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Venous Leg Ulcers: An Analysis of Nursing Knowledge

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This doctoral project, directed and approved by the candidate's committee, has been accepted by the College of Graduate and Professional Studies of Abilene Christian University in partial fulfillment of the requirements for the degree

Doctor of Nursing Practice

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of the requirements for the degree of

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by

Shelia Moore-Miller

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Dedication

I dedicate this project to my two daughters: Erin and Ciara. They have endured my educational endeavors. Simultaneously, we enrolled in postsecondary education. I am grateful to watch my children pursue healthcare careers.

Acknowledgments

I acknowledge the help of Hope Stanphill and Dr. Tony Sawyer-McGee. I am uncertain of the origin of my fear of completing a doctoral project. No one in my family attained a master's or doctoral level of education. Therefore, I needed Hope to call me every four weeks, encouraging me to move to the next step and setting deadlines.

As I attempted to complete each chapter, Dr. Sawyer-McGee steered me out of my comfort zone; however, I had to overcome my fear and accept the guidance. She saw something in me that I was not able to visualize. I feared the doctoral project so much that I made it complicated. Dr. Sawyer-McGee dissected my project's layers to identify one area to focus on for my doctoral project. I appreciate her patience with my reluctance to change and my ever-changing work schedule.

Abstract

This project evaluated the knowledge level of wound center nursing staff on venous leg ulcer etiology and treatments after an educational intervention. To determine the effectiveness of the educational intervention, participants completed a pretest and posttest evaluation. Venous leg ulcers (VLUs) are chronic lower extremity ulcers affecting older Americans. VLUs are painful and negatively affect activities of daily living. Inadequate VLU treatment can become an infectious process that can ultimately threaten limb existence. A quantitative, quasi-experimental study was conducted over three weeks in a hospital-based wound care center in central Florida. The theoretical framework applied to this project is Lydia Hall's care cure and core nursing theory. There were seven participants evaluated in this study. Five of the nurses had a BSN degree as the highest level of education, while one was an APRN who had obtained an MSN. Two of the participants were licensed practical nurses. The nurses' knowledge of VLUs was evaluated with a NetCE continuing education pretest and posttest. Before the posttest, participants completed a continuing education course.

Keywords: venous leg ulcers, wound care, clinical evidence, compression therapy, physical activity

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Chapter 1: Introduction

The increase in the aging population and the prevalence of illnesses such as diabetes, vascular diseases, and obesity has increased the number of patients suffering from chronic and acute wounds (Applewhite et al., 2018). Globally, expenses related to wound care increased from an average of $2.8 billion in 2014 to a projected $3.5 billion in 2021(Sen, 2019, p. 40). In the United States, approximately 10–35% of adults suffer from chronic venous insufficiency (CVI) (Vivas et al., 2016). In addition, chronic venous insufficiency causes about 80% of venous leg ulcers (VLUs), making the illness' annual financial burden, based on Medicare and private insurance data, almost $14.9 billion (Vivas et al., 2016).

Problem of Interest

CVI results from a dysfunction of the valves of the veins, associated with impaired blood flow in the leg veins and causes symptoms such as aching, itching, edema, eczema, and heaviness (Lim et al., 2018; Spiridon & Corduneanu, 2017). A VLU is a common wound that results from CVI (Lim et al., 2018). The elderly, obese, physically inactive, and individuals with severe leg injuries are at risk for developing VLUs. Misdiagnosis, inadequate training, not recognizing VLUs, lack of structured care delivery procedures, and ineffective coordination among healthcare providers can hinder adopting evidence-based practices (EBP) and guidelines (Franks et al., 2016). Therefore, the problem of interest for the proposed quantitative project is the lack of knowledge of evidence-based treatment of VLUs that could result in increased outpatient visits, decreased quality of life among convalescents, and growing costs for target agencies.

