calorimetry is defined as "a method for estimating energy production by measuring oxygen consumption and carbon dioxide rather than by directly measuring heat transfer; typically takes 30 minutes to 1 hour to complete (Mahan & Escott-Stump, 2008, p. 22)." There are also equations that can be used, such as the Mifflin-St. Jeor Equation or the Harris-Benedict equation; however, the Mifflin-St. Jeor is more accurate, especially in obese individual without health issues (Dorner et al., 2009).

Yet, another way of calculating energy is through a calorie range based off of current, individual body weight. For example, patients who have a Stage III or Stage IV

pressure ulcer require 35 to 40 kcal/kg of body weight and the recommendation for obese patients is 21 kcal/kg of bodyweight (Posthauer, 2006). Elderly patients may only need 30-35 kcal/kg (Ayello et al., 1999). Overfeeding patients with pressure ulcer creates metabolic stress and does not benefit the wound healing process (Fleishman, 2005). Increased carbon dioxide production, impaired respiration, and increased glucose levels result when giving a patient too many calories (Leininger, 2002).

Patients with pressure ulcers can meet their calorie needs by eating a well-balanced diet. If patients are unable to meet their calorie needs through a healthy diet, the patient will lose weight and adipose and muscle tissue will be used for energy (Brown, 2009). Unintentional muscle loss can significantly impede the wound healing process and the issue should be corrected immediately (Posthauer, 2006). It is important to determine why the patient is losing weight, such as swallowing difficulties, medication interactions, or infection in order to fix the nutrition problem and provide any nutrition interventions (Posthauer, 2006). To prevent muscle tissue loss, the patient's diet order can be liberalized (if he/she is on a restricted diet) by the physician in order to encourage intake through a broader range of food options (Dorner et al., 2009). For example, a patient can be on a 2-gram sodium diet, but is not eating enough due to the unappealing meals provided. With a physician's order, the patient's diet can be liberalized to a "No Added Salt" (NAS) diet for more palatable food choices.

If a liberalized diet is still not helping the patient achieve adequate calories, an appetite stimulant may benefit the patient, especially if weight loss is occurring

(Posthauer, 2006). An appetite stimulant known as Megestrol (Megace) may be used to help increase appetite and correct malnutrition (The National Center for Biotechnology Information [NCBI], 2008). Before an appetite stimulant is recommended, the patient should try to consume the calories from fortified foods or supplements (Posthauer, 2006). There are a variety of nutrition supplements to choose from that vary in calories, fat, protein, carbohydrates, vitamin, mineral, and fluid content. Examples of adult oral nutritional supplements include Carnation Instant Breakfast, Boost, or Ensure. They come in liquid, powder, or pudding form, and are chosen for the patient based on the patient's personal preferences compliant with his/her medical condition (Fleishman, 2005). For example, diabetics should choose a nutrition supplement that is compliant with the carbohydrate-consistent diet order.

Protein. Proteins are described as "complex nitrogenous compounds made up of amino acids in peptide linkages (Mahan & Escott-Stump, 2008, p. 41)." Amino acids are known as the building blocks for protein. This macronutrient differs from the other macronutrients (carbohydrates and fat) in that it contains nitrogen (Dorner et al. 2009; McArdle, Katch, & Katch, 2009). Protein is one of the macronutrients and serves many purposes in the human body. The structure of a protein varies in size and makeup, which determines its function. For example, structural protein contains a long, strong, string, super-coiled helical shape called collagen. Collagen is defined as "Any of various tough, fibrous proteins found in bone, cartilage, skin, and other connective tissue ("Collagen," n.d., the American Heritage Dictionary definition)." Structural protein provides support

for connective tissues; the average adult body contains up to 10 to 12 kg of protein (McArdle et al., 2009). Protein is also needed for enzyme synthesis, hormones, and energy for the body for muscle contraction (Mahan & Escott-Stump, 2008).

Protein plays an important role in wound healing due to its function in building and maintaining tissues, which is important for all pressure ulcer stages (Dorner et al., 2009; Posthauer, 2006; Fonder et al., 2008). It is involved in cell multiplication, collagen and connective tissue synthesis, and epithelial cell proliferation (Mahan & Escott-Stump, 2008; Scemons & Elston, 2009). Protein contains amino acids that play a role in anabolism, the tissue synthesis process, and serve as building blocks for tissues in the body, which occurs when the nitrogen intake is higher than the excretion rate. Examples of this building process would occur during pregnancy, child growth and development, and weight gain. However, when the body is in negative nitrogen balance, nitrogen excretion exceeds the intake rate, and is known as a catabolic state. Examples of this breaking down process occur during weight loss and aging. Nitrogen balance occurs when nitrogen excretion and intake are equal (McArdle et al., 2009). The ultimate goal with managing pressure ulcers through nutrition is achieving positive nitrogen balance; this goal is achieved by monitoring and evaluating the individual's caloric and protein needs and adjusting to heal wounds (Dorner et al., 2009; Posthauer, 2006).

A healthy individual, excluding pregnant women and athletes, needs 0.8 g/kg body weight of protein per day (Scemons & Elston, 2009). However, patients with pressure ulcers require additional protein for wound repair and healing and should

consume between 1.5 to 2 g/kg body weight protein per day; about 20 to 25% of calories should come from protein (Baranoski & Ayello, 2008; Posthauer, 2006; Scemons & Elston, 2009). These patients need additional protein because they are in a hypermetabolic state. Protein needs are also increased when exudate leaks from the pressure ulcer site; this fluid may contain a high content of protein. Clinicians should use their clinical judgment and individualize protein recommendations based of the patient's medical conditions and nutrition status (Dorner et al., 2009). Patients with pressure ulcers can obtain their protein requirements through both animal and plant products. Those who consume an animal-protein restricted diet should combine other protein sources (such as grains and legumes) to combine essential amino acids for a more complete high-quality protein. Animal-protein sources contain higher-quality proteins. Good sources of protein include eggs, fish, nuts/seeds, beef, milk, and poultry (Mahan & Escott-Stump, 2008).

In order for wound repair to take place and spare protein, sufficient calories need to be consumed by the patient (Dorner et al., 2009). Otherwise, protein may be broken and used for energy (instead of using the body's preferred energy sources: carbohydrates and fat) and the patient may start to lose weight (Brown, 2009; Posthauer, 2006). Protein tissue is preserved when a person has adequate glycogen reserves from adequate carbohydrate intake (McArdle et al., 2009). However, when glycogen is depleted, body protein will be converted to glucose for energy by gluconeogenesis (McArdle et al., 2009). Body protein sources include muscle, visceral tissue, and blood plasma (McArdle

et al., 2009). When depletion of protein storage or inadequate protein intake occurs, it results in impaired wound healing and a prolonged inflammatory state, which preventing a wound bed from forming (Brown, 2009; Fleishman, 2005). In addition, oxygen diffusion from capillaries to the cells is decreased due to tissue edema caused by inadequate protein intake. Not consuming enough protein in the diet also promotes lean body mass (LBM) losses, especially from the area around the site. The nutrients closest to the pressure ulcer are utilized for wound repair, such as the amino acids from the protein that make up the LBM (Tempest et al., 2010).

Physical signs of protein deficiency include dry, dull, or sparse hair (Baranoski & Ayello, 2008; Posthauer, 2006) and result in impaired healing, edema, lymphopenia, and impaired cellular immunity (Scemons & Elston, 2009). An individual who cannot meet their protein needs may benefit from protein supplements. Even obese patients with pressure ulcers require additional protein for wound healing and would benefit from protein supplements (Posthauer, 2006). When choosing a protein supplement, consider the Protein Digestibility Corrected Amino Acids Score (PDAAS) for better quality, digestible proteins, such as those that contain egg, casein, and/or whey (Tempest et al., 2010). In addition, caution should be given when protein is increased to 2 g/kg body weight as too much protein will increase the patient's fluid needs and strain the kidneys and liver, especially when given to elderly patients, who are already at increased risk of dehydration than younger adults (Dorner et al., 2009; Fleishman, 2005). This increase in

protein will not be beneficial for protein synthesis and when the increased fluid needs are not met, the healing process can be inhibited (Brown, 2009; Dorner et al., 2009).

There are commercially available protein supplements that contain arginine and glutamine. One example is Juven®, which contains beta-hydroxy-beta-methylbutyrate (HMB) in addition to arginine and glutamine. This powdered drink contains 7 g of arginine, 7 g of glutamine, and 1.5 g of HMB. Juven® aims to support wound healing and maintain or build LBM (Abbott Nutrition, n.d.). Arginine helps encourage blood flow, glutamine is involved in protein/collagen synthesis, and HMB protects protein from breakdown and aids in protein production. Two servings a day of this powder is recommended accompanied with a balanced diet. To help encourage wound healing, it can be mixed in 8-10 fluid ounces of water or juice or in foods, such as yogurt, applesauce, or ice cream (Collins, 2010). Juven® offers fruit punch or orange flavors, but also unflavored.

One randomized, placebo-controlled study examined 35 healthy older-adult participants' wound collagen accumulation after subcutaneous placement of polytetrafluoroethylene (PTFE) implants (Williams, Abumrad & Barbul, 2002). One group (n=18) received 7 g of arginine, 7 g of glutamine, and 1.5 g of HMB twice daily, and the other group (n=17) was given an isonitrogenous and isocaloric mixture of nonessential amino acids. The PTFE catheters were removed seven and 14 days after implantation to analyze the hydroxyproline (OHP) content within the catheters. Although there were no differences after one week, by the 14^{th} day, the experimental group

receiving the amino acid mixture of arginine, glutamine, and HMB accumulated 67% more collagen than the control group (OHP :72.2±10.6 vs. 43.2±7.2 nmol/cm implant). A similar prior study with arginine alone showed that healthy, elderly patients with implanted PTFE catheters receiving 17 g of arginine daily for two weeks had a 52% increase in collagen deposition than the placebo group (Kirk, Hurson, Regan, Holt, Wasserkrug & Barbul, 1993). The OHP content measured 26.49±2.39 nmol/cm for the experimental group and 17.41±2.04 nmol/cm for the placebo group. These studies showed that healthy, elderly participants showed an increase in wound repair with arginine supplementation, and that the OHP deposition was higher for the study with arginine, glutamine, and HMB as opposed to the study with arginine alone, but healing among patients with chronic, non-healing wounds is unknown. Arginine and glutamine have been studied on the effects of pressure ulcer healing and results showed that it may not significantly improve the healing process and more research is needed (Dorner et al., 2009). For example, a randomized, controlled three-week trial supplementing arginine, vitamin C, and zinc with inpatients who have a Stage II, III, or IV pressure ulcer showed an improvement with the rate of pressure ulcer healing and patient discomfort (Desneves, Todorovic, Cassar, & Crowe, 2005). The limitation to this study was that they used a small sample (n=16). Therefore, larger studies may be needed to test the efficacy of supplementing arginine, vitamin C, and zinc on patients with pressure ulcers. Witte and Barbul (2003) believed that arginine plays a role in collagen metabolism and wound healing, but the exact mechanism is not fully understood. The authors do know that arginine is responsible for reducing the negative effects on injured T-cells and involved

in bone marrow B-lymphocyte differentiation, all of which aid in wound healing and fibroblastic responses (Witte & Barbul, 2003).

Zinc. Zinc is a trace mineral found in meat sources and small amounts in our body, such as our bones, skin, and muscles (Posthauer, 2005). It is found in almost every cell in the body and functions as a cofactor for around 100 enzymes, acts as an antioxidant, and plays a role in in cell proliferation (Dorner et al., 2009; Mahan & Escott-Stump, 2008). Along with cell proliferation and wound healing, zinc also aids in collagen formation, metabolizes protein, and assists with immune function (Baranoski & Ayello, 2008; Dorner et al., 2009; Posthauer, 2005; Posthauer, 2006; Scemons & Elston, 2009).

The RDA for zinc is 11 mg/d for adult males and 8 mg/d for adult females ("Dietary reference intakes," 2010). Good sources of zinc is included in a lot of meat sources and high protein foods, which include oysters, meat, fish, liver, eggs, shellfish, legumes, and milk (Ayello et al., 1999; Dorner et al., 2009). Milk is a good source of zinc, but the iron and calcium interacts with it and fights for absorption. Zinc absorption is lower in plant protein foods than animal proteins. Therefore, vegetarians should be monitored for signs and symptoms of a zinc deficiency (Mahan & Escott-Stump, 2008).

Although a zinc deficiency is not common for healthy adults who eat a well-balanced diet, excess loss from the gastrointestinal tract, poor oral intake, and excessive drainage coming from the pressure ulcer may indicate that there is a possibility of a zinc deficiency (Brown, 2009; Dorner et al., 2009; Posthauer, 2005; Tempest et al., 2010).

Signs and symptoms of a zinc deficiency include prolonged healing time, hair loss, diarrhea, anorexia, taste alteration, decreased immunity, depleted albumin levels, and lesions in the skin and eyes (Posthauer, 2005; Dorner et al., 2009; Scemons & Elston, 2009). A zinc deficiency is difficult to determine as blood tests are not always reliable and the signs and symptoms are similar to other conditions. Normal serum levels for adults remain in the range of 0.66-1.1 mcg/mL; critical value occurs when it is less than 0.6 mcg/mL. The best way to diagnose a zinc deficiency is checking the urinary zinc excretion rate in combination with the plasma zinc levels (Litchford, 2010). Because zinc is a cofactor for protein synthesis and is transported by albumin, zinc levels may drop if albumin levels decrease (Dorner et al., 2009; Tempest et al., 2010). Those with chronic, severe zinc deficiencies are at increased risk of infection and can experience delayed wound healing due to dysfunctional white blood cells and lymphocytes (Brown, 2009). In the case of high drainage of the wound when a zinc deficiency is present, a zinc supplement would be beneficial for wound healing; however, excess zinc supplementation should be monitored due to the competition of absorption of other minerals such as copper and iron (Brown, 2009; Posthauer, 2005). If a zinc deficiency is not corrected, wound bed closure can be inhibited and tensile strength decreased (Tempest et al., 2010). Elemental zinc supplementation of 25 to 50 mg per day for 10 to 14 days is recommended for those who have a zinc deficiency (Posthauer, 2006). Once the deficiency is corrected, supplementation should stop to avoid a copper deficiency (Dorner et al., 2005). Supplementing zinc when deficiency is not present does not speed pressure ulcer healing, and may inhibit improvement in the site due to other minerals

playing a role in collagen synthesis (Dorner et al., 2009; Tempest et al., 2010). Additional research is needed to test the effectiveness and safety of zinc supplementation in high doses (Posthauer, 2005).

Copper. Copper is an essential mineral that serves in many tissue-related functions. It is also involved in many enzymes. For example, copper makes up ceruloplasmin, which functions as an enzyme for red cell formation and aids in oxidizing iron. Copper also acts as a cofactor to help build connective tissue proteins in another enzyme known as lysyl oxidase. Lysyl oxidase is needed for cross-linking of collagen and elastin, which provides great tensile strength (Mahan & Escott-Stump, 2008).

The RDA for copper is 900 μg/d for adult males and females ("Dietary reference intakes," 2010). The RDA for copper can be achieved through a balanced diet because it is found in a variety of foods. It is found to be high in animal products, but not very high in cow's milk. However, foods high in copper are shellfish, liver, muscle meats, chocolate, nuts, dried fruits, cereal grains, and dried legumes (Mahan & Escott-Stump, 2008).

A deficiency of copper is rare because it can be stored in the liver. However, it can be harmful because of decreased collagen synthesis and can lead to bone demineralization and anemia (Scemons & Elston, 2009). Low levels of serum copper, ceruplasmin, and superoxide dismutase indicate a copper deficiency is present. In addition, increasing the copper intake will decrease the absorption rate because the body better regulates copper through low amounts (Mahan & Escott-Stump, 2008). The

decreased absorption rate can make the wound more susceptible to infection, reduce oxygen transport to cells (inhibits iron absorption), and can suppress the immune system – all of which can delay wound healing (Tempest et al., 2010).

Iron. Iron is a nutrient found throughout the body in every cell. It functions by being a part of myoglobin in muscles and hemoglobin in red blood cells. The main function of iron is to carry oxygen. In addition, iron is part of several enzymes and proteins in the body (Mahan & Escott-Stump, 2008). For pressure ulcer patients, iron is especially important for collagen transport, oxygen transport to cells, and enhancement of leukocytic bacterial activity (Scemons & Elston, 2009).