Background

A VLU is a chronic illness associated with decreased quality of life, lower productivity, and increased care costs (Melikian et al., 2018). Leg ulcers are a serious medical problem for a growing proportion of the population. As the population ages and older individuals in the United States increasingly experience comorbidities, unhealed leg wounds are increasing (de Leon et al., 2016). Estimates of the prevalence of VLUs range from 1–3% of the population (Klonizakis et al., 2018; White-Chu & Conner-Kerr, 2014). Venous leg ulcers are principally managed and treated in outpatient medical settings, with the guidance of dermatologists. Effective management and treatment of VLU requires a combination of different experts to ensure correct diagnosis, evaluate the venous supply, and establish other factors which can be modified to ensure optimum remediation (Alavi et al., 2016). Knowledge regarding the treatment of VLUs ought to be constantly updated, considering the constant therapeutic changes that occur in the pathophysiology of medical conditions.

According to Probst et al. (2019), the prevalence of VLUs is approximately one percent of the general population. For those older than 80, the prevalence increases to 3%. As medical care continues to improve and people live longer, the frequency of VLUs will also rise. As Vivas et al. (2016) noted, CVI is often overlooked as a cause, meaning the prevalence of this condition is underestimated. Data suggests 2.5 million people in the United States experience CVI and of those, approximately 20% develop venous leg ulcers (Eberhardt & Raffetto, 2014, p. 333).

Approximately 70% of venous ulcers heal in 24 weeks. However, 30% do not heal within that time (Parker et al., 2017). In 60–70% of patients, VLUs recur within a year. Lim et al. (2018) found that VLU reoccurs in 26–69% of patients within 12 months of treatment. In another study, Probst et al. (2019) indicated VLUs have a recurrence rate of 70% and a 60% peril of

becoming chronic. Probst et al. (2019) noted that VLUs are classified as poorly healing wounds. According to Frykberg and Banks (2015), VLUs may account for 60% of all poorly healing wounds, with the majority (60%) healing within 6 months, with others (33%) taking a year, and some (7%) never healing. 60–70% of individuals experiencing a VLU will have a recurrence 3 months after the wound closes (Frykberg & Banks, 2015). VLUs can therefore become a long-term problem.

The increase in patients with comorbidities and an aging population cause an increase in healthcare costs. As de Leon et al. (2016) outlined, increasing costs of acute care have compelled third-party payers, including Medicare, to seek alternative treatment venues for wound care. In 2000, the Centers for Medicare and Medicaid Services (CMS) developed a payment system, the Outpatient Prospective Payment System (OPPS). OPPS allows complex services (e.g., ongoing wound treatment) to be billed as outpatient care.

These service innovations led to the formation of hospital-based outpatient wound care departments (HOPDs). When Medicare pays for a patient's care, the extent of care covered at an HOPD is determined by applying a national coverage determination (NCD) or a local coverage determination (LCD), which outline reimbursable Medicare treatment and procedures. However, not all procedures and treatments are subject to coverage determinations. LCDs and NCDs establish evidence-based rules for the appropriate use of technologies and procedures (Foote & Town, 2007). Some LCDs and NCDs are applicable to wound care treatment in outpatient wound care departments.

Financial Impact

VLUs have several economic and social effects on individuals and the U.S. healthcare system. Vivas et al. (2016) noted that the financial burden to third-party payers is close to $14.9

billion, with a single case of VLU possibly exceeding $400,000 over a patient's lifetime. White-Chu and Conner-Kerr (2014) estimated that annual costs in 2000 were between $19,000 and $24,000 annually per patient for each occurrence. These figures include expenses for dressings, hospitalizations, medications, home health care, and outpatient costs for facility and physicians. These 'hard' costs are easily quantifiable. Quality-of-life impacts such as reduced social activities and work, as well as increased personal financial costs are difficult to quantify but need to be considered negative impacts on the patient. VLUs also cause increased pain, impaired sleep, and reduced mobility (Jull et al., 2018).