The RDA for iron is 8 mg/d for adult males, 18 mg/d for females between the age of 19-50, and 8 mg/d for females 51 and over ("Dietary reference intakes," 2010). Iron comes in two different forms: heme iron and nonheme iron. Heme iron is better absorbed than nonheme iron. Good sources of heme iron come from oysters, liver, lean red meat, poultry (dark red meat), tuna, salmon, iron-fortified foods, whole grains, eggs (especially the yolk), and dried fruits. Nonheme iron sources primarily come from fruits, vegetables, and grains such as raisins, broccoli, asparagus, almonds, and kidney beans (Mahan & Escott-Stump, 2008). Iron absorption can be inhibited with intake of milk, cereals, dietary fiber, tea, coffee, and eggs, whereas equal or greater amounts of vitamin C supplementation can enhance iron absorption (Scemons & Elston, 2009).

A deficiency of iron may result in impaired tensile strength, impaired collagen cross-linkage, and lead to risk of local tissue ischemia due to anemia (Scemons & Elston,

2009). A signs if iron deficiency can be spoon-shaped nails and/or pale skin (Posthauer, 2006). An iron deficiency can be corrected through high dose iron supplements in the form of ferrous sulfate or ferrous gluconate and a diet that contains iron rich foods (Mahan & Escott-Stump, 2008). However, caution should be given as an iron overload or poisoning (hemochromatosis or hemosiderosis) can result in organ dysfunction where excess iron is stored and build up, such as in the liver, brain, and heart (Litchford, 2010).

Vitamin C. Vitamin C, ascorbic acid, is a water-soluble vitamin. This vitamin is needed throughout the body in order for certain metabolic reactions to occur. Vitamin C is a cofactor of iron, plays a role in amino acid metabolism, wound healing, and hormone synthesis (Posthauer, 2006; Scemons and Elston, 2009). It helps with tissue repair by aiding in collagen formation (Baranoski & Ayello, 2008; Brown, 2009; Fleishman, 2005; Tempest et al., 2010). Vitamin C helps increase tensile strength to ensure stable collagen elasticity (Tempest et al., 2010).

The RDA for vitamin C is 90 mg/d for adult males and 75 mg/d for adult females ("Dietary reference intakes," 2010). Good sources of vitamin C occur in a variety of fruits, vegetables, and citrus juice (Dorner et al., 2009; Posthauer, 2006). Examples include guava, red sweet peppers, kiwi, orange, green peppers, and strawberries (Mahan & Escott-Stump, 2008). Those with wound pressure ulcers are recommended to consume between 500 to 1,000 mg per day (Tempest et al., 2010).

A deficiency of vitamin C in the body can inhibit the wound healing process by the decrease in collagen synthesis. A deficiency also makes a person more susceptible to

infection and causes capillary fragility and scurvy (Ayello et al., 1999; Baranoski & Ayello, 2008; Brown, 2009; Dorner et al., 2009; Posthauer, 2006; Scemons & Elston, 2009). Very high doses of vitamin C may be used to correct the deficiency; however, these high doses (above the 2000 mg/day tolerable upper limit) does not speed the healing process (Ayello et al., 1999; Fleishman, 2005; Posthauer, 2006; Tempest et al., 2010). Large vitamin C doses can be excreted by the kidneys because it is a water-soluble vitamin, but it puts renal patients at risk of developing kidney stones (Ayello et al., 1999; Posthauer, 2006).

While a vitamin C deficiency can inhibit collagen synthesis, limited research shows that a high dose of vitamin C increases the wound healing process. For example, a randomized trial of 88 typical nursing home participants (many with dementia, cerebrovascular disease, and hemiplegia) were assessed the effects of ascorbic acid supplementation with treatment of pressure ulcers (ter Riet, Kessels, & Knipschild, 1995). The treatment group was given 500 mg of ascorbic acid, the reduced form of vitamin C, twice a day; the control group was given 10 mg twice a day to prevent deficiencies. Results from this study showed that ascorbic acid (500 vs. 10 mg twice daily) did not speed the recovery process of pressure ulcers. Therefore, a vitamin C supplement is not typically recommended unless a vitamin C deficiency is noticed (Ayello et al., 1999; Brown, 2009; Dorner et al., 2009).

Vitamin A. Vitamin A is a fat-soluble vitamin that is involved in roles for vision, normal cell differentiation, gene regulation, immune function, epithelium maintenance,

bone growth, reproduction, and collagen synthesis (Ayello et al., 1999; Baranoski & Ayello, 2008; Mahan & Escott-Stump, 2008; Scemons & Elston, 2009; Tempest et al., 2010). Vitamin A also plays an important role in wound healing by acting as an antioxidant and reducing inflammation (Tempest et al., 2010). Vitamin A stimulates fibroplasia to increase collagen synthesis (Posthauer, 2006).

The RDA for vitamin A is 900 μg/d for adult males and 700 μg/d for adult females ("Dietary reference intakes," 2010). Good sources of vitamin A include dark, leafy greens and yellow/orange colored fruits and vegetables such as carrots, cantaloupe, spinach, greens, and sweet potatoes (Mahan & Escott-Stump, 2008).

A deficiency of vitamin A is uncommon do to storage ability in the liver, but can lead to night blindness, impair the healing process, degenerate epithelial tissue and inhibit growth, and make a patient more susceptible to infection (Ayello et al., 1999; Baranoski & Ayello, 2008; Fleishman, 2005; Scemons & Elston, 2009; Tempest et al., 2010). Deficiencies can be a result of inadequate intake or caused by protein-energy malnutrition, a zinc deficiency, liver disease, impaired transport from abetalipoproteinemia, or biliary or pancreatic in sufficiency (Mahan & Escott-Stump, 2008). Large vitamin A doses are given orally to treat deficiencies; however, if it is caused by protein-energy malnutrition, that must be corrected first for treatment to be effective (Mahan & Escott-Stump, 2008). Patients with pressure ulcers that are vitamin A deficient are treated with a daily supplement of 20,000 to 25,000 internationals units for 10 days (Fleishman, 2005). It is recommended to watch closely and limit the

supplementation to 7 to 12 days to reduce the chance of vitamin A toxicity. Excessive doses of vitamin A do not improve the wound healing (Tempest et al., 2010).

Fluid. Achieving adequate hydration status is an important part of wound care (Baranoski & Ayello, 2008; Brown, 2009; Posthauer, 2005). Those who have pressure ulcers should be adequately hydrated because water acts as a solvent and carries vitamins, minerals, and amino acids while carrying away waste from the wound; water also aids in oxygen perfusion for proper healing (Baranoski & Ayello, 2008; Dorner et al., 2009; Posthauer, 2005; Posthauer, 2006). Hydration status can be assessed by measuring Blood Urea Nitrogen levels (BUN), BUN/creatinine ratios, serum osmolality values, serum sodium, and urine specific gravity (Dorner et al., 2009; Posthauer, 2006). These values will show whether or not patients with pressure ulcers are meeting their fluid goals.

Fluid goals/recommendations can be are calculated in several ways (Dorner et al., 2009). For example, fluid recommendations can be estimated at 30 mL/kg of body weight, 1 mL/kcal, or at least 1500 mL per day (Posthauer, 2006). The standard fluid recommendation is calculated at 1mL/kcal and is adjusted based off of the patient's individual needs and tolerance (Dorner et al., 2009). To achieve the proper hydration status, patients are to avoid a diuretic effect from certain types of beverages; patients should drink fluids that are caffeine-free, low in sugar, and non-alcoholic (Ayello et al., 1999).

Dehydration, defined as “Excessive loss of body water” (Mahan & Escott-Stump, 2008, p. 144), can occur if fluid intake is inadequate and can also happen from bodily fluid loss, such as excess vomiting, diarrhea, and sweating (American Academy of Family Physicians Foundation [AAFPF], n.d.). The elderly are at increased risk of dehydration compared to younger people due to their change in body composition and decreased thirst sensation (Litchford, 2010). As people age, they gain fat and lose lean muscle mass (which has a higher water composition than fat) (Litchford, 2010). Fluid needs are increased up to 35 mL/kg of body weight for patients experiencing fluid loss from heavy pressure ulcer drainage, high-protein diets, vomiting, diarrhea, elevated temperature, increased perspiration, or reside on air-fluidized beds (Baranoski & Ayello, 2008; Dorner et al., 2009; Litchford, 2010; Posthauer, 2006). Dehydration should be taken seriously because it can inhibit the wound healing process and contribute to even further skin breakdown (Baranoski & Ayello, 2008; Brown, 2009; Posthauer, 2005). Without water to carry the nutrients to the wound, it cannot heal. Health care professionals who are taking care of patients with pressure ulcers should be educated and knowledgeable of the dehydration signs and symptoms (Dorner et al., 2009; Posthauer, 2005). Signs and symptoms of dehydration include: decrease in body weight, headaches, fatigue, flushed skin, heat intolerance, dry skin, cracked lips, thirst, fever, loss of appetite, nausea, dizziness, poor skin turgor, increased confusion, increased pulse rate, decreased blood pressure, constipation, and dark, low urine output (sometimes accompanied with a strong odor) (Baranoski & Ayello, 2008; Brown, 2009; Dorner et al., 2009; Litchford,

2010). If patients are unable to meet their fluid needs orally, intravenous fluids (IVs) can be used to correct any signs and symptoms of dehydration (AAFPF, n.d.).

Nutrition support. If the patient is unable to meet his or her caloric needs orally, such as if the patient is unable to chew or swallow, enteral or parenteral nutrition may be an option (Baranoski & Ayello, 2008; Lyder, 2003; NPUAP, 1992; Posthauer, 2006). Conditions that may require nutrition support include stroke, Parkinson's disease, cancer, Alzheimer's, and dysphagia (Baranoski & Ayello, 2008). If the gastrointestinal tract is functioning, enteral nutrition is the preferred route, but if it is not functioning properly, total parenteral nutrition (TPN) can be provided to the patient so that adequate nutrients can help heal the pressure ulcer(s) (Baranoski & Ayello, 2008; Dorner et al., 2009). Parenteral nutrition is administered through the veins and does not involve the digestive tract (Baranoski & Ayello, 2008). There are some tube-feeding formulas that support pressure ulcer healing through high protein, and additional amounts of vitamin C, zinc, and arginine (Fleishman, 2005); however, Dorner et al. (2009) reviewed studies on enteral nutrition support for patients that have pressure ulcers, but they did not notice any beneficial health outcomes. Then again, patients that require enteral nutrition may benefit from Juven® in flushes. Packets of Juven® should be mixed in a small container with about 120 mL of room-temperature water (never mixed in a tube-feeding bag) and administered through a feeding tube, followed by an additional 30 mL of water through the tube (Abbott Nutrition, n.d.)

Health Professionals' Role in Pressure Ulcer Care

Vinayagasundaram, Halpin, and Sullivan (2009), who are members of a wound care team at Island Nursing and Rehab Center in Holtsville, New York, believed that a successful wound care program entails staff education, continuity of team, strong communication between nursing staff and wound care team, and support materials in place. The successful team effort at this nursing facility would begin wound assessments and treatment within 24 hours of the patients' admission. Not all health facilities will have a formal "wound care team;" however, health professionals still play a role in the treatment and prevention of the patients' pressure ulcer care, who include physicians, physical, occupational and speech therapists, nurses, and registered dietitians (RDs) (Baranoski & Ayello, 2008; Brown, 2009; Scemons & Elston, 2009).

Physicians

Physicians are responsible for directing the patients' care, ordering tests and treatments, prescribing diet orders and medications, and evaluating the results of the patients' care. Physicians frequently communicate with the other health professionals and determine treatment methods with them (Berlowitz et al., n.d.). For example, physicians can communicate with nurses for the type of dressing and pain medication to be used on the patient with pressure ulcers based on the characteristics of the wound. Physicians are also responsible for prescribing pain medications or topical medications if pressure ulcer itching is occurring ("Caring for Pressure Ulcers," n.d.).

Physical, Occupational, and Speech Therapists

Physical and occupational therapists play a unique role in pressure ulcer care as well. Physical therapists prescribe appropriate positions for beds and chairs, recommend pressure reducing surfaces, and improve mobility and activity levels (Masspro, 2009). They can also help pick out the appropriate wheelchairs and evaluate seating and laying angles and positions (Baranoski & Ayello, 2008). Occupational therapists assist with proper positioning in seating and beds, encourage activity that results in position changes, provide pressure relieving equipment, and prevent friction and shear (Masspro, 2009). Speech therapists are also involved in the team approach by evaluating, diagnosing, and treating any type of swallowing difficulties that will inhibit the patient from eating and consuming adequate nutrition (American Speech-Language-Hearing Association, n.d.).

Registered Nurses

Registered nurses are responsible for the daily interaction of the patients' prevention and treatment of pressure ulcers. Nurses have several responsibilities; some are able to prescribe medications, and they are involved in lab value assessments, team assessment, debridement, pressure relief, assist with feeding patients, fluid intake, infection control, odor control, and skin care. They frequently communicate and work with other health professionals to ensure the patients are receiving the appropriate care. Nurses monitor the patient's medical and skin conditions and are responsible for providing treatment for healing (Zulkowski, Ayello, & Wexler, 2007). They are responsible for performing head-to-toe skin and risk assessments (Braden Scale) and

document the results for team assessment. These assessments are performed upon admission and are an important part of treating and preventing pressure ulcers (Berlowitz et al., n.d.).

Nurses have an impact on the nutrition aspect of pressure ulcers by obtaining anthropometric measurements and reporting patients' oral intake, which is communicated with RDs (Ayello et al., 1999; Zulkowski et al., 2007). The nurses are responsible for recording height and weight, which is very important because assessing weight status is one of the ways for monitoring the patients' nutrition status (Ayello et al., 1999). In addition, the nurses also fill out the nutrition section of the risk assessment to determine the pressure ulcer risk. A documented low nutrition rating is associated with an increased risk of pressure ulcer development (Berlowitz et al., n.d.).

However, if a pressure ulcer is present, they are responsible for assessing and determining the tissue involvement. Nurses can assess the pressure ulcer and collaborate with the physician to come up with the appropriate dressing used for treatment ("Caring for Pressure Ulcers," n.d.). Dressing changes are the responsibility of a nurse. These dressing changes can happen on a daily basis or the patients can have the same one on for days. It is the responsibility of the nurse to make the patient feel comfortable during these painful changes by providing them with pain medications and redistributing the pressure ("Caring for Pressure Ulcers," n.d.).

Registered Dietitians

The goal for RDs is to help the patients achieve proper hydration status and oral intake to prevent any significant weight loss that can be detrimental to their health ("Caring for Pressure Ulcers," n.d.). Inadequate nutrient consumption can lead to malnutrition. Malnutrition increases the risk of morbidity and rates (Ayello et al., 1999). Mortality rates examined in a cohort study of high-risk, bed and chair-bound older hospitalized patients from admission to one year post-hospital discharge revealed that a history of weight loss decreased life expectancy; targeting these patients upon admission and discharge and providing nutrition education and intervention may help improve survival rates (Thomas, Goode, Tarquine, & Allman, 1996).

Along with RDs' contribution to malnutrition prevention, they also play an important role on the wound care team for the treatment and prevention of pressure ulcers. Unfortunately, RDs go unnoticed, or their role is misunderstood by other health professionals. For example, not all health professionals perceived RDs as experts in both food and nutrition. Physicians often believed that RDs were more involved with the foodservice component of their profession, and not from a clinical standpoint (Sneed & Gregoire, 1998). However, RDs have been clinically involved in the treatment and prevention of pressure ulcers by monitoring nutrition, fluid status, Braden Scores, laboratory values, and anthropometric measurements (Litchford, 2010). Identifying and correcting any type of eating difficulties or significant weight loss and/or low body mass index can help with the prevention of pressure ulcers; nutrition risk factors identifying

inadequate nutrition status include unintentional weight loss, undernutrition, protein energy malnutrition (PEM), and dehydration (Dorner et al., 2009).

Nutrition screening that is performed early can help identify these risk factors that may contribute to the development of a pressure ulcer. This nutrition screening also helps with assuring that patients receive referral from other qualified health professionals. Determining when the patients' nutritional status is declining is difficult, especially when there is no set method. Mental issues, depression, dysphagia, food-medication interactions, gastrointestinal disorders, and difficulty eating or swallowing all contribute to the risk of unintentional weight loss, undernutrition, inadequate intake, or PEM (Dorner et al., 2009).