Once a VLU appears, proper wound care is critical to reducing pain, suffering, and expense. White-Chu and Conner-Kerr (2014) indicated that comprehensive care of CVIs and associated ulcers require multipronged and interprofessional approaches. VLUs are generally treated in outpatient settings, and WCCs provide specialized healthcare services using different wound care therapies and are managed by professionals from various specialties (Parker et al., 2017). Having a multidisciplinary team under one roof allows those with persistent wounds to receive care beyond that which would typically be available in a primary care physician's office (de Leon et al., 2016).

The increased incidence of VLU creates the need for guidelines that optimize patient care. There are various comprehensive clinical guidelines for diagnosing and managing VLUs. Couch et al. (2017) supported the need for rigorous evidence formulated by various medical societies to help healthcare providers make the appropriate healthcare decisions. Clinical guidelines are used as a standard of care or recommendations. Guidelines, such as those from the Association for the Advancement of Wound Care (AAWC), use current evidence (Couch et al., 2017).

Statement of the Problem

Enhancing nurses' skills improves patient outcomes and decreases healthcare expenses. Properly assessing and identifying such wounds are critical. As de Leon et al. (2016) explained, if those tasked with assessing wounds have deficits in their abilities in this area, this could lead to not recognizing early signs of wound infection or deterioration. This failure could lead to wound complications, which could require more costly treatments and increased risks, such as antibiotic therapy or hospital stays. The admitting clinician's ability to correctly identify the wound type and any atypical characteristics are the keys to success with the multidisciplinary team. Consequently, the clinician must provide proper treatment guidelines and interventions.

The need for following treatment guidelines is paramount, as De Carvalho et al. (2018) concluded. Failure to apply the appropriate policy could also subject the patient to additional treatments that could result in higher risk and costs. If clinicians do not follow EBGs, patient outcomes might be diminished. The International Consolidated Venous Ulcer Guideline (ICVUG) serves as the primary source of EBGs for treating VLUs and contains a compendium of evidence-based recommendations with references and rankings of recommendations. By following them, clinicians benefit from years of research in this field, can properly assess the wound, and determine the best treatment.

Whether a wound is treated in a WCC or HOPD depends on the facility's scope of practice. Even if wound treatment is within the range of care for a nurse, wound care has advanced beyond the initial training of many clinicians, as de Leon (2016) noted. There have been several recent innovations in wound dressings and a number of in-clinic diagnostic tests have been developed. There is an increased risk of ulcers not healing if HOPDs lack educated professionals to perform all elements needed to care for and properly instruct patients on self-

care at home. Haddock (2000, cited in Ashton & Price, 2006) suggested nurses' knowledge of wound assessment is not adequate to inform practice. This study will explore their levels of expertise to determine if remediation is needed in these areas so that patients can receive the best possible care when they go to WCCs to treat their VLUs.

Clinical evidence suggests that patients experience improved outcomes if patients treated with the evidence-based recommendations in the ICVUG. According to Stevens (2013), "EBP is aimed at hardwiring current knowledge into common care decisions to improve care processes and patient outcomes" (para. 1). A recent search of scholarly writing on nurses' compliance with ICVUG standards revealed a lack of research in this area. Additional studies, such as the one proposed, would establish the relationship between extent of knowledge, implementation, and patient outcomes. Those managing WCCs and the nurses working in them will benefit from the insights generated by this study.

Purpose of the Study

This study evaluated knowledge of VLU etiology and EBP VLU treatment by clinical nursing staff at the proposed hospital outpatient wound care department. Assessing clinicians' knowledge before completing an online continuing education course allowed me to determine if the staff had knowledge deficits. Taking an online continuing education course with postcompletion testing determined if online education maintained or increased knowledge of VLUs. Research has shown statistically significant correlations between knowledge and wound assessment competence in those who updated their wound care training in the previous two years (McCluskey & McCarthy, 2012, p. 47).

Current knowledge in clinically useful forms and implemented across the care team can be measured to assess its impact on performance and health outcomes (Stevens, 2013). The

WCC nursing staff needs to be aware of the latest EBPs to ensure that patients receive the highest standard of care.

Research Question

The premise of this research was to provide ICVUG training for nurses to increase their knowledge of EBP regarding VLU treatment. In turn, this knowledge would translate into improved patient outcomes in an HOPD setting. The first step of EPB involved formulating a clinical question using the population, intervention, comparison, outcome, and time (PICOT) format (Melnyk & Fineout-Overholt, 2015). The proposed research was guided by one research question using the PICOT framework:

RQ1: In a wound care center (P), does completing an online continuing education activity guideline on venous disease and leg ulcers for the nursing staff increase their knowledge of ICVUG (I) and lead to achieving a score of at least 80% on the assessment (compared to their previous level of knowledge [C]) and evidence based ICVUG guidelines (O) after completion of the educational activity (T)?

Pre- and posttest scores were analyzed at the end of the educational intervention to assess gains in knowledge. Melnyk and Gallagher-Ford (2015) suggested developing a PICOT question, research, and clinical evidence appraisal before adopting it into practice. It is essential to know the extent to which nurses are knowledgeable regarding the ICVUG in their daily practice. Melnyk and Gallagher-Ford (2015) concluded: “There is a tremendous need to enhance nurses’ skills so that they achieve competency in EBP to ensure the highest quality of care and best population health outcomes” (p. 16).

The hypotheses for this study were:

H_1: An online continuing education class will improve nurses' knowledge level after completion of the educational activity.

H_0: An online continuing education class will not improve nurses' knowledge level after completion of the educational activity.

Definition of Key Terms

Chronic venous insufficiency (CVI). A CVI is generally considered a manifestation of venous hypertension caused by either valve leaflets that are failing to close due to thickening, scarring, or dilated veins that are functionally inadequate (Gasper et al., 2019).

Evidence-based practice (EBP). The integration of the latest evidence-based knowledge with clinical knowledge, family preferences, and values used to deliver the best possible care (Melnyk & Fineout-Overholt, 2015).

International Consolidated Venous Leg Ulcer Guidelines (ICVUG). The ICVUG is a consolidated set of VLU treatment guidelines containing recommendations from all relevant, published evidence-based guidelines for VLU care. The latest revision was overseen by the American Association for the Advancement of Wound Care (AAAWC), the Wound Healing Society, and the Canadian Association of Enterostomal Therapy (CAET; Couch et al., 2017). It functions as the 'guideline of guidelines' of VLU care.

NetCE. An online continuing education site that provides continuing education activity in support of improving patient care. It is accredited by the Accreditation Council for Continuing Medical Education (ACCME), the Accreditation Council for Pharmacy Education (ACPE), and the American Credentialing Center (ANCC).

Venous leg ulcer (VLU). A VLU is an open skin wound on the lower leg that is painful and slow to heal (Norman et al., 2018).

Wound care center (WCC). A WCC is a medical center that provides a combination of specialized wound care services generally not available in a primary care setting (de Leon et al., 2016).

Scope and Limitations

This study collected data on the effectiveness of teaching LPNs and RNs VLU care standards outlined by an online continuing education course from NetCE. Data were collected utilizing a pretest/posttest methodology. The previous knowledge of the clinicians could cause limitations on the effectiveness of the material. The clinicians' varied experience and education could have affected their pretest score. The NetCE activity may be more indicative of current EBP treatment methods because the ICVUG are from 2015.

VLUs are medical events that can negatively impact the quality of life. When a skilled clinician assesses the wound, incorrect treatment recommendations increase the risk of infection, leading to costly care such as antibiotics or hospitalization. When patients are evaluated using evidence-based practices, the clinician identifies the best treatment approach based on the available evidence. The ICVUG is the recognized practice guideline for treating VLUs. Following EBP guidelines leads to better health outcomes. It is unknown if wound-care nurses follow EBP VLU guidelines.