RDs are responsible for performing a nutrition assessment after a nutrition screening (Dorner et al., 2009). Nutrition assessments incorporate the Nutrition Care Process (NCP) to assess the patient's nutrition status and provide any type of interventions or recommendations for the patients and other health professionals (Dorner et al., 2009). The Academy of Nutrition and Dietetics Foundation (ANDF) (formerly the American Dietetic Association) created the NCP to enhance communication, create consistency, and improve health outcomes. The NCP is a problem-solving model that involves four inter-related steps: Nutrition Assessment, Nutrition Diagnosis, Nutrition Intervention, and Nutrition Monitoring and Evaluation (American Dietetic Association, 2011).

The first step, Nutrition Assessment, involves the RD analyzing anthropometrics, food/nutrition-related history, biochemical data, medical history, medical tests/procedures, nutrition-related physical finding, and any laboratory values (American Dietetic Association, 2011; "Caring for Pressure Ulcers," n.d.). Laboratory values can be used as a tool for RDs to indicate nutritional status; however, caution should be given when looking at these values as the patient's overall medical condition, hydration status, medications, and metabolic changes can alter these values (Litchford, 2010; Posthauer, 2006). Nutrition-related physical findings involve the RDs reviewing the patient's skin assessment for any type of skin breakdown, such as pressure ulcers.

The second step, Nutrition Diagnosis, identifies a nutrition problem that a RD can help correct (Dorner et al., 2009). Dorner et al. (2009) described an example of a nutrition diagnosis of a patient with a pressure ulcer: "Inadequate food and fluid intake related to less than 50% intake of meals as evidenced by non-healing Stage IV pressure ulcer and five pound weight loss in two weeks (Nutrition Screening and Assessment section, para. 6)." The Nutrition Intervention, the third step, is to help improve the patient's nutrition status that is specific to the nutrition diagnosis, which in this case, would be improving food and fluid intake at or above 50% (Dorner et al., 2009). For example, a nutritional supplement given twice a day such as Ensure, Boost, or Carnation Instant Breakfast can be recommended to a patient who is experiencing inadequate oral intake. In addition, Juven® may also be recommended to pressure ulcer patients to help boost collagen synthesis and support tissue building. The last step, Nutrition Monitoring

and Evaluation, is used for following up on the patients to see if nutrition intervention was effective and if the nutrition goals were being met (Dorner et al., 2009). Assessing the patient's anthropometric measurements, physical findings, and the patient's symptoms in conjunction with laboratory values can support the results of the nutrition intervention (Litchford, 2010). If goals are not being met, additional nutrition interventions and recommendations may be needed for improving the patient's nutrition status.

Pressure Ulcer Knowledge

Knowledgeable clinicians play an important role in the treatment and prevention of pressure ulcers. Clinicians with a lower level of pressure ulcer knowledge are linked to a higher prevalence of pressure ulcers. Incidence of pressure ulcers in health care settings have decreased as pressure ulcer knowledge increased (Baranoski & Ayello, 2008). Having the increased knowledge to manage pressure ulcers can improve the quality of patient care, whereas knowledge gaps can impede wound healing (Smith & Waugh, 2009). The NPUAP Board of Directors (2001) has set education goals for prevention and management of pressure ulcers. The three goals for educating healthcare providers include: provide regional and national conferences, implement web-based information for professionals, and develop programs for nursing home caregivers. These educational goals signify the importance of having knowledgeable clinicians in the treatment and prevention of pressure ulcers. For example, clinicians can improve knowledge on pressure ulcer care through resources such as continuing education

programs, attending conferences, and completing online modules, which can decrease the incidence of pressure ulcers and improve patient outcomes (Baranoski & Ayello, 2008).

Registered Nurses' Knowledge

Nursing students first learn basic information about pressure ulcers in the classroom, but may experience knowledge gaps in the pressure ulcer prevention and treatment as the information they learn from textbooks may be inaccurate, insufficient, or inconsistent (Pieper & Mattern, 1997; Pieper & Mott, 1995). The knowledge that nurses gain from pressure ulcers also depends on their individual study habits and clinical experience (Pieper & Mott, 1995). Since nurses' knowledge affects the way they care for patients, Pieper & Mott (1995) examined the knowledge levels of registered nurses (n=228) based on pressure ulcer risk and prevention, pressure ulcer staging, and wound descriptions using the "Pieper Pressure Ulcer Knowledge Test" (PPUKT). These authors developed the test based off of the guidelines of the Agency for Health Care Policy and Research's (AHCPR) "Pressure Ulcers in Adult Prediction and Prevention," and then ensured the validity and appropriateness of the test through four expert nurses specialized in enterostomal therapy. The registered nurses answered an average of about 71.7% (33.7 out of 47) of the true-false questions correct. Results of this study determined that the time of most recent pressure ulcer exposure (e.g. lectures, journal articles, and class) significantly affected the scores of the questionnaire. Therefore, this study supports the importance of continuing education on the topic of pressure ulcers

throughout the nurses' careers to maintain current knowledge of appropriate pressure ulcer care.

Likewise, other studies have also studied nurses' knowledge level of pressure ulcers with treatment, prevention, pressure ulcer staging, and/or wound description (Boxer & Maynard, 1999; Lamond & Farnell, 1998; Maylor & Torrance, 1999; Pieper & Mattern, 1997; Smith & Waugh, 2009). In 1997, Pieper and Mattern used the same reliable and valid questionnaire used by Pieper and Mott's (1995) study (PPUKT). In this study, 75 critical care nurses took the survey and the total knowledge score averaged 33.5 out of 47 (71.3%) true-false statements correct. Also found in this study was that those who attended a lecture about pressure ulcers scored higher on the test; however, reading an article on pressure ulcers, number of years of experience, and highest nursing education level did not affect the scores. Knowledge deficits occurred in areas of prevention and prediction of pressure ulcers. Improving prevention methods of pressure ulcers in intensive care units is important, especially for the elderly who are at higher risk of developing these lesions (Baumgarten et al., 2008).

Another study showed that nurses' attendance at a lecture did not affect the scores of the questionnaire (Smith & Waugh, 2009). Smith and Waugh (2009) assessed the treatment, prevention, pressure ulcer staging, and wound description of registered nurses (n=96) from an acute, general hospital located in the Midwest using the PPUKT. Similar to Pieper and Mott's (1995) study, nurses that scored higher on the pressure ulcer test were those who read articles or books about pressure ulcers in the recent past. Nurses

who used the internet to look up pressure ulcer information scored higher on the questionnaire than those who had not. This study determined that age, nursing certificates, number of years of nursing experience, highest nursing degree, and attendance at a lecture did not affect the scores of the questionnaire. It appeared that nurses experienced knowledge deficits in heel protection and pressure relief (Smith & Waugh, 2009).

Nurses can improve pressure ulcer knowledge by obtaining a wound care certification (Baranoski & Ayello, 2008). Nurses can get wound care certification from three organizations in the United States: The Wound Ostomy and Continence Nurses Society (WOCN), The American Academy of Wound Management (AAWM), and The National Alliance of Wound Care (NAWC) (Baranoski & Ayello, 2008; Zulkowski et al., 2007). Zulkowski et al. (2007) performed a study to determine if registered nurses that were certified in wound care scored higher on a pressure ulcer test. Results from this study showed that the mean scores of wound certified nurses (89%) scored higher on a pressure ulcer test than the mean scores of nurses without a wound certificate (76.5%), which verified the importance of these certificates. Unfortunately, the care for patients suffering from pressure ulcers is being affected by the healthcare environment, which is under stress due to financial pressure (NPUAP Board of Directors, 2001). Reducing costs by eliminating health care professionals that are most experienced in pressure ulcer care is becoming more common in the healthcare settings; with this type of staff

reduction there is a possibility of unavailable resources for pressure ulcer prevention and care (NPUAP Board of Directors, 2001).

Registered Dietitians' Knowledge

RDs are experts in food and nutrition and are highly-qualified to educate a broad range of clients and patients due to their practice skills developed from their knowledge background, supervised internship experience, and application (Sneed & Gregoire, 1998). The minimum training required to be an entry-level RD is completion of a bachelor's degree in food and nutrition and a hands-on dietetic internship approved by the Academy of Nutrition and Dietetics' Accreditation Council for Education in Nutrition and Dietetics (ACEND) (Academy of Nutrition and Dietetics Foundation [ANDF], n.d.). During their internship experience, dietetic interns are also required to complete a list of competencies. After completion of the internship and schooling, the Commission on Dietetic Registration also requires the individual to pass a national examination in order to obtain the "RD" credential. To maintain their registration, the RD also needs to complete continuing professional educational requirements (ANDF, n.d.).

A Dietetics Practice Audit (DPA) was performed in 2010 to determine where entry-level RDs (those practicing in the first three years since registration) were working and their job responsibilities in practice (Ward, Rogers, Mueller, Touger-Decker & Sauer, 2011). One of the questions in the survey asked entry-level RD practitioners (n=1,829) to select their primary position out of a list of 60 positions; 31% chose Clinical Dietitian, 10% listed as a Clinical Dietitian, Long-Term Care, and 8% selected

WIC (Women, Infants, and Children) Nutritionist. The survey results also concluded that entry-level RDs worked mostly with patients in hospital or long-term care facilities using clinical nutrition care practices, rather than performing managerial or research activities. Therefore, since the majority of entry-level RDs are working as a clinical dietitian, they should be familiar with and knowledgeable of various diseases and health conditions, including wound care.

Even though RDs are knowledgeable in various clinical applications, there are no studies on their knowledge of pressure ulcers. Possible reasons may be that RDs feel that their role in the treatment and prevention of pressure ulcers is not important or there could be a lack of interest in this topic. For example, one study examined the knowledge level and attitudes towards working with older adults among dietetic students (Kaempfer et al., 2002). Results from this test showed that dietetic students (n=286) scored an average of 40.1%, which indicated that dietetic students may need improvement in knowledge about older adults. This study also examined the work preferences of these students and the three older adults categories were ranked the lowest (old, old-old, oldest).

While little evidence has shown RDs' knowledge level of pressure ulcer treatment and prevention, there are other studies on knowledge and perception as it relates to dietetic practice. For example, Byham-gray, Gilbride, Dixon, and Stage's (2005) study examined RDs' perceptions, attitudes, and knowledge level of evidence-based practice. A total of 258 RDs took a survey on their ability to apply their evidenced-based

knowledge in practice. RDs who scored highest on the survey were the ones who had higher education degrees, were employed in research for dietetics, members of at least two associations, and read research the most. Although RDs in this study valued evidenced-based practice, not all RDs were knowledgeable in applying it into their clinical practice due to lack of time and ability to research. Therefore, this study demonstrated the need for not only providing RDs with more resources and educational programs to assist them with increasing their knowledge of evidenced-based practice, but to also incorporate it into the dietetic curriculum.

Available resources include journal articles and books, lectures, and continuing education courses. Students and RDs who are members of the Academy of Nutrition and Dietetics Foundation can also access the Evidence Analysis Library for up to date nutrition findings and guidelines. For example, the Evidence Analysis Library has various topics under "Diseases/Health Conditions," with one of the topics including "Wound Care." Once clicked on the link, the questions regarding energy, protein, micronutrient, and fluid needs for wound care are directed to the NPUAP and the European Pressure Ulcer Advisory Panel (EPUAP) evidence-based guidelines.

Another resource, *Krause's Food & Nutrition Therapy*, is a widely used textbook among dietetic students and practitioners (Mahan & Escott-Stump, 2008). This book covers a vast amount of information pertaining to nutrition and medical nutrition therapy for chronic disease and health conditions. The book, however, only covers a small portion of the topic of pressure ulcers, such as pressure ulcer staging definitions and who

are at risk of developing theses sores. The textbook does not expand on the nutrients involved in wound healing or provide nutrition recommendations.

Another way RDs can increase their knowledge of pressure ulcers is by obtaining professional certificates, such as a Certified Specialist in Gerontological Nutrition or a certificate in wound care. RDs may become a wound management specialist with a title of "Certified Wound Specialist" (CWS) from the AAWM. This type of certifications is intended for licensed health professionals who have a bachelor's, master's, or doctoral degree in a life sciences field with three or more years of clinical wound care experience (American Board of Wound Management [ABWM], n.d.). However, RDs are not eligible to receive a wound certificate from the WOCN because the program is provided only for registered nurses who hold a baccalaureate degree or higher (WOCN, n.d.). Likewise, the NAWC does not offer wound certification to RDs and only offers wound certificates to the following medical professionals: Registered Nurses, Licensed Practical/ Vocational Nurses, Physical Therapists, PTAs, Occupational Therapists, Nurse Practitioners, Physicians and Physician Assistants (NAWC, n.d.).

Patients' Knowledge

According to Brown (2009), education should be specific to the patient's needs and recommended all healthcare professionals work together towards the patient's treatment plan. In addition, the education provided for the patients should be at the appropriate education level to support the understanding and agreement with the treatment plan (Brown, 2009). The patient's literacy, education, language, and culture

should also be taken into consideration. Patients with pressure ulcers view health professionals' advice as crucial for the treatment and management of their pressure ulcers; however, patients describing their perceptions on the advice given by healthcare professionals as unclear and the patients felt that they were given conflicting information (Spilsbury et al., 2007). Patients should be given proper information on realistic time frames for healing (Spilsbury et al., 2007). Patients should be educated on the food and fluids that enhance pressure ulcer healing and the importance of monitoring the healing process (Scemons & Elston, 2009). For example, those affected with pressure ulcers with uncontrolled diabetes should be provided with education on the importance of controlling glucose for successful wound healing. These individuals may experience slow wound healing due to the decreased amount of oxygen to the wound for healing (Posthauer, 2006).

CHAPTER III

METHODOLOGY

Participants

The participants in this study were registered dietitians (RDs) from Ohio, which included all levels of education, age, and years of experience. A total of 3,279 email addresses of licensed dietitians (LDs) were obtained from the Ohio Board of Dietetics. Those that were eligible to complete the electronic test were required to be a RD.

Test Design

Once email addresses were obtained, emails with an explanation of the purpose of the study were sent out. The email contained a cover letter (Appendix A) that explained the study and the confidentiality of the test. The email also provided a link that directed the person to the web-based test known as Survey Monkey. The link sent the participants to the study's electronic consent form (Appendix B) that contained the procedure and the contact information of the researcher and the Kent State University's (KSU) Institutional Review Board (IRB) if the participants had any questions. After the participants understood and agreed to the consent form, they were asked to select whether or not they were a LD only or RD, LD. This selection was used as a filter question to eliminate participants that were not RDs. After the screening question and the consent form, there

were three parts to the test (Appendix C): demographics (Part I), nutrition care of pressure ulcers (Part II), and treatment and prevention of pressure ulcers (Part III).

Part One: Demographics

Appendix C shows the first part of the test, demographics, which consisted of 12 questions in order to identify age, sex, work setting, age group frequently assessed, and interest towards working with older adults (very low, low, neutral, high, or very high). They were also asked about their education level, certifications, and years of experience. In addition, the RDs were asked to recall the length of time since exposure to pressure ulcer information (in the past month, within the past 6 months, within the past year, over a year ago/never, or don't know) and asked to rate the exposure to pressure ulcer information (poor, fair, neutral, good, or excellent) during education and training. After demographics, the participants were asked 40 multiple-choice questions.

Part Two: Nutrition Care of Pressure Ulcers

Part two of Appendix C contained 20 multiple-choice questions that involved knowledge of the nutrition aspect of pressure ulcer care. Seven of the 20 questions pertained to nutritional complications of pressure ulcers. For example, participants were asked to identify signs of a protein deficiency and who were at risk of a zinc deficiency. Other nutritionally related complications involve dehydration, site drainage, metabolic rate, and overfeeding complications. The other 13 questions pertained to the nutrition-related treatment of pressure ulcers. These questions reflected nutrients involved in the

healing process, for example protein, calories, water, copper, and zinc. Questions also related to obese patients and the elderly requirements for wound healing. Other questions concerned nutrition interventions, and protein and fluids recommendations.