Data from this study benefit nursing practice and wound care professionals by providing data on whether attaining education regarding the ICVUG is sufficient to increase adherence to ICVUG standards in a WCC setting by nurses. Chapter 2 includes an in-depth evaluation of the literature on the topics considered in this project.

Chapter 2: Literature Review

Literature Search Methods

Acquiring and analyzing evidence is an indispensable EBP (Melnyk & Fineout-Overholt, 2015). Therefore, this researcher conducted a comprehensive review of the literature to identify research studies relevant to the proposed problem using EBSCOHost, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), and PubMed Central databases. Keywords and Medical Subject Headings used were *venous leg ulcers*, *recurrence*, *guidelines*, *compression therapy*, *dressing*, *topical agents, and physical activities*. Keywords were combined using the Boolean operators and escudos or to generate results. Search terms that retrieved studies were (venous leg ulcers or venous ulceration) and guidelines, treatment and (venous leg ulcers or venous ulceration); compression therapy and (venous leg ulcers or venous ulceration), dressing and (venous leg ulcers or venous ulceration); physical activities and (venous leg ulcers or venous ulceration), and topical agents and venous leg ulcers.

Applying selection criteria ensured that only relevant journal articles were retrieved, appraised, and included in the synthesis of literature. The articles used had to meet the following criteria: available in full text, written in English, relevant to the problem of interest, published between 2015 and 2019, and peer reviewed. Articles were excluded if: only abstracts were available, they were not written in English, or published before 2015. Sixteen studies were included in the literature review and categorized by themes.

Theoretical Framework Discussion

The theoretical framework applied to this project was Hall's three aspects of nursing. As Umara (2019) outlined, the three aspects of nursing involve care, core, and cure. As applied to this study, the function of care is how nurses provide care, including direct care and preventive

care, to patients with VLU. By carefully analyzing patients and their risk factors, nurses can determine the most efficacious and evidence-based practices from the ICVUG to apply. This will lead to their ability to select the best form of treatment supported by the evidence, giving patients the best opportunity to heal.

According to Hall's theory (1964, as cited in Sumarno, 2019), 'care' represents patients' bodies and reflects the nursing aspect that involves physical care. It is associated with the nurse's role in providing comprehensive care, which encompasses attitudes and actions such as providing for patients' physical and psychological needs, being attentive, getting to know the patient, taking time, being firm, showing respect, and providing the extra touch (McCance, 2003, as cited in Sumarno, 2019).

The patient, family, or primary caregiver is educated during wound care visits on etiology, care, and actions to reduce the recurrence of VLUs. There is a partnership between the patient and the clinician in the wound care center to achieve positive outcomes. Successful wound healing requires the patient to be receptive to healing components such as compliance with nutrition, exercise, and care of the ulcer. If the patient does not participate in the healing partnership and solely relies on the clinic's actions, healing is delayed or does not occur. For the wound care clinician, care includes knowing how to correctly assess ulcers, recommend the appropriate EBP treatment, and teach the patient and family.

As Umara (2019) outlined, the core component of the model refers to how nurses use their clinical experience and knowledge of the ICVUG to facilitate patient awareness and understanding. Training their clients in the NetCE continuing education information, which supports ICVUG, will enable the clients to gain the knowledge required to manage their care correctly. A patient educated in their disease process and preventative/maintenance care may