Part Three: Treatment and Prevention of Pressure Ulcers

The next 20 questions in Appendix C pertained to knowledge of the general treatment and prevention of pressure ulcers. These questions were developed based off the previous literature of description, definition, and care of the actual pressure ulcer site. Nine of the 20 related to prevention and risk factors and 11 of the questions pertained to the treatment methods. For the prevention section, participants were tested on their knowledge level of risk factors and medical conditions for those who may develop a pressure ulcer. Other questions were about and Braden scores properly caring for the skin to prevent breakdown. Treatment questions involved the actual pressure ulcer site and staging. For example, RDs were asked to select the correct pressure ulcer stage (Stage I, II, III, or IV) for "Intact skin with non-blanchable redness of a localized area usually over a bony prominence." Other treatment questions related to infection, wound healing, dressings, cleanings, and debridement.

Data Collection

Data collection began when written approval from the IRB at KSU was obtained. To protect the participants' privacy, all participants' email addresses were entered into

the blind carbon copy (Bcc) field. The Bcc hides other recipients in the email so the participants' email addresses were not identifiable.

Included in the email was an incentive for taking the test to enhance participation; those who participated had the opportunity to win one of five $20 gift cards to Wal-Mart. In order to be entered into the gift card drawing, the participants were asked to enter their email address at the end of the test. After data was collected, five participants were randomly selected from the list of email addresses that were entered by the participants. The winners were contacted for a name and a mailing address so that they could receive the gift card through the mail.

The test was accessible for one month. Two reminder emails were sent to the participants to remind them to complete the test. After the four weeks of collecting data, the responses from Survey Monkey were organized and summarized.

Statistical Analysis

Statistical Package for the Social Sciences Version 15.0 (SPSS Inc., Chicago, Illinois, 2007) was used to perform the statistical analysis. Frequency, descriptive, and comparative statistics were used to analyze the test results. Frequency tables were organized as frequency and percentage to report demographic information, which included sex, work setting, age group frequently assessed, interest working with older adults, education level, length of time since exposed to pressure ulcer information, and rating of exposure to pressure ulcer information during training and education. The

frequency data responses for 40 multiple-choice questions are summarized in Appendix D. Questions 1-20 pertain to the nutrition care of pressure ulcers, and questions 21-40 relate to the general treatment and prevention of pressure ulcers. The minimum score possible for each section was 0 and the maximum was 20; therefore, the highest possible score of the pressure ulcer test was 40. Differences between means were considered significant at $p \leq 0.05$.

Hypothesis 1

An independent sample t-test was run to determine if there was significant differences between RDs with a bachelor's degree and master's degree on either the knowledge of nutrition or the knowledge of treatment of pressure ulcers.

Hypothesis 2

Pearson's correlation was conducted to test if there were significant correlations in RDs' length of experience in profession on either the knowledge of nutrition or the knowledge of treatment of pressure ulcers.

Hypothesis 3

To examine if there were significant correlations in RDs' age on either the knowledge of nutrition or the knowledge of treatment of pressure ulcers, Pearson's correlation was also conducted.

Hypothesis 4

A one-way analysis of variance (ANOVA) was used to determine if there were significant differences in RDs' work settings on either the knowledge of nutrition or the

knowledge of treatment of pressure ulcers. Participants were able to select six different work settings: hospital, long term care facility, assisted living center, home health care, public health, and/or rehab center. Long term care facility and assisted living were combined into the same category during analysis, which resulted in five different work settings to analyze.

Hypothesis 5

To determine possible significant differences in RDs' recency of exposure to educational materials on either the knowledge of nutrition or the knowledge of treatment of pressure ulcers, a one-way ANOVA was also performed. Participants were asked to select the time since exposed to educational lectures, CEUs, or reading a book or journal article on pressure ulcers and also the time since using the internet to retrieve pressure ulcer information. RDs were able to select "In the past month," "Within the past 6 months," "Within the past year," "Over a year ago/never," or "Don't Know" for each question. Before ANOVAs were run, the "Don't Know" selection was removed.

Hypothesis 6

Lastly, a one-way ANOVA was also used to determine if there were significant differences in RDs' interest towards working with older adults on either the knowledge of nutrition or the knowledge of treatment of pressure ulcers. RDs were asked to rank their interest towards working with older adults as "very low," "low," "neutral," "high," or "very high." Analyses of these variables were organized into three groups: "very low" and "low" were combined into one group, "neutral" was categorized in the second group, and "high" and "very high" were categorized as the third group.

CHAPTER IV

JOURNAL ARTICLE

Introduction

About 2.5 million people in the United States develop pressure ulcers and 60,000 hospital patients will die from complications of these painful, chronic skin wounds every year (Joint Commission, 2008; Lyder, 2011). Healthy, mobile individuals do not develop pressure ulcers; however, occurrence of these lesions most likely occur in the elderly population, critically ill patients in intensive care units, diabetics, stroke victims, and those with impaired mobility and/or those who have inadequate nutrition status, occurring usually at the sacrum, coccyx, heels, elbows, and scapulae (Baranoski & Ayello, 2008; Baumgarten et al., 2008; Margolis, Bilker, Knauss, Baumgarten, & Strom, 2002; Margolis, Knauss, Bilker, & Baumgarten, 2003; Russo, Steiner, & Spector, 2008; Scemons & Elston, 2009). The elderly are more susceptible to the development of pressure ulcers due to decreased mobility and sensation, along with multiple disease states, loss of muscle mass, and poor nutrition (Baranoski & Ayello, 2008; Baumgarten et al., 2008).

Those who do develop pressure ulcers contribute to higher healthcare costs due to the extension of their hospital stay, increased staffing cost, and the amount of supplies required for their treatment (Baranoski & Ayello, 2008; Graves, Birrell, & Whitby, 2005; Sendelbach, Zink, & Peterson, 2011). The occurrence of a pressure ulcer increases the

cost of care from $10,000 to $86,000 per pressure ulcer, depending on the severity of the wound (Sendelbach et al., 2011). The financial, physical, social, emotional, and mental impact of having a pressure ulcer can result in decreased quality of life and increased dependence on others (Baranoski & Ayello, 2008; Hopkins, Dealey, Bale, Defloor, & Worboys, 2006; Spilsbury et al., 2007).

Effective treatment from a multidisciplinary team approach, which includes physicians, physical, occupational, and speech therapists, nurses, and registered dietitians (RDs), should be involved in the treatment of a patient's pressure ulcer (Baranoski & Ayello, 2008; Brown, 2009). RDs are competent in performing nutrition assessments, monitoring the patients' food and fluid intake, and watching the patient's weight status ("Caring for Pressure Ulcers," n.d.). Nutrition especially plays an important role in the wound healing process; adequate calories, protein, fluid, zinc, vitamin A, and vitamin C help heal and repair tissue while keeping the body in positive nitrogen balance, whereas vitamin, mineral, and protein deficiencies delay wound healing (Ayello et al., 1999; Baranoski & Ayello, 2008; Fonder et al., 2008; Lyder, 2003; Posthauer, 2005; Scemons & Elston, 2009). Nutrition status can also play a role in the prevention of pressure ulcers as inadequate nutrition, unintentional weight loss, underweight, and those with Braden scores ≤ 13 are associated as risk factors of pressure ulcers (Baranoski & Ayello, 2008; Fife et al., 2001; Scemons & Elston, 2009).

Poor knowledge in the treatment and prevention of pressure ulcers can significantly contribute to high health care costs, reduce patients' quality of life, impede

wound healing, and increase the risk of mortality associated with malnutrition (Ayello, Thomas, & Litchford, 1999; Baranoski & Ayello, 2008). Moreover, patient outcomes may be improved when there is an increase in knowledge of pressure ulcer care (Maylor & Torrance, 1999; Pieper & Mattern, 1997; Pieper & Mott, 1995). Previous research with nurses studying their knowledge level of pressure ulcers has shown knowledge deficits in prevention such as repositioning, turning, and heel protection (Pieper & Mattern, 1997; Pieper & Mott, 1995; Smith & Waugh, 2009; Zulkowski et al., 2007), yet there has been very little, if any, improvement in nurses' knowledge of pressure ulcers since the original study performed in 1995 by Pieper and Mott (Smith & Waugh, 2009).

While there has been knowledge deficits present among nurses, wound care knowledge among RDs is not well-known. It is especially important to have knowledgeable RDs on the topic of wound care not only because nutrition plays a crucial role in the treatment and prevention of pressure ulcers (Ayello et al., 1999; Baranoski & Ayello, 2008), but due to the growing older adult population with whom these sores commonly occur (Baranoski & Ayello, 2008; Baumgarten et al., 2008; Lu et al., 2010). Therefore, due to an increased need of knowledgeable RDs on wound care, studying pressure ulcer knowledge among RDs may help determine whether there is a need to improve educational interventions to help reduce healthcare costs and enhance patient outcomes.

The purpose of this study was to measure the general knowledge and the nutrition knowledge of pressure ulcer care of RDs in practice. The research hypotheses for this

study was that there will be differences in test scores for the general knowledge and the nutrition knowledge of pressure ulcer care between the levels of education, years of experience, age, different work settings, recency of exposure to educational material, and interest level towards working with older adults.

Methodology

Study Design

The design of this study was non-experimental and descriptive. The study used registered dietitians (RDs) from Ohio, which included all levels of education, age, and years of experience. A total of 3,279 email addresses of licensed dietitians (LDs) were obtained from the Ohio Board of Dietetics. Those that were eligible to complete the electronic test were required to be a RD.

Test Design

Survey Monkey was used to design the web-based test in this study. There were three parts to the test: demographics (Part I), nutrition care of pressure ulcers (Part II), and treatment and prevention of pressure ulcers (Part III).

Part One: Demographics. The first part of the test, demographics, which consisted of 12 questions in order to identify age, sex, work setting, age group frequently assessed, and interest towards working with older adults (very low, low, neutral, high, or very high). They were also asked about their education level, certifications, and years of experience. In addition, the RDs were asked to recall the length of time since exposure to

pressure ulcer information (in the past month, within the past 6 months, within the past year, over a year ago/never, or don't know) and asked to rate the exposure to pressure ulcer information (poor, fair, neutral, good, or excellent) during education and training. After demographics, the participants were asked 40 multiple-choice questions.

Part Two: Nutrition care of pressure ulcers. Part two contained 20 multiple-choice questions that involved knowledge of the nutrition aspect of pressure ulcer care. Seven of the 20 questions pertained to nutritional complications of pressure ulcers. For example, participants were asked to identify signs of a protein deficiency and who were at risk of a zinc deficiency. Other nutritionally related complications involve dehydration, site drainage, metabolic rate, and overfeeding complications. The other 13 questions pertained to the nutrition-related treatment of pressure ulcers. These questions reflected nutrients involved in the healing process, for example protein, calories, water, copper, and zinc. Questions also related to obese patients and the elderly requirements for wound healing. Other questions concerned nutrition interventions, and protein and fluids recommendations.

Part Three: Treatment and prevention of pressure ulcers. The next 20 questions pertained to knowledge of the general treatment and prevention of pressure ulcers. These questions were developed based off the previous literature of description, definition, and care of the actual pressure ulcer site. Nine of the 20 related to prevention and risk factors and 11 of the questions pertained to the treatment methods. For the prevention section, participants were tested on their knowledge level of risk factors and

medical conditions for those who may develop a pressure ulcer. Other questions were about Braden scores and properly caring for the skin to prevent breakdown. Treatment questions involved the actual pressure ulcer site and staging. For example, RDs were asked to select the correct pressure ulcer stage (Stage I, II, III, or IV) for "Intact skin with non-blanchable redness of a localized area usually over a bony prominence." Other treatment questions related to infection, wound healing, dressings, cleanings, and debridement.

Procedure

Once email addresses were obtained, emails with an explanation of the purpose of the study were sent out. To protect the participants' privacy, all participants' email addresses were entered into the blind carbon copy (Bcc) field. The email contained a cover letter that explained the study and the confidentiality of the test. The link sent the participants to the study's electronic consent form that contained the procedure and the contact information of the researcher and the Kent State University's (KSU) Institutional Review Board (IRB) if the participants had any questions. After the participants understood and agreed to the consent form, they were asked to select whether or not they were a LD only or RD, LD. This selection was used as a filter question to eliminate participants that were not RDs.

Included in the email was an incentive for taking the test to enhance participation; those who participated had the opportunity to win one of five $20 gift cards to Wal-Mart. In order to be entered into the gift card drawing, the participants were asked to enter their

email address at the end of the test. After data was collected, five participants were randomly selected from the list of email addresses that were entered by the participants. The winners were contacted for a name and a mailing address so that they could receive the gift card through the mail.

The test was accessible for one month. Two reminder emails were sent to the participants to remind them to complete the test. After the four weeks of collecting data, the responses from Survey Monkey were organized and summarized.

Statistical Analysis

Statistical Package for the Social Sciences Version 15.0 (SPSS Inc., Chicago, Illinois, 2007) was used to perform the statistical analysis. Frequency, descriptive, and comparative statistics were used to analyze the test results. Frequency tables were organized as frequency and percentage to report demographic information, which included sex, work setting, age group frequently assessed, interest working with older adults, education level, length of time since exposed to pressure ulcer information, and rating of exposure to pressure ulcer information during training and education.

An independent sample t-test was run to determine if there was significant differences between RDs with a bachelor's degree and master's degree on either the knowledge of nutrition or the knowledge of treatment of pressure ulcers. Pearson's correlation was conducted to test if there were significant correlations in RDs' length of experience in profession on either the knowledge of nutrition or the knowledge of

treatment of pressure ulcers. To examine if there were significant correlations in RDs' age on either the knowledge of nutrition or the knowledge of treatment of pressure ulcers, Pearson's correlation was also conducted.

ANOVA was used to determine if there were significant differences in RDs' work settings on either the knowledge of nutrition or the knowledge of treatment of pressure ulcers. Participants were able to select six different work settings: hospital, long term care facility, assisted living center, home health care, public health, and/or rehab center. Long term care facility and assisted living were combined into the same category during analysis, which resulted in five different work settings to analyze. **T**o determine possible significant differences in RDs' recency of exposure to educational materials on either the knowledge of nutrition or the knowledge of treatment of pressure ulcers, a one-way ANOVA was also performed. Participants were asked to select the time since exposed to educational lectures, CEUs, or reading a book or journal article on pressure ulcers and also the time since using the internet to retrieve pressure ulcer information. RDs were able to select "In the past month," "Within the past 6 months," "Within the past year," "Over a year ago/never," or "Don't Know" for each question. Before ANOVAs were run, the "Don't Know" selection was removed. Lastly, a one-way ANOVA was also used to determine if there were significant differences in RDs' interest towards working with older adults on either the knowledge of nutrition or the knowledge of treatment of pressure ulcers. RDs were asked to rank their interest towards working with older adults as "very low," "low," "neutral," "high," or "very high." Analyses of these variables were organized into three groups: "very low" and "low" were combined into one group,

"neutral" was categorized in the second group, and "high" and "very high" were categorized as the third group. Differences between means were considered significant at $p \leq 0.05$.

Results

A total of 3,279 Ohio LDs that were electronically invited to participate in the research study. Among 786 LDs who responded to the test, only 760 were used for analysis. The 26 respondents that were excluded from the study included seven with LD only status, 14 with doctoral degrees, and five who did not select the highest education level completed. There were a small number of doctorate respondents because there are very few practicing RDs with doctorate degrees. Overall, in the dietetics profession, there is also a very small number of RDs with a doctoral degree (<5%) and more than 95% of practicing RDs work outside the academic setting (Bryk & Soto, 2002). The doctoral respondents were excluded because the purpose of this study focused on RDs in practice, which consists of RDs who have a bachelor's or master's degree.

Demographic characteristics of the participants are presented in frequency and percentage in Table 2. The majority of participants were female (96.7%), worked at a hospital (50%), and frequently assessed adults (71.3%). The mean age of participants was 42.1 ± 12.1 years, with a range of 22 to 74 years. Years of experience averaged 16.3 ± 11.2 years, with the length ranging from less than half a year to 50 years. Results also showed that the majority of the participants had not reviewed pressure ulcer educational material in over a year/never (36.6%). It also appeared that the majority of the

participants had not accessed the internet for pressure ulcer information in over a year/never (44.2%). None of the participants listed any type of wound certificate; however, the participants did maintain other professional certifications. The most common certification was the Certified Diabetes Educator (CDE).