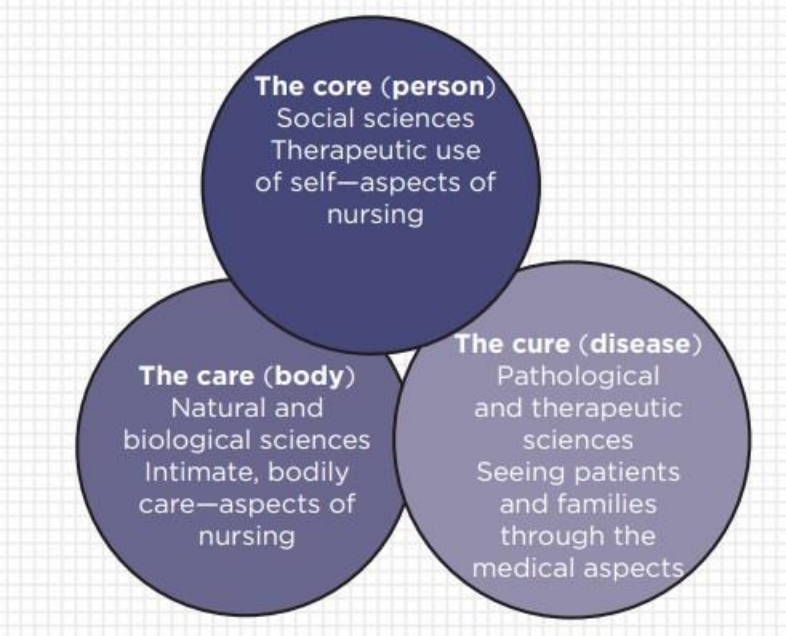
improve outcomes. The core of Hall's (1964) theory is the patients who receive nursing care. This aspect of Hall's theory requires the whole person to be considered in the treatment plan. The quality-of-life impacts with VLUs, such as reductions in socializing, work, financial challenges, and isolation, need to be considered when deciding on a course of action. According to Sumarno (2019), involving patients in the decision-making process (i.e., patient-centered care) and providing holistic care is imperative to overcome these issues. The core also refers to the patient's emotional, spiritual, and intellectual needs, which are associated with the family and the community.

Finally, the aspect of cure applies to the nurse's use of medical management of the situation. Nurses will use the ICVUG to select the most suitable medical management approach to treat VLUs and prevent them from becoming worse over time. According to Hall (1964, as cited in Sumarno, 2019), the cure represents the pathological and therapeutic basis on which the patient and their family receive medical care. This aspect of the theoretical model requires proper assessment and identification of wounds. Utilizing appropriate clinic diagnostics helps the clinician determine the appropriate treatment modalities. The treating nurses need to be aware of the current ICVUG. Specifically, Hall explained that the 'cure' aspect is shared by the nurse with other health professionals, such as primary care physicians, physical therapists, nutritionists, and surgeons, as noted by Sumarno (2019). This concept coincides with the multidisciplinary approach of wound care centers. Strategies involving insurance organizations and CMS are needed to institute and promote venous leg ulcer prevention.

By applying Hall's theory, nurses can provide holistic care that will benefit the patient in both short-term and long-term time frame. Figure 1 represents how Hall's three aspects of nursing work together (Hall, 1964, Alligood, 2014 as cited in Sumarno, 2019)

Figure 1

Lydia Hall: Care, Cure, Core Nursing Theory



Note: Lydia Hall's theory encompasses the whole person in the disease process. Pressure ulcers: The core, care and cure approach. *British Journal of Community Nursing*, *24*(Sup12), p. S38 https://doi.org/10.12968/bjcn.2019.24.Sup12.S38. Reprinted with permission.

Literature Review

Tan et al. (2019) conducted a systematic review to assess the quality of clinical guidelines related to VLU. The team conducted their study based on Rumbo-Prieto et al. (2018) recommendations and argued that some existing clinical guidelines for treating and managing VLUs are limited by scientific quality and lack of editorial rigor. These uncertainties and differences in clinical practices about VLUs affect patient outcomes. Rumbo-Prieto et al. (2018) recommended using the Appraisal of Guidelines for Research and Evaluation (AGREE) II instrument to assess the quality of guidelines.