Table 2 *Description of Participants (N=760)*

Demographic	N	%
Sex		
Male	23	3%
Female	735	96.7%
Work Setting *		
Hospital	380	50%
Long Term Care Facility	200	26.3%
Assisted Living Center	39	5.1%
Home Health Care	36	4.7%
Public Health	174	22.9%
Rehab Center	53	7%
Age Group Frequently Assessed *		
Children	163	21.4%
Adolescents	103	13.6%
Adults	542	71.3%
Elderly	450	59.2%
Interest Working With Older Adults		
Very Low	37	4.9%
Low	52	6.8%
Neutral	245	32.2%
High	269	35.4%
Very High	155	20.4%
Education Level		
Bachelor's degree	439	57.8%
Master's degree	321	42.2%
Educational Lectures, CEUs, or Reading a Book or Journal Article on Pressure Ulcers		
In the Past Month	133	17.5%
Within the Past 6 Months	172	22.6%
Within the Past Year	123	16.2%
Over a Year Ago/Never	278	36.6%
Don't Know	51	6.7%

Table 2 *continued*

Demographic	N	%
Internet Use to Retrieve Pressure Ulcer Information		
In the Past Month	89	11.7%
Within the Past 6 Months	150	19.7%
Within the Past Year	107	14.1%
Over a Year Ago/Never	336	44.2%
Don't know	74	9.7%

*Participants were allowed to select all that applied

Table 3 represents the participants' ratings (poor, fair, neutral, good, or excellent) of their exposure to pressure ulcer information in the education setting and work place. Results showed that most participants rated their exposure to pressure ulcer information below neutral (poor and fair) for undergraduate and graduate school. Above ratings of neutral (good and excellent) included dietetic internship, on-the-job training, and CEU work relevant to pressure ulcers.

Table 3 *Ratings of Exposure to Pressure Ulcer Information (N=760)*

	N, %	Poor	Fair	Neutral	Good	Excellent
Undergraduate Degree	N	248	210	146	126	10
	%	32.6%	27.6%	19.2%	16.6%	1.3%
Dietetic Internship	N	107	163	123	250	65
	%	14.1%	21.4%	16.2%	32.9%	8.6%
Graduate School	N	106	58	120	75	10
	%	13.9%	7.6%	15.8%	9.9%	1.3%
On the Job Training	N	62	48	87	320	160
	%	8.2%	6.3%	11.4%	42.1%	21.1%
CEU Work (Relevant to Pressure Ulcers)	N	82	54	109	249	78
	%	10.8%	7.1%	14.3%	32.8%	10.3%

Hypothesis 1

The overall mean score of knowledge of pressure ulcers for bachelor's and master's degrees was 24.73± 9.09, 12.26± 4.01 for the nutrition knowledge, and 12.47± 5.73 for the treatment knowledge. An independent sample t-test determined that there was no significant differences between RDs with a bachelor's degree and master's degree on either the knowledge of nutrition (p=.265) or the knowledge of treatment (p=.303) of pressure ulcers. These results are presented as means and standard deviations in Table 4.

Table 4 *Scores of the Nutrition and Treatment Section Between Bachelor's and Master's Degrees (N=760)**

Test	Bachelor's (n=439)	Master's (n=321)	P-value
Nutrition Section	12.22± 3.98	12.31±4.05	.265
Treatment Section	12.50±5.81	12.43±5.62	.303

*Difference significant at $p \leq 0.05$.

Hypothesis 2

Pearson's correlation was conducted to test if there were significant correlations in RDs' length of experience in profession on either the knowledge of nutrition or the knowledge of treatment of pressure ulcers. There were significant negative correlations between years of experience and the knowledge of nutrition (r=-.085, p=.020) and the knowledge of treatment (r=-.095, p=.009) of pressure ulcers.

Hypothesis 3

Pearson's correlation analyses also revealed significant negative correlations between age and the knowledge of nutrition (r=-.090, p=.023) and the knowledge of treatment (r=-.114, p=.004).

Hypothesis 4

The means and standard deviations of the nutrition and treatment section among the different work settings are seen in Table 5. Participants were able to select six different work settings: hospital, long term care facility, assisted living center, home health care, public health, and/or rehab center. Long term care facility and assisted living were combined into the same category during analysis, which resulted in five different work settings to analyze. A one-way ANOVA test and consequent pairwise comparisons showed that RDs working in a hospital scored higher than RDs working in public health ($p \leq .001$), and RDs working in long term care/assisted living also scored higher than RDs in the public health setting ($p \leq .001$) for the knowledge of nutrition of pressure ulcers. For the knowledge of treatment of pressure ulcers, the RDs working in a hospital scored higher than RDs working in public health ($p = .007$).

Table 5 *Scores of the Nutrition and Treatment Section According to Work Setting (N=622)**

Knowledge Test	Hospital (n=326)	Long Term Care/Assisted Living (n=132)	Home Health Care (n=16)	Public Health (n=141)	Rehab Center (n=7)
Nutrition Section	12.96 ± 3.87^{a}	12.44 ± 4.29^{b}	12.31 ± 5.17^{abc}	10.39 ± 3.62^{c}	12.71 ± 3.25^{abc}
Treatment Section	12.95 ± 5.39^{a}	12.07 ± 6.35^{ab}	12.38 ± 6.38^{ab}	10.99 ± 5.77^{b}	15.43 ± 3.36^{ab}

*Values with different letters are significantly different at $p \leq 0.05$; a, c=.000, b, c=.000 for the nutrition section and a, b=.007 for the treatment section. Values with "ab" letters are not significantly different at $p \leq 0.05$.

Hypothesis 5

Table 6 and Table 7 represent the scores of the nutrition and treatment section with regard to time since exposed to educational materials. Participants were asked to select the time since exposed to educational lectures, CEUs, or reading a book or journal article on pressure ulcers and also the time since using the internet to retrieve pressure ulcer information as "In the past month," "Within the past 6 months," "Within the past year," "Over a year ago/never," or "Don't Know." Before one-way ANOVAs were run, the "Don't Know" selection was removed.

Table 6 showed that there were significant differences in the knowledge of nutrition of pressure ulcers between "Within the past 6 months" versus "Over a year ago/never" (p=.011) and "Within the past year" versus "Over a year ago/never" (p=.001). Pairwise comparisons showed that there were also significant differences in the knowledge of treatment of pressure ulcers between "Within the past year" versus "Over a year ago/never" (p=.033).

Table 6 *Scores of the Nutrition and Treatment Section According to Last Time Since Exposed to Educational Lectures, CEUs, or Reading a Book or Journal Article on Pressure Ulcers (N=706)**

Knowledge Test	In the past month (n=133)	Within the past 6 months (n=172)	Within the past year (n=123)	Over a year ago/never (n=278)
Nutrition Section	12.60±4.04[ab]	12.79±4.28[a]	13.24±3.69[c]	11.59±3.76 [b;d]
Treatment Section	12.59±5.96[ab]	12.72±6.12[ab]	13.59±4.81[a]	11.87±5.61[b]

*Values with different letters are significantly different at p≤0.05; a, b=.011 and c, d= .001for the nutrition section and a, b=.033 for the treatment section. Values with "ab" letters are not significantly different at p≤0.05.

In Table 7, pairwise comparisons showed that there were significant differences in the knowledge of nutrition between "In the past month" versus "Over a year ago/never" (p=.002), "Within the past 6 months" versus "Over a year ago/never" (p=.002), and "Within the past year" versus "Over a year ago/never" (p=.015). However, there were no significant differences in the knowledge of treatment of pressure ulcers between any of the time variables.

Table 7 *Scores of the Nutrition and Treatment Section According to Last Time Since Using the Internet to Retrieve Pressure Ulcer Information. (N=682)**

Knowledge Test	In the past month (n=89)	Within the past 6 months (n=150)	Within the past year (n=107)	Over a year ago/never (n=336)
Nutrition Section	13.30±4.16[a]	13.00±3.76[c]	12.91±4.23[e]	11.57±3.92 [b;d;f]
Treatment Section	12.40±6.59[ab]	13.13±5.65[ab]	13.31±5.45[ab]	11.90±5.64[ab]

*Values with different letters are significantly different at p≤0.05; a, b=.002, c,d=.002, and e,f= .015 for the nutrition section. Values with "ab" letters are not significantly different at p≤0.05.

Hypothesis 6

RDs were asked to rank their interest towards working with older adults as "very low," "low," "neutral," "high," or "very high." Analyses of these variables were organized into three groups: "very low" and "low" were combined into one group (n=89), "neutral" was categorized in the second group (n=245), and "high" and "very high" were categorized as the third group (n=424). Lastly, a one-way ANOVA was used to determine if there were significant differences in RDs' interest towards working with older adults on either the knowledge of nutrition or the knowledge of treatment of pressure ulcers. Pairwise comparisons showed that there were significant differences

between a high/very high interest and very low/low interest in the knowledge of nutrition (p=.001) and the knowledge of treatment (p=.024) of pressure ulcers, as seen in Table 8. The neutral ranking was not significantly different from a very low/low ranking and high/very high ranking.

Table 8 *Scores of the Nutrition and Treatment Section According to Interest Towards Working with Older Adults (N=760)**

Knowledge Test	Very low/low (n=89)	Neutral (n=245)	High/very high (n=424)
Nutrition Section	10.91 ± 3.58^{a}	12.08 ± 3.89^{ab}	12.64 ± 4.11^{b}
Treatment Section	11.03 ± 5.93^{a}	12.46 ± 5.32^{ab}	12.80 ± 5.86^{b}

*Values with different letters are significantly different at $p \leq 0.05$; a, b=.001 for the nutrition section and a, b=.024 for the treatment section. Values with "ab" letters are not significantly different at $p \leq 0.05$.

Discussion

The development of a pressure ulcer can occur within as little as two to six hours (Lyder & Ayello, 2008), but the healing process can take months, which will contribute to higher healthcare costs, with the treatment and management ranging up to $10,000 to $86,000 per pressure ulcer, depending on the severity of the wound (Sendelbach et al., 2011). Since October 2008, the Centers for Medicare and Medicaid Services (CMS) is no longer reimbursing health facilities as the policy stated that pressure ulcers are "non-reimbursable serious hospital-acquired conditions" as they are "reasonably preventable" through implementation of evidence-based practices (Lembitz & Clarke, 2009).

Furthermore, the number of people aged 65 and older are expected to double from year 2000 to 2030, which is attributed to the baby-boom generation, according to the U.S. Census Bureau (2004) (as cited in Lu, Hoffman, Hosokawa, Gray & Zweig, 2010). Due

to the growing older adult population with whom these sores commonly occur (Baranoski & Ayello, 2008; Baumgarten et al., 2008; Lu et al., 2010), there is an increased need to have knowledgeable RDs on the topic of wound care because nutrition plays a crucial role in the treatment and prevention of pressure ulcers (Ayello et al., 1999; Baranoski & Ayello, 2008). RDs who are knowledgeable about wound care may help reduce healthcare costs, as it has been reported that incidence of pressure ulcers in healthcare settings have decreased as pressure ulcer knowledge increased (Baranoski & Ayello, 2008). The purpose of this study was to measure the general knowledge and the nutrition knowledge of pressure ulcer care of RDs in practice with regards to education, years of experience, age, different work settings, recency of exposure to educational material, and interest level towards working with older adults.

Hypothesis 1

Previous research reported mixed results about education level and knowledge in pressure ulcer care. Some studies indicated a higher level of education was associated with a higher test score (Byham-gray et al., 2005; Pancorbo-Hidalgo, García-Fernández , López-Medina & López-Ortega, 2006). In a study by Pancorbo-Hidalgo et al. (2006), RNs had a higher pressure ulcer test score than LPNs, which showed they were more knowledgeable about pressure ulcers if they had a higher level of education. However, other researchers showed there were no differences in test scores with regards to the level of education (Pieper & Mattern, 1997; Pieper & Mott, 1995; Zulkowski et al., 2007). For example, one study found no difference in pressure ulcer scores in critical care nurses'

educational background consisting of a diploma, associate, or bachelor's degree (Pieper & Mattern, 1997). The authors believed that these results may be due to the nursing textbooks' inaccurate, insufficient, or inconsistent information about pressure ulcers. In the study, they examined previous work on nurses' textbooks and found inappropriate treatment and prevention methods (such as massaging bony prominences) and minimal, disorganized pressure ulcer text and tables.

Research that investigated knowledge differences based on education level among RDs has been scarce; however, in Byham-gray et al.'s (2005) study, participants with a bachelor's or master's degree scored lower on the perceptions, attitudes, and knowledge of evidence-based practice (PAK) test than RDs with a doctoral degree. This indicates that there is a possibility that higher education may increase overall pressure ulcer knowledge among RDs. In the current study, however, there were no significant differences on the knowledge of nutrition or the knowledge of treatment of pressure ulcers between RDs with bachelor's and master's degrees. A possible explanation for this result could be that graduate school at the master's level does not expand on the topic of overall pressure ulcer care. .

In this investigation, only 17.9% of participants with undergraduate degrees and 11.2% of those with master's degrees rated their exposure of pressure ulcer educational material during their education as good and excellent. These results indicate that the participants received little exposure of pressure ulcer information during undergraduate and graduate schooling at the master's level. When examining a widely used textbook,

Krause's Food & Nutrition Therapy, among dietetic students and practitioners, it was found that the book covers limited information on pressure ulcers, and only includes pressure ulcer staging definitions and who are at risk of developing theses sores. The textbook does not expand on the nutrients involved in wound healing or provide nutrition recommendations for patients suffering from these wounds (Mahan & Escott-Stump, 2008). On the other hand, more than 40% of participants in this study rated their exposure to pressure ulcer educational materials as good and excellent during internship and job training. This difference may have been observed because, during internship or job training, they usually go through one-on-one training with another experienced RD or supervisor. These results propose that there is a need for improving exposure of pressure ulcer educational material in the academic setting to enhance the knowledge of nutrition and the knowledge of treatment of pressure ulcers.

Hypothesis 2

The present investigation found that there were significant negative correlations between years of experience and the knowledge of nutrition and the knowledge of treatment of pressure ulcers. This result suggests that as length of time in profession increase, knowledge of the nutrition and the treatment of pressure ulcer care decreases. It is consistent with findings from other previous research with nurses that displayed knowledge of pressure ulcer care. For example, Pancorbo-Hidalgo et al. (2006) have observed a decrease in pressure ulcer knowledge in nurses with over 20 years of experience. Furthermore, nurses with 2-5 and 5-10 years of experience scored higher on

the pressure ulcer test than those with less than two years of experience. However, other previous research with nurses' knowledge of pressure ulcers did not correlate with years of experience (Pieper & Mattern, 1997; Pieper & Mott, 1995; Smith & Waugh, 2009; Zulkowski et al., 2007). A possible explanation for a negative correlation between years of work experience and pressure ulcer knowledge may be that RDs are not continuing their education and updating new practices of pressure ulcer information throughout their profession, which was reflected by the fact that the average time since they were exposed to pressure ulcer educational materials was over one year.

Hypothesis 3

Similar to years of experience, this study also showed that there were significant negative correlations between age and the knowledge of nutrition and the knowledge of treatment of pressure ulcers. Therefore, as age increases, knowledge of the nutrition and the treatment of pressure ulcer care decrease. Other pressure ulcer studies using the Pieper Pressure Ulcer Knowledge Test" (PPUKT) found that age did not affect the scores of the knowledge test (Pieper & Matter, 1997; Smith & Waugh, 2009). Perhaps the reason for why this study showed that knowledge of pressure ulcers decreases when age increases may be that RDs who are older may have more years of experience and may not be updating new practices throughout their career.

Hypothesis 4

This study revealed that there were also significant differences in the knowledge of nutrition and the knowledge of treatment of pressure ulcers between RDs working in the different work settings. RDs work in a wide variety of work environments, such as healthcare, research, education, public health, business, government practice, and private practice (ANDF, n.d.). According to a report by NPUAP Board of Directors (2001), the pressure ulcer incidence ranged from 0.4% to 38% in hospitals and 2.2 to 23.9% in long-term care facilities, showing that development of these sores is common in these work settings. High prevalence of pressure ulcer development in long-term care could be explained by the fact that as age increases, so does the risk of pressure ulcer development due to immobility, impaired mental status, incontinence, and poor nutritional status (Margolis et al., 2002). In the current study, participants who worked in a hospital/ long-term care facility where pressure ulcer prevalence is higher were more knowledgeable in the nutrition aspects of pressure ulcer care than RDs working in the public health setting where exposure to pressure ulcer patients is limited. RDs who work in public health settings focus on teaching the community healthy eating habits to increase their quality of life whereas RDs who work in hospitals and other healthcare facilities use medical nutrition therapy when educating patients (ANDF, n.d.). Therefore, these results highlight the importance of patient exposure in increasing pressure ulcer knowledge among RDs working in hospitals or long-term care facilities.