Using Rumbo-Prieto et al. (2018) recommendations, Tan et al. (2019) retrieved articles from electronic databases, including PubMed and Embase that focused on VLU clinical practice guidelines. Two reviewers assessed the guidelines retrieved using the AGREE-II instrument and found 14 guidelines published in articles between 1999 and 2016, with the majority formulated in North America or Europe. The 6-component AGREE II instrument assessed scope and purpose, stakeholder involvement, rigor development, clarity of presentation, applicability, and editorial independence. None of the identified 14 guidelines received the highest score in any of the six facets. The researchers also identified managing patients with VLUs, assessing and managing VLUs, managing chronic VLUs, and of Australian and New Zealand clinical practice guidelines for preventing and managing venous leg ulcers. Tan et al. (2019) concluded there is a need for quality guidelines applied in the clinical setting.

Melikian et al. (2018), in their retrospective cohort study, found there are perilous factors associated with the failure of VLUs to heal. In their study, the researchers included 66 patients with VLUs. The patients were treated using guidelines from the American Venous Forum (AVF) and the Society for Vascular Surgery (SVS). The 66 patients were treated using compression, ligation and strapping, iliac vein stenting, perforator surgery, radiofrequency ablation, skin grafting, or debridement. Of these patients, the applied interventions facilitated complete healing of the VLU in 40. The researchers assessed the risk factors of the 20 patients whose VLUs did not heal after 52 weeks. The identified risk factors were superficial or deep venous involvement, size of the ulcer, obesity, hypertension, heart diseases, depression, smoking history, and diabetes mellitus. Melikian et al. (2018) concluded that it is essential for healthcare providers to consider risk factor disparity and systematic and condition-based factors when applying VLUs treatment guidelines.

Couch et al. (2017) explained the process by which the ICVUG is updated. The process involved a task force from members of the AAWC, WHS, and (CAET). The task force adhered to National Guideline Clearinghouse (NGC) procedures. The researchers conducted a systematic review of Cochrane, Medline, and CINAHL databases that retrieved 1069 studies, of which 27 were included. The guidelines contain 141 recommendations that consisted of 77% containing A-level evidence, 4% had B-level evidence, and 18% were at the C-level. The researchers recommended using compression, dressing, topical agents, and exercise. The collaboration of various organizations supports the rigor and quality of the guidelines and their use in clinical settings. Lurie et al. (2019) explained that guidelines from the SVS support compression.

Rumbo-Prieto et al. (2018) found that existing guidelines lack quality and editorial rigor. The researchers recommended using the AGREE-II instrument to assess the quality of guidelines. Tan et al. (2019) conducted such a study and found four guidelines of quality but suggested the need for comprehensive recommendations for the clinical setting. Lurie et al. (2019) and Melikian et al. (2018) support using the guidelines by the AVF and SVS, but those recommendations focus primarily on compression therapy. Couch et al. (2017) explained the quality and evidence that support the ICVUG.

Venous Leg Ulcers and Compression Therapy

Andriessen et al. (2017) concluded that compression is important in treating VLUs, but there is a lack of clarity on peril factors, adverse events, contraindications, and complications when the therapy is used. Thus, the researchers conducted a study to assess adverse events, complications, and risk factors associated with compression therapy. The study involved a search for literature on current clinical guidelines relating to the prevention, management, and

maintenance of VLUs. The researchers found 20 guidelines on compression therapy. Adequate assessment can facilitate complications associated with compression.

Weller et al. (2019) conducted a systematic review of international guidelines to determine whether there is consensus concerning the recommendations for applying compression. The 13 VLU guidelines helped researchers conclude that the recommendations are vague about the ankle-brachial pressure index. Some guidelines did not recommend compression based on the index, while others advocated reduced compression. Weller et al. (2019) concluded that the lack of consensus is associated with the implications of using compression. Further, inconsistencies in the grades given to recommendations limit clinicians' ability to compare guidelines. De Carvalho et al. (2018) conducted a meta-analysis to compare the effectiveness of 4-layer compression compared to short-stretch bandages. The researchers found that at 12 and 16 weeks, 259 and 234 ulcers were healed entirely using four-layer and short-stretch bandage groups, respectively. At 24 weeks, 268 and 257 ulcers were completely healed using four-layer and short-stretch bandage groups. Both four-layer and short stretch bandage systems facilitate complete healing of VLUs. De Carvalho et al. (2018) concluded that the choice of compression system choice depends on patient tolerance and preference.