Supporting this idea, a group of researchers examined nursing students' transfer of learning from the university clinical nursing labs to the clinical workplace. The researchers found that authentic experiences with real patients in the clinical setting were more engaging because of the communication and interactions with the patient (Newton, Billett, Jolly & Ockerby, 2009). The participants' learning was also enhanced when new practices learned in the university were applied to the practice setting rather than in theory. Perhaps this is another reason why nearly half of participants in this study rated their exposure to pressure ulcer information during their internship and training as good and excellent. The theoretical knowledge learned from lectures, texts, and articles were difficult to understand and translate if they could not relate it to experience or apply it into practice. If educators in the academic setting and the work environment work together, students will receive an overall positive learning experience, especially if the educators are engaging and knowledgeable. Educators may also assist students with resources and educational programs so that they have the tools and skills to research or continue their education (Newton et al., 2009).

Hypothesis 5

This investigation also found significant differences in RDs' knowledge of nutrition and the knowledge of treatment of pressure ulcers between the time since exposed to educational lectures, CEUs, or reading a book or journal article on pressure ulcers and also the time since using the internet to retrieve pressure ulcer information. RDs were more knowledgeable about the nutrition and the treatment of pressure ulcers if

they were exposed to lectures, CEUs , books or journal articles on pressure ulcers within the past year compared to over a year ago or never. When RDs used the internet to access pressure ulcer information, there were no significant differences in the knowledge of treatment of pressure ulcers between any of the time variables; however, there were significant differences in the knowledge of nutrition of pressure ulcers if RDs used the internet in the past month, within the past six months, and within the past year compared to over a year ago or never.

There have been numerous studies that suggest that the recency of exposure to educational material is a predictor of knowledge score in nurses (Pieper & Mattern, 1997; Pieper & Mott, 1995; Smith & Waugh, 2009; Zulkowski et al., 2007). In a study done by Smith and Waugh (2009), authors reported that nurses' overall scores of the PPUKT were higher the more recent they listened to lectures, used the internet, or read a book or article about pressure ulcers. Pieper and Mattern's (1997) research demonstrated that there were significant differences when the nurses had last listened to a pressure ulcer lecture. The authors, however, found that test scores were not affected by nurses who had last read an article on pressure ulcers.

Most participants had not accessed the internet for pressure ulcer information in over a year/never (44.2%) or other educational material in over a year/never (36.6%). In a study performed by Byham-gray, Gilbride, Dixon, and Stage's (2005), the authors examined RDs' perceptions, attitudes, and knowledge level of evidence-based practice. Although RDs in this study valued evidenced-based practice, not all RDs were

knowledgeable in applying it into their clinical practice due to lack of time and ability to research. Therefore, the study demonstrated the need for not only providing RDs with more resources and educational programs to assist them with increasing their knowledge of evidenced-based practice, but to also incorporate it into the dietetic curriculum. Perhaps RDs are not aware of resources, such as the Academy of Nutrition and Dietetics Foundation's (ANDF) Evidence Analysis Library and journal, continuing education courses, and professional certificates. Students and RDs who are members of the ANDF can access the Evidence Analysis Library for up-to-date nutrition findings and guidelines. For example, the Evidence Analysis Library has various topics under "Diseases/Health Conditions," with one of the topics including "Wound Care." Once clicked on the link, the questions regarding energy, protein, micronutrient, and fluid needs for wound care are directed to the NPUAP and the European Pressure Ulcer Advisory Panel (EPUAP) evidence-based guidelines.

Hypothesis 6

Another important finding of this study was that both the general knowledge and the knowledge of nutrition of pressure ulcer care scores were significantly higher in a group with a high/very high interest than in a group with a low/very low interest towards working with older adults. Correspondingly, some authors proposed that interest level in a knowledge domain, rather than the participants' education level, was a better predictor of knowledge gain (Chew & Palmer, 1994; Genova & Greenberg, 1979). Knowledge gaps widen when there are differences found in interest levels. One of the theories of a

knowledge gap is due to the motivation to seek out information in a knowledge domain (Ettema & Kline, 1977). Therefore, if RDs are interested in working with the elderly, they perhaps are more likely to seek further information about pressure ulcers to become more knowledgeable about it.

A previous study that examined the knowledge level and attitudes towards working with older adults among dietetic students showed that these students scored an average of 40.1% on the knowledge test, which indicated that dietetic students may need improvement in knowledge about older adults (Kaempfer et al., 2002). Low knowledge scores may be attributed to low interest as dietetic students ranked the three older adult categories (old, old-old, and oldest) as the lowest preferred population to work with. These results raise concern since the majority of entry-level RDs are working as a clinical dietitian in hospitals or long-term care facilities using clinical nutrition care practices, as shown by a Dietetics Practice Audit (DPA) that was performed in 2010 (Ward, Rogers, Mueller, Touger-Decker & Sauer, 2011). Therefore, entry-level RDs should be familiar with and knowledgeable of various diseases and health conditions, including wound care. These results emphasized the role of educators, both in the academic and work setting, to provide positive experiences with gerontology coursework and positive views about aging to promote interest in working with the elderly, especially because the older adult population is increasing and pressure ulcers commonly occur in the elderly (Russo et al., 2008). With the expanding population of older adults, there will be a need for additional health professionals to care for this segment of the population; therefore, it is important to

consider possible geriatric educational interventions to increase students' interest in working with elderly patients (Lu et al., 2010).

Additional Data

Overall, RDs in this study were knowledgeable about staging and description of pressure ulcers. With regards to the role of nutrition in wound care, RDs understood that patients with pressure ulcers, regardless of their weight status, need an adequate amount of protein and calories for wound healing. For example, over 90% of participants knew that inadequate oral intake will result in delayed wound healing for obese patients with pressure ulcers. Furthermore, nearly two-thirds of participants well-understood that when protein or calories are inadequate, patients can experience delayed wound healing.

However, RDs seemed to have a mistaken belief in regards to vitamin and mineral supplementation. Participants believed that providing vitamin and mineral supplementation to pressure ulcer patients sped the healing time. Over half of participants answered protein and vitamin C when asked, "Which nutrients have been proven to speed the pressure ulcer healing?" While this was a tricky question, only 11.2% answered the correct response (none of the above). A vitamin C supplement is not typically recommended unless a vitamin C deficiency is noticed (Ayello et al., 1999; Brown, 2009; Dorner et al., 2009). Although supplementation is crucial to correct any type of nutrient deficiency, supplementation far above the Recommended Dietary Allowance (RDA) when deficiency is not apparent does not speed the wound healing,

and may even be harmful (Dorner et al., 2009; Tempest, Siesennop, Howard, & Hartoin, 2010).

There also appeared to be confusion about copper's role in wound healing. For question #12, over 40% of participants believed that Vitamin E was involved in cross-linking of collagen and only 31.2% answered copper (correct answer). In addition, when asked, "Which of the following nutrients does NOT play a significant role in the wound healing process?" 45% picked Vitamin K and 41% believed copper. Participants poorly understood that copper plays a role in wound healing, although copper acts as a cofactor to help build connective tissue proteins in another enzyme known as lysyl oxidase. Lysyl oxidase is needed for cross-linking of collagen and elastin, which provides great tensile strength (Mahan & Escott-Stump, 2008).

Limitations

There were some limitations to this research study. Because this was an anonymous web-based test, participants were not monitored, which means there is the possibility that they could have retrieved pressure ulcer information from different sources, such as the internet, text books, or journal articles. There is also a chance that the participants may have copied off of another participant's responses, or worked in groups. Neither the cover letter nor the study consent form stated that researching the correct answer was not allowed. Therefore, the test results may not be completely reliable.

Another limitation is that this study only invited participants from Ohio. Selecting RDs from one specific geographic area to provide demographics and pressure ulcer knowledge may not reflect other areas of the United States; therefore, the results cannot be generalized to the general population.

Also a limitation that this study faced was that research lacks the pressure ulcer knowledge among RDs. Due to limited literature on this topic, comparing the results of this current investigation with previous studies on nurses' knowledge of pressure ulcers was a challenge. This is seen as a limitation because the knowledge that nurses gain from pressure ulcers is different than RDs due to differences in education, training, and clinical experiences.

Conclusion and Applications

In summary, this research study demonstrated no differences in the general knowledge or the nutrition knowledge of pressure ulcer care of RDs with bachelor's degrees and master's degrees. In this study, years of experience, age, different work settings, recency of exposure to educational material, and interest level towards working with older adults were found to contribute to the knowledge of nutrition and the knowledge of treatment of pressure ulcers. Study findings suggest that continuous exposure of updated pressure ulcer educational material throughout the RDs' career is important for maintaining or increasing knowledge of pressure ulcers.

Because of the negative correlation found between the knowledge of nutrition and the knowledge of treatment of pressure ulcers with regards to years of experience, it is especially important that RDs continue their education on wound care throughout their careers. Because RDs are trained to work in a wide variety of work settings with various types of patients and clients (Sneed & Gregoire, 1998), not all RDs will benefit from being knowledgeable in the nutrition or the treatment of pressure ulcers. This current investigation specifically supports the importance of continuing education on the topic of pressure ulcers for RDs who work in hospitals or long-term care facilities to maintain current knowledge of appropriate practices. RDs can improve knowledge on pressure ulcer care through resources such as the Evidence Analysis Library, continuing education programs, attending conferences, completing online modules, and certification.

Another way RDs can increase their knowledge of pressure ulcers is by obtaining professional certificates, such as a Certified Specialist in Gerontological Nutrition or a certificate in wound care. RDs appear to be unaware of opportunities to obtain a certificate in wound care as no RD was certified with wound care in this study. RDs may become a wound management specialist with a title of "Certified Wound Specialist" (CWS) from the AAWM. This type of certifications is intended for licensed health professionals who have a bachelor's, master's, or doctoral degree in a life sciences field with three or more years of clinical wound care experience (American Board of Wound Management [ABWM], n.d.). Essentially, if nurses can improve pressure ulcer knowledge by obtaining a wound care certificate (Baranoski & Ayello, 2008; Zulkowski

et al, 2007), there is a possibility that RDs may also be able to increase knowledge of pressure ulcer care with a certificate in wound care. Therefore, if RDs who work in hospitals or long-term care facilities are aware of this opportunity to obtain a wound care certificate, it is possible that they will expose themselves to pressure ulcer information more frequently, consequently maintaining up-to-date practices and increasing knowledge of pressure ulcers, which may reduce healthcare costs and enhance patient outcomes.

APPENDICES

APPENDIX A

EMAIL TO PARTICIPANTS

Appendix A

Email to Participants

Hello!

My name is Kate Sample and I am a graduate student at Kent State University's Combined Masters/Dietetic Internship Program. I am doing my master's thesis project on registered dietitians' knowledge level of pressure ulcer care, to support a multidisciplinary approach to wound care. The purpose of this study is to measure the general knowledge and the nutrition aspect of pressure ulcer care in registered dietitians.

The survey will take about 15 minutes to complete. This survey is completely voluntary and confidential. Those who would like to take this survey will be entered to win one of five $20 gift cards to Wal-Mart. In order to be entered into the gift card drawing, please enter your email address at the end of the survey.

If you choose to take part in this research study, please click on the link below or copy and paste it into your browser and you will be directed to the survey.

https://www.surveymonkey.com/s/PUsurvey

Thank you,

Kate Sample

APPENDIX B

STUDY CONSENT FORM

Appendix B

Study Consent Form

Hello and welcome to a web-based questionnaire for determining knowledge of pressure ulcer care. You are invited to take this survey because you are a licensed dietitian in Ohio. Please carefully read the consent form below and decide if you wish to participate in this voluntary research study.

Electronic Consent Form

The purpose of this research project is to determine the degree of knowledge of general and the nutrition aspect of pressure ulcer among registered dietitians. This is a research project being conducted by Kate Sample, a graduate Nutrition major at Kent State University, which has been approved by the Kent State University Institutional Review Board. There is no deception involved, and the study involves no more than minimal risk to participants. (i.e., the level of risk encountered in daily life).

The online survey will take approximately 15 minutes. The beginning of the survey will contain demographic questions and the rest of the survey questions will be about treatment and prevention of pressure ulcers.

Your participation in this research study is voluntary; you may choose not to participate. If you decide to participate in this research survey, you may withdrawl at any time. If you decide not to participate in this study or if you withdrawl from participating at any time, you will not be penalized. We will maintain anonymity and keep your information confidential. To help protect your confidentiality, the surveys will not contain information that will personally identify you. However, please be aware that there is a small chance that responses could be viewed by unauthorized parties (computer hackers) because the site is not being run from a "secure" https server (secure servers are the ones used to run credit card transactions).

An incentive for participating in this survey is a chance to win one of five $20 gift cards to Wal-Mart. At the end of the survey, please enter your email address. Participants will not be identifiable with their questionnaire results; all surveys will be anonymous.

If you have any questions about the research study or your rights, please contact Kate Sample at ksample1@kent.edu or the Kent State University Institutional Review Board at (330) 672-2704.

Clicking on the "agree" button below indicates that:
• you have read and understand the above information
• you voluntarily agree to participate

Clicking on the "disagree" button below indicates that:
• you do not wish to participate in the research study

Agree or Disagree

- o Agree
- o Disagree

Please select the appropriate professional credentials.

- o Licensed Dietitian (LD) only -- IF SELECTED YOU DO NOT MEET THE CRITERIA FOR THIS STUDY
- o RD (RD), LD -- IF SELECTED PLEASE CONTINUE WITH THE SURVEY

APPENDIX C

TEST QUESTIONS

Appendix C

Test Questions

Part One: Demographics

1. **What is your age?**

   [ ]

2. **What is your sex?**
   - Male
   - Female

3. **Which of the following best describes your work setting? (check all that apply)**
   - Hospital
   - Long term care facility
   - Assisted living center
   - Home health care
   - Public heath
   - Rehab center

4. **Which of the following age group do you frequently assess? (check all that apply)**
   - Children
   - Adolescents
   - Adults
   - Elderly

5. **Please rate your interest towards working with older adults.**
   - Very low
   - Low
   - Neutral
   - High
   - Very high

6. **What is your highest education level?**

    - Bachelor degree
    - Master's degree
    - Doctoral

7. **Do you have a wound certificate (i.e Certified Wound Specialist (CWS))?**
    - Yes
    - No

8. **Please list any professional certifications that you have acquired (i.e. CDE).**

    - Not applicable

9. **How many years have you been working as a dietitian?**

10. **Length of time since attending educational lectures, CEUs, reading a book, or journal article on pressure ulcers?**
    - In the past month
    - Within the past 6 months
    - Within the past year
    - Over a year ago/never
    - Don't know

11. **Length of time since you last used the internet to access pressure ulcer information?**
    - In the past month
    - Within the past 6 months
    - Within the past year
    - Over a year ago/never
    - Don't know

12. Please rate your exposure to pressure ulcer information during the following: (if applicable)

	Poor	Fair	Neutral	Good	Excellent
Undergraduate degree	O	O	O	O	O
Dietetic internship	O	O	O	O	O
Graduate school	O	O	O	O	O
Wound certification	O	O	O	O	O
On the job training	O	O	O	O	O
CEU work (Relevant to pressure ulcers)	O	O	O	O	O

Part Two: Nutrition Care of Pressure Ulcers

1. Which of the following nutrients does NOT play a significant role in the wound healing process?

a. Water
b. Copper
c. Vitamin K
d. Zinc

2. Which of the following is true about obese patients with pressure ulcers?

- o They are rarely malnourished and can go a week without eating
- o Do not require additional protein for wound repair
- o Losing weight will benefit the healing process
- o Inadequate oral intake will result in delayed wound healing

3. Patients who are at increased risk of developing a pressure ulcer:

- o Underweight patients
- o Patients with low Braden scores
- o Patients experiencing unintentional weight loss
- o All of the above

4. Patients who have pressure ulcers experience:

- o Increased metabolic rate
- o Decreased metabolic rate

- Respiratory acidosis
- Respiratory alkalosis

5. **Which calorie range is recommended for a patient with a Stage III or Stage IV pressure ulcer with a normal BMI range?**
    - 20-25 kcal/kg body weight
    - 35-40 kcal/kg body weight
    - 40-45 kcal/kg body weight
    - 45-50 kcal/kg body weight

6. **Overfeeding patients with pressure ulcers leads to:**
    - Decreased carbon dioxide production
    - Impaired respiration
    - Decreased glucose levels
    - All of the above

7. **What is one of the first nutrition interventions for a patient with pressure ulcers that is losing weight?**
    - Liberalize the restricted diet
    - Immediately recommend TPN
    - Recommend an appetite stimulant
    - Begin enteral nutrition when possible

8. **What percent of calories should come from protein for patients with pressure ulcers?**
    - 10-15%
    - 20-25%
    - 30-35%
    - 40-45%

9. **Physical signs of a protein deficiency include:**
    - Dry, cracked lips
    - Dry, dull sparse hair
    - Flaky, itchy skin
    - None of the above

10. Who are at higher risk of zinc deficiency?

- Vegetarians
- Those with high-draining pressure ulcers
- Those taking iron and calcium supplements
- All of the above

11. A zinc supplement should be recommended:

- To speed the wound healing process
- Only for patients with a Stage III or Stage IV pressure ulcer
- For patients with **ALL** pressure ulcer stages
- Only when a zinc deficiency is present

12. Which of the following nutrients play a role in cross-linking of collagen?

- Vitamin E
- Copper
- Thiamin
- Riboflavin

13. Which nutrients have been proven to speed the pressure ulcer healing?

- Zinc and vitamin A
- Protein and vitamin C
- Vitamin C and iron
- None of the above

14. How are fluid needs calculated for patients with pressure ulcers?

- 1 mL/kcal
- 30 mL/kg of body weight
- At least 1500 mL per day
- All of the above

15. Fluid needs are increased up to 35 mL/kg of body weight for pressure ulcer patients:

- With increased blood pressure
- Residing on air-fluidized beds
- With low Blood Urea Nitrogen levels (BUN) levels
- Who are on a multivitamin/mineral supplement

16. What can dehydration lead to for patients with pressure ulcers?

- Decreased blood pressure
- Even further skin breakdown
- Loss of appetite
- All of the above

17. Which is statement is true with regard to nutrition support?

- Pressure ulcers heal more quickly in tube-fed patients.
- If the gastrointestinal tract is functioning, enteral nutrition is the preferred route.
- TPN is always recommended for pressure ulcer patients.
- TPN is never recommended for pressure ulcer patients.

18. Excessive drainage coming from the pressure ulcer site:

- May result in a zinc deficiency
- Can lead to dehydration
- May contain protein
- All of the above

19. Which of the following is true?

- Nutrition does not play a role in prevention of pressure ulcers.
- Inadequate protein or energy can delay wound healing.
- Wound healing is increased with high dose vitamin supplements.
- All of the above

20. Elderly patients with pressure ulcers:

- Should receive a B12 vitamin to speed wound healing
- May only need 30-35 kcal/kg
- Have calculated fluid needs at 2 mL/kcal
- All of the above

Part Three: Treatment and Prevention of Pressure Ulcers

21. What causes the development of a pressure ulcer?

- Pressure
- Shear
- Friction
- All of the above

22. Where is a common area of the body for pressure ulcers to occur?

- Heels
- Hips
- Torso
- Toes

23. Who are at higher risk of developing pressure ulcers?

- Those with decreased circulation and motility
- The elderly population
- All of the above
- None of the above

24. Select the TRUE statement.

- Pressure ulcers are not preventable.
- Pain increases as the depth of the wound increases.
- Pressure ulcers can decrease the patient's quality of life.
- All of the above

25. Intact skin with non-blanchable redness of a localized area usually over a bony prominence.

- Stage I
- Stage II
- Stage III
- Stage IV

26. Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle is not exposed.

- Stage I
- Stage II
- Stage III
- Stage IV

27. Which stage might be difficult to detect in individuals with dark skin tones?

- Stage I
- Stage II
- Stage III
- Stage IV

28. What stage should a patient be evaluated for osteomyelitis?

- Stage I
- Stage II
- Stage III
- Stage IV

29. What are signs that an infection is present with a pressure ulcer?

- Non-healing wound
- Strong odor and thick, yellow or green-colored pus
- Pain and/or warmth around the wound
- All of the above

30. If a patient has a Stage III pressure ulcer and has shown wound healing, his or her pressure ulcer can be classified as:

- Stage 0 (if completely healed)
- Stage II or Stage I
- Healing or healed Stage III pressure ulcer
- Stage IV

31. The skin is at risk of developing a pressure ulcer when there is:

- Low amounts of pressure for a long duration
- High amounts of pressure for a short duration
- When the epidermis is overhydrated from urinary and bowel incontinence
- All of the above

32. Select the TRUE statement.

- Untreated osteomyelitis may result in bone damage or amputation.
- The wound will heal and replace the lost muscle, subcutaneous fat, or dermis.
- Donut-shaped cushions help prevent pressure ulcers.
- All of the above

33. Select the TRUE statement for prevention of pressure ulcers.

- The skin should be kept clean with hot, soapy water.
- Alcohol-based moisturizers should be used to keep the skin dry.
- Massage bony areas of the body to prevent pressure ulcers.
- None of the above

34. Which intervention for urinary continence increases the risk of pressure ulcer development?

- Diaper
- Foley catheter
- Bedpan
- Urine does not damage the skin

35. Bruising is a sign of

- Healing
- Infection
- Suspected deep tissue injury
- An unstageable wound

36. Which subscale is NOT included in the Braden Scale?

- Sensory perception
- Nutrition status
- Cognitive function
- Activity level

37. A Braden score of 10 to 12 indicates that the patient:

- Is at high risk of pressure ulcer development
- Is at low risk of pressure development
- Braden score does not affect pressure ulcer risk
- The patient needs nutrition support

38. Which of the following medical conditions are at risk of developing a pressure ulcer?

- Diabetes mellitus
- Congestive heart failure
- Chronic obstructive pulmonary disease
- All of the above

39. Select the FALSE statement.

- When choosing the dressing, keep the wound bed moist and the surrounding skin dry.
- Pressure ulcers can develop in hours.

- Using normal saline to cleanse the wound will damage the healing tissue.
- Taking pressure off the wound is one of the first steps to the healing process.

40. Which is true about debridement?

- Enhances cell movement and exposes the severity of the site
- Enables the wound to begin healing
- If this step is skipped, bacteria can damage tissue even further
- All of the above

By completing this survey, you have provided valuable information that will help Kate Sample better understand your knowledge level of pressure ulcers. Please note that your responses to this survey are kept confidential. Please know this is only to improve the understanding of the knowledge level of pressure ulcer care of registered dietitians.

Would you consent to allow your information to be shared with Kate Sample?

- Yes
- No

If you would like to be entered to win one of five $20 gift cards to Wal-Mart, please enter your email address below.

Thank you for your time.

APPENDIX D

TEST ANSWERS

Appendix D

Test Answers

Questions, multiple-choice	N	%
1. Which of the following nutrients does NOT play a significant role in the wound healing process?		
a) Water	65	8.6%
b) Copper	314	41.3%
c) Vitamin K*	343	45.1%
d) Zinc	5	.7%
2. Which of the following is true about obese patients with pressure ulcers?		
a) They are rarely malnourished and can go a week without eating	2	.3%
b) Do not require additional protein for wound repair	2	.3%
c) Losing weight will benefit the healing process	28	3.7%
d) Inadequate oral intake will result in delayed wound healing*	708	93.2%
3. Patients who are at increased risk of developing a pressure ulcer:		
a) Underweight patients	7	.9%
b) Patients with low Braden scores	23	3%
c) Patients experiencing unintentional weight loss	26	3.4%
d) All of the above*	681	89.6%
4. Patients who have pressure ulcers experience:		
a) Increased metabolic rate*	677	89.1%
b) Decreased metabolic rate	28	3.7%
c) Respiratory acidosis	18	2.4%
d) Respiratory alkalosis	8	1.1%
5. Which calorie range is recommended for a patient with a Stage III or Stage IV pressure ulcer with a normal BMI range?		
a) 20-25 kcal/kg body weight	17	2.2%
b) 35-40 kcal/kg body weight*	560	73.7%
c) 40-45 kcal/kg body weight	131	17.2%
d) 45-50 kcal/kg body weight	26	3.4%
6. Overfeeding patients with pressure ulcers leads to:		
a) Decreased carbon dioxide production	68	8.9%
b) Impaired respiration*	494	65%
c) Decreased glucose levels	4	.5%
d) All of the above	109	14.3%

7. What is one of the first nutrition interventions for a patient with pressure ulcers that is losing weight?		
a) Liberalize the restricted diet*	625	82.2%
b) Immediately recommend TPN	4	.5%
c) Recommend an appetite stimulant	19	2.5%
d) Begin enteral nutrition when possible	54	7.1%
8. What percent of calories should come from protein for patients with pressure ulcers?		
a) 10-15%	14	1.8%
b) 20-25%*	323	42.5%
c) 30-35%	314	41.3%
d) 40-45%	48	6.3%
9. Physical signs of a protein deficiency include:		
a) Dry, cracked lips	15	2%
b) Dry, dull sparse hair*	523	68.8%
c) Flaky, itchy skin	31	4.1%
d) None of the above	124	16.3%
10. Who are at higher risk of zinc deficiency?		
a) Vegetarians	48	6.3%
b) Those with high-draining pressure ulcers	160	21.1%
c) Those taking iron and calcium supplements	17	2.2%
d) All of the above*	474	62.4%
11. A zinc supplement should be recommended:		
a) To speed the wound healing process	119	15.7%
b) Only for patients with a Stage III or Stage IV pressure ulcer	102	13.4%
c) For patients with ALL pressure ulcer stages	177	23.3%
d) Only when a zinc deficiency is present*	277	36.4%
12. Which of the following nutrients play a role in cross-linking of collagen?		
a) Vitamin E	318	41.8%
b) Copper*	237	31.2%
c) Thiamin	43	5.7%
d) Riboflavin	48	6.3%
13. Which nutrients have been proven to speed the pressure ulcer healing?		
a) Zinc and vitamin A	125	16.4%
b) Protein and vitamin C	448	58.9%
c) Vitamin C and iron	12	1.6%
d) None of the above*	85	11.2%
14. How are fluid needs calculated for patients with pressure ulcers?		
a) 1 mL/kcal	73	9.6%
b) 30 mL/kg of body weight	219	28.8%
c) At least 1500 mL per day	22	2.9%
d) All of the above*	355	46.7%

15. Fluid needs are increased up to 35 mL/kg of body weight for pressure ulcer patients:		
a) With increased blood pressure	62	8.2%
b) Residing on air-fluidized beds*	320	42.1%
c) With low Blood Urea Nitrogen (BUN) levels	207	27.2%
d) Who are on a multivitamin/mineral supplement	61	8%
16. What can dehydration lead to for patients with pressure ulcers?		
a) Decreased blood pressure	6	.8%
b) Even further skin breakdown	99	13%
c) Loss of appetite	2	.3%
d) All of the above*	554	72.9%
17. Which is statement is true with regard to nutrition support?		
a) Pressure ulcers heal more quickly in tube-fed patients.	31	4.1%
b) If the gastrointestinal tract is functioning, enteral nutrition is the preferred route.*	619	81.4%
c) TPN is always recommended for pressure ulcer patients.	1	.1%
d) TPN is never recommended for pressure ulcer patients.	8	1.1%
18. Excessive drainage coming from the pressure ulcer site:		
a) May result in a zinc deficiency	15	2%
b) Can lead to dehydration	53	7%
c) May contain protein	14	1.8%
d) All of the above*	580	76.3%
19. Which of the following is true?		
a) Nutrition does not play a role in prevention of pressure ulcers.	3	.4%
b) Inadequate protein or energy can delay wound healing.*	537	70.7%
c) Wound healing is increased with high dose vitamin supplements.	6	.8%
d) All of the above	114	15%
20. Elderly patients with pressure ulcers:		
a) Should receive a B12 vitamin to speed wound healing	68	8.9%
b) May only need 30-35 kcal/kg*	343	45.1%
c) Have calculated fluid needs at 2 mL/kcal	45	5.9%
d) All of the above	193	25.4%

*Correct Answer

Questions, multiple-choice	N	%
21. What causes the development of a pressure ulcer?		
a) Pressure	52	6.8%
b) Shear	1	.1%
c) Friction	2	.3%
d) All of the above*	600	78.9%
22. Where is a common area of the body for pressure ulcers to occur?		
a) Heels*	466	61.3%
b) Hips	139	18.3%
c) Torso	47	6.2%
d) Toes	2	.3%
23. Who are at higher risk of developing pressure ulcers?		
a) Those with decreased circulation and motility	27	3.6%
b) The elderly population	4	.5%
c) All of the above*	620	81.6%
d) None of the above	2	.3%
24. Select the TRUE statement.		
a) Pressure ulcers are not preventable.	0	0%
b) Pain increases as the depth of the wound increases.	24	3.2%
c) Pressure ulcers can decrease the patient's quality of life.*	525	69.1%
d) All of the above	105	13.8%
25. Intact skin with non-blanchable redness of a localized area usually over a bony prominence.		
a) Stage I*	584	76.8%
b) Stage II	53	7%
c) Stage III	9	1.2%
d) Stage IV	2	.3%
26. Full thickness tissue loss. Subcutaneous fat may be visible but bone, tendon or muscle is not exposed.		
a) Stage I	6	.8%
b) Stage II	159	20.9%
c) Stage III*	442	58.2%
d) Stage IV	27	3.6%
27. Which stage might be difficult to detect in individuals with dark skin tones?		
a) Stage I*	547	72%
b) Stage II	61	8%
c) Stage III	17	2.2%
d) Stage IV	11	1.4%
28. What stage should a patient be evaluated for osteomyelitis?		
a) Stage I	34	4.5%
b) Stage II	101	13.3%

c) Stage III	206	27.1%
d) Stage IV*	288	37.9%
29. What are signs that an infection is present with a pressure ulcer?		
a) Non-healing wound	0	0%
b) Strong odor and thick, yellow or green-colored pus	34	4.5%
c) Pain and/or warmth around the wound	7	.9%
d) All of the above*	601	79.1%
30. If a patient has a Stage III pressure ulcer and has shown wound healing, his or her pressure ulcer can be classified as:		
a) Stage 0 (if completely healed)	2	.3%
b) Stage II or Stage I	75	9.9%
c) Healing or healed Stage III pressure ulcer*	558	73.4%
d) Stage IV	2	.3%
31. The skin is at risk of developing a pressure ulcer when there is:		
a) Low amounts of pressure for a long duration	53	7%
b) High amounts of pressure for a short duration	41	5.4%
c) When the epidermis is overhydrated from urinary and bowel incontinence	40	5.3%
d) All of the above*	494	65%
32. Select the TRUE statement.		
a) Untreated osteomyelitis may result in bone damage or amputation.*	336	44.2%
b) The wound will heal and replace the lost muscle, subcutaneous fat, or dermis.	2	.3%
c) Donut-shaped cushions help prevent pressure ulcers.	45	5.9%
d) All of the above	248	32.6%
33. Select the TRUE statement for prevention of pressure ulcers.		
a) The skin should be kept clean with hot, soapy water.	99	13%
b) Alcohol-based moisturizers should be used to keep the skin dry.	20	2.6%
c) Massage bony areas of the body to prevent pressure ulcers.	118	15.5%
d) None of the above*	394	51.8%
34. Which intervention for urinary continence increases the risk of pressure ulcer development?		
a) Diaper*	501	65.9%
b) Foley catheter	64	8.4%
c) Bedpan	59	7.8%
d) Urine does not damage the skin	7	.9%
35. Bruising is a sign of		
a) Healing	32	4.2%

b) Infection	0	0%
c) Suspected deep tissue injury*	551	72.5%
d) An unstageable wound	51	6.7%
36. Which subscale is NOT included in the Braden Scale?		
a) Sensory perception	203	26.7%
b) Nutrition status	55	7.2%
c) Cognitive function*	319	42%
d) Activity level	32	4.2%
37. A Braden score of 10 to 12 indicates that the patient:		
a) Is at high risk of pressure ulcer development*	457	60.1%
b) Is at low risk of pressure development	113	14.9%
c) Braden score does not affect pressure ulcer risk	7	.9%
d) The patient needs nutrition support	26	3.4%
38. Which of the following medical conditions are at risk of developing a pressure ulcer?		
a) Diabetes mellitus	235	30.9%
b) Congestive heart failure	1	.1%
c) Chronic obstructive pulmonary disease	5	.7%
d) All of the above*	379	49.9%
39. Select the FALSE statement.		
a) When choosing the dressing, keep the wound bed moist and the surrounding skin dry.	141	18.6%
b) Pressure ulcers can develop in hours.	98	12.9%
c) Using normal saline to cleanse the wound will damage the healing tissue.*	323	42.5%
d) Taking pressure off the wound is one of the first steps to the healing process.	53	7%
40. Which is true about debridement?		
a) Enhances cell movement and exposes the severity of the site	30	3.9%
b) Enables the wound to begin healing	78	10.3%
c) If this step is skipped, bacteria can damage tissue even further	16	2.1%
d) All of the above*	493	64.9%

*Correct Answer

REFERENCES

REFERENCES

Abbott Nutrition. (n.d.). *Juven®*. Retrieved from http://abbottnutrition.com/Products/Juven

Academy of Nutrition and Dietetics Foundation. (n.d.). *Educational and professional requirements*. Retrieved from http://www.eatright.org/BecomeanRDorDTR/content.aspx?id=8143

American Academy of Family Physicians Foundation. "Dehydration." *quickcare.org*. N.p., n.d. Web. 23 Jan 2012. <http://quickcare.org/gast/dehydrate.html>.

American Board of Wound Management. (n.d.). *CWS: Why certify?*. Retrieved from http://www.abwmcertified.org/abwm-certified/cws/cws-why-certify/

American Dietetic Association. (2011). *Pocket guide for international dietetics & nutrition terminology (IDNT): Reference manual*. (3 ed.). Chicago: American Dietetic Association.

American Speech-Language-Hearing Association (n.d.). *Fact sheet for speech-language pathology*. Retrieved from http://www.asha.org/careers/professions/slp.htm

Ayello, E. A., Thomas, D. R., Litchford, M. A. (1999). Nutritional aspects of wound healing. *Home Healthcare Nurse*, 17(11), 719-729.

Baranoski, S., & Ayello, E. A. (2008). *Wound care essentials: Practice principles*. (second ed.). Philadelphia: Lippincott Williams & Wilkins.

Baumgarten, M., Margolis, D. J., Localio, A. R., Kagan, S. H., Lowe, R. A., Kinosian, B., … Mehari, T. (2008). Extrinsic risk factors for pressure ulcers early in the hospital stay: A nested case-control study. *Journal of Gerontology*, 63(4), 408-413.

Beckrich, K., & Aronovitch, S. A. (1999). Hospital-acquired pressure ulcers: A comparison of costs in medical vs. surgical patients. *Advances in Wound Care*, *17*(5), 263-271.

Berlowitz, D., Lukas, C. V., Parker, V., Niederhauser, A., Silver, J., Logan, C.,… & Zulkowski, K. *Preventing pressure ulcers in hospitals*. Agency for Healthcare Research and Quality. Retrieved from http://www.ahrq.gov/research/ltc/pressureulcertoolkit/putoolkit.pdf

Boxer, E., & Maynard, C. (1999). The management of chronic wounds: Factors that affect nurses' decision making. *Journal of Wound Care*, *8*(8), 409-412.

Brown, P. (2009). *Quick reference to wound care*. (third ed.). Sudbury: Jones and Bartlett publisher.

Bryk, J. A., & Soto, T. K. (2001). Report on the 1999 membership database of the American Dietetic Association. *Journal of the American Dietetics Association, 101*(8), 947-953.

Byham-gray, L. D., Gilbride, J. A., Dixon, B., & Stage, F. K. (2005). Evidenced-based practice: What are dietitians' perceptions, attitudes, and knowledge?. *Journal of the American Dietetic Association, 105*, 1574-1581.

Cai, S., Mukamel, D. B., & Temkin-Greener, H. (2010). Pressure ulcer prevalence among black and white nursing home residents in New York state: Evidence of racial disparity? *Medical Care*, 48(3), 233-239.

Chew, F., & Palmer, S. (1994). Interest, the knowledge gap, and television programming. *Journal of Broadcasting & Electronic Media, 38*(3), 271-287.

Collagen. (n.d.) *The American Heritage® Dictionary of the English Language, Fourth Edition*. (2003). Retrieved February 13 2012 from http://www.thefreedictionary.com/collagen

Collins, N. (2010, January). Nutrition product news you can use. *Ostomy Wound Management, 56*(1), 12-14.

Cunningham, B. (2009, January 31). *Pressure ulcers are medical errors*. Retrieved from http://www.bcmlawyers.com/pressure-ulcers-are-medical-errors/

Desneves, K. J., Todorovic, B. E., Cassar, A., & Crowe, T. (2005). Treatment with supplementary arginine, vitamin and zinc in patients with pressure ulcers: A randomized controlled trial. *Clinical Nutrition*, 24, 979-987.

Dorner, B., Posthauer, M. E., & Thomas, D. National Pressure Ulcer Advisory Panel, (2009). *The role of nutrition in pressure ulcer prevention and treatment: National Pressure Ulcer Advisory Panel white paper*. Retrieved from website: http://www.npuap.org/Nutrition White Paper Website Version.pdf

Ettema, J. S., & Kline, F. G. (1977). Deficits, differences, and ceilings: Contingent conditions for understanding the knowledge gap. *Communication Research, 4*, 179-202.

Fife, C., Otto, G., Capsuto, E. G., Brandt, K., Lyssy, K., Murphy, K., & Short, C. (2001). Incidence of pressure ulcers in a neurologic intensive care unit. *Critical Care Medicine*, 29(2), 283-290.

Fleishman, A. (2005, January). Management of pressure ulcers. *Today's Dietitian, 7*(1), 38. Retrieved from http://www.todaysdietitian.com/newarchives/td_0105p38.shtml

Fonder, M. A., Lazarus, G. S., Cowan, D. A., Aronson-Cook, B., Kohli, A. R., & Mamelak, A. J. (2008). Treating the chronic wound: A practical approach to the care of nonhealing wounds and wound care dressings. *Journal of the American Academy of Dermatology*, 58(2), 185-206.

Genova, B. K. L., & Greenberg, B. S. (1979). Interest in news and the knowledge gap. *The Public Opinion Quarterly*, *43*(1), 79-91.

Graves, N., Birrell, F., & Whitby, M. (2005). Effect of pressure ulcers on length of hospital stay. *Infection Control and Epidemiology*, 26(3), 293-297.

Hopkins, A., Dealey, C., Bale, S., Defloor, T., & Worboys, F. (2006). Patient stories of living with a pressure ulcer. *Journal of Advanced Nursing*, 56(4), 345-353.

Joint Commission. (2008). Strategies for preventing pressure ulcers. *Joint Commission Perspectives on Patient Safety*, 8(1), 5-7.

Kaempfer, D., Wellman, N. S., & Himburg, S. P. (2002). Dietetics students' low knowledge, attitudes, and work preferences toward older adults indicate need for improved education about aging. *Journal of the American Dietetic Association, 102*(2), 197-202.

Kirk, S. J., Hurson, M., Regan, M. C., Holt, D. R., Wasserkrug, H. L., & Barbul, A. (1993). Arginine stimulates wound healing and immune function in elderly human beings. *Surgery, 114*(2), 155-160.

Lamond, D., & Farnell, S. (1998). The treatment of pressure sores: A comparison of novice and expert nurses' knowledge information use and decision accuracy. *Journal of Advanced Nursing, 27*, 280-286.

Leininger, S. M. (2002). The role of nutrition in wound healing. *Critical Care Nurse, 25*(1), 13-21.

Lembitz, A., & Clarke, T. J. (2009). Clarifying "never events" and introducing "always events". *Patient Safety in Surgery, 3*(26).

Litchford, M. D. (2010*). Laboratory assessment of nutritional status: Bridging theory & practice*. Greensboro: CASEsoftware.

Lu, W., Hoffman, K., Hosokawa, M., Gray, M., & Zweig, S. (2010). First year medical students' knowledge, attitudes, and interest in geriatric medicine. *Educational Gerontology*, *36*, 687-701.

Lyder, C. H. (2003). Pressure ulcer prevention and management. *Journal of the American Medical Association*, 289(2), 223-226.

Lyder, C. H. (2011, August 10). The benefits of a multi-disciplinary approach to the prevention and treatment of pressure ulcers. *Infection Control Today*.

Lyder, C. H., & Ayello, E. A. (2008). *Patient safety and quality: An evidence-based handbook for nurses*. Rockville: Agency for Healthcare Research and Quality. Retrieved from http://www.ahrq.gov/qual/nurseshdbk/nurseshdbk.pdf

Mahan, L. K., & Escott-Stump, S. (2008). *Krause's food & nutrition therapy*. (12 ed.). St. Louis: Saunders Elsevier.

Margolis, D. J., Bilker, W., Knauss, J., Baumgarten, M., & Strom, B. L. (2002). The incidence and prevalence of pressure ulcers among elderly patients in general medical practice. *Annals of Epidemiology*, 12(5), 321-325.

Margolis, D. J., Knauss, J., Bilker, W., & Baumgarten, M, (2003). Medical conditions as risk factors for pressure ulcers in an outpatient setting. *Age and Ageing*, 32(3), 259-264.

Masspro. (2009, August). *Taking the pressure off*. Retrieved from http://www.masspro.org/NH/PS/docs/educationtraining/Taking the Pressure Off.8.09.pdf

Maylor, M., & Torrance, C. (1999). Pressure sore survey, part 2: Nurses knowledge. *Journal of Wound Care*, *8*(2), 49-52.

McArdle, W. D., Kach, F. I., & Katch, V. L. (2009). *Sports and exercise nutrition*. (3rd ed.). Philadelphia: Lippincott Williams & Wilkins. National Alliance of Wound Care. (n.d.). *Eligibility for certification*. Retrieved from http://www.nawccb.org/wound-care-certification

Miller, A. (2009). Hospital reporting and "never events". *Medicare Patient Management*, 20-22.

National Pressure Ulcer Advisory Panel. (1992). *Statement on pressure ulcer prevention*. Retrieved from http://www.npuap.org/

National Pressure Ulcer Advisory Panel. (2007). *Pressure ulcer stages revised by NPUAP*. Retrieved from http://www.npuap.org/

National Pressure Ulcer Advisory Panel of Board of Directors. (2001). Pressure ulcers in America: Prevalence, incidence, and implications for the future: An executive summary of the National Pressure Ulcer Advisory Panel monograph. *Advances in Skin and Wound Care*, 14(4), 208-215.

Newton, J., Billett, S., Jolly, B., & Ockerby, C. (2009). Lost in translation: Barriers to learning in health professional clinical education. *Learning in Health and Social Care*, *8*(4), 315-327.

Pancorbo-Hidalgo, P., García-Fernández , F., López-Medina , I., & López-Ortega , J. (2006). Pressure ulcer care in Spain: Nurses' knowledge and clinical practice. *Journal of Advanced Nursing*, *58*(4), 327-338.

Pieper, B., & Mattern, J. C. (1997). Critical care nurses' knowledge of pressure ulcer prevention, staging and description. *Ostomy/wound Management*, *43*(2), 22-31.

Pieper, B., & Mott, M. (1995). Nurses' knowledge of pressure ulcer prevention, staging, and description. *Advances in Wound Care*, *8*(3), 34-48.

Posthauer, M. E. (2005). Do patients with pressure ulcers benefit from oral zinc supplementation? *Advances in Skin and Wound Care*, 18(9), 32-33.

Posthauer, M. E. (2005). Hydration: An essential nutrient. *Advances in Skin and Wound Care*, 18(1), 32-33.

Posthauer, M. E. (2006). The role of nutrition in wound care. *Advances in Skin and Wound Care*, 19(1), 43-52.

PubMed Health. (2010). Osteomyelitis. In D. Dugdale (Ed.), *The National Center for Biotechnology Information* Retrieved from http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0001473/

Russo, C. A., Steiner, C., Spector, W. Agency for Healthcare Research and Quality, Healthcare Cost and Utilization Project. (2008). *Hospitalizations related to pressure ulcers among adults 18 years and older, 2006.* Retrieved from website: http://www.hcup-us.ahrq.gov/reports/statbriefs/sb64.pdf

Scemons, D., & Elston, D. (2009). *Nurse to nurse wound care*. Chicago: McGraw-Hill.

Sendelbach, S., Zink, M., & Peterson, J. (2011). Decreasing pressure ulcers across a healthcare system: Moving beneath the tip of the iceberg. *The Journal of Nursing Administration*, 41(2), 84-89.

Skipper, A., & Lewis, N. M. (2005). A look at the educational preparation of the health-diagnosing and treating professions: Do dietitians measure up?. *Journal of the American Dietetics Association*, *105*(3), 420-427.

Smith, D., & Waugh, S. (2009). Research study: An assessment of registered nurses' knowledge of pressure ulcers prevention and treatment. *The Kansas Nurse*, *84*(1), 3-5.

Sneed, J., & Gregoire, M. (1998). Down-board thinking: What are our next moves? *Journal of the American Dietetic Association*, 98, 860-862.

Spilsbury, K., Nelson, A., Cullum, N., Iglesias, C., Nixon, J., & Mason, S. (2007). Pressure ulcers and their treatment and effects on quality of life: Hospital inpatient perspectives. *Journal of Advanced Nursing*, 57(5), 494-504.

StopPain.org. (n.d.). *Caring for pressure ulcers*. Retrieved from http://www.stoppain.org/pressureulcers/caregivers_care.asp

Tempest, M., Siesennop, E., Howard, K., & Hartoin, K. (2010). Nutrition, physical assessment, and wound healing. *Support Line*, *32*(3), 22-28.

ter Riet, G., Kessels, A. G., & Knipschild, P. G. (1995). Randomized clinical trial of ascorbic acid in the treatment of pressure ulcers. *Journal of Clinical Epidemiology*, 48(12), 1453-1460.

The National Center for Biotechnology Information (2008, September 01). *Megestrol*. Retrieved from http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0000539/

Thomas, D. R., Goode, P. S., Tarquine, P. H., Allman, R. M. (1996). Hospital-acquired pressure ulcers and risk of death. *Journal of the American Geriatrics Society*, 44(12), 1435-1440.

United States Department of Agriculture, Food and Nutrition Board, Institute of Medicine, National Academies. (2010). *Dietary reference intakes*. Retrieved from website: http://iom.edu/Activities/Nutrition/SummaryDRIs/~/media/Files/Activity Files/Nutrition/DRIs/RDA and AIs_Vitamin and Elements.pdf

Vinayagasundaram, B., Halpin, L., Sullivan, C. (2009). A team approach to effective wound care. *Long-Term Living*, 58(5), 20-22.

Vorvick, L. J. (2011, September 26). *Urinary catheters*. Retrieved from http://www.nlm.nih.gov/medlineplus/ency/article/003981.htm

Ward, B., Rogers, D., Mueller, C., Touger-Decker, R., & Sauer, K. L. (2011). Entry-level dietetic practice today: Results from the 2010 commission on dietetic registration entry-level dietetics practice audit. *Journal of the American Dietetics Association*, *111*(6), 914-941.

Williams, J. Z., Abumrad, N., & Barbul, A. (2002). Effect of a specialized amino acid mixture on human collagen deposition. *Annals of Surgery*, *236*(3), 369–375.

Witte, M. B., & Barbul, A. (2003). Arginine physiology and its implications for wound healing. *Wound Repair and Regeneration*, 11(6), 419-423.

Wound Ostomy and Continence Nurses Society. (n.d.). *Become a WOC nurse*. Retrieved from http://www.wocn.org/?page=become_a_woc_nurse

Zeller, J. L., Lynm, C., & Glass, R. M. (2006). Pressure ulcers. *The Journal of the American Medical Association*, *296*(8), 1020.

Zulkowski, K., Ayello, E. A., Wexler, S. (2007). Certification and education: Do they affect pressure ulcer knowledge in nursing? *Advances in Skin and Wound Care*, 20(1), 34-38.