Andriessen et al. (2017) and Weller et al. (2019) argued for consensus on the guidelines that govern the use of compression. De Carvalho et al. (2018) conducted research to facilitate developing a consensus for using compression by comparing the efficacy of different bandages. Similar to Couch et al. (2017), the study by De Carvalho et al. supported the efficacy of both bandaging systems.

Venous Leg Ulcers, Dressing, and Topical Agents

Norman et al. (2018) indicated that compression therapy is used as the first-line treatment for VLU, but there were differences in the dressings and treatments applied. Therefore, the researchers conducted a study to assess the effectiveness of dressings and topical agents on the VLUs. Norman et al. (2018) searched for randomized controlled trials in various electronic databases such as EBSCO, CINAHL, and Ovid. Two review authors independently selected the studies included in the article as a technique for eliminating bias. In the study, the researchers did not explicitly indicate the dressings that increase the likelihood of healing. Norman et al. (2018) recommended the need for additional studies on the impact of various dressings and agents on the healing of VLUs. Like Norman et al. (2018), Lean et al. (2019) conducted a study that included systematic reviews, randomized controlled trials, and meta-analysis which supported the need for studies with rigor on the effectiveness of these interventions.

In another study, Bianchi et al. (2017) conducted a randomized controlled trial in 15 different healthcare facilities in the United States to assess dehydrated human amnion/chorion (EpiFix) membrane compared to a multilayer compression therapy for VLUs. The researchers performed a Cox regression analysis to determine that EpiFix had a significantly higher likelihood of facilitating healing within 12 weeks. Bianchi et al. (2017) concluded that EpiFix could be an alternative for multilayer compression therapy to give better VLUs healing outcomes.

Walczak et al. (2017) indicated that treating VLUs is often slow, difficult, and the wounds are likely to recur. The researchers conducted a study that involved 14 patients with VLUs. The patients were treated with negative pressure wound therapy, and the dressing was impregnated with silver ions and neutral triglycerides. Next, a polyurethane form was applied

over the dressing. A 92% rate of healing was observed, and recurrence happened in only one patient. Walczak et al. (2017) concluded that applying a negative pressure to VLUs enhances treatment results.

Bianchi et al. (2017) and Norman et al. (2018) stated that compression therapy is supported as the first line of treatment for VLUs. Other studies suggested using EpiFix biological skin graft applied to the VLU wound bed with negative pressure as an alternative to multilayer compression therapy. Negative pressure wound therapy can be used with or without a biological skin graft (Bianchi et al., 2017; Walczak et al., 2017).

Venous Leg Ulcers, Compression, and Physical Activities

Jull et al. (2018) indicated that exercises are recommended as a complementary technique for improving calf muscle pump function. The association of exercise with compression, though, has not yet been determined. Thus, the researchers conducted a systematic meta-analysis to assess whether the use of exercise with compression increases the likelihood of VLUs healing compared to the interventions used on their own. Searching the literature helped researchers retrieve five randomized clinical trials relevant to this study. Assessing data from the five sources helped them conclude that combining compression with physical activity effectively facilitates better outcomes (Jull et al., 2018).

Like Jull et al. (2018), Smith et al. (2018) and Yim et al. (2015) agreed that compression therapy is the standard practice for treating VLUs. Exercise, in addition to compression, is associated with improved patient outcomes. Thus, the researchers conducted a search for evidence from databases such as Web of Science, CINAHL, PsycINFO, and Cochrane to assess the impact of exercise on the healing time, recurrence, adverse events, quality of life, and pain of the VLUs. Applying the inclusion criteria led to selecting six studies that were assessed.

Reviewing three trials showed no difference in the number of ulcers healed after 12 weeks with physical activity and compression compared to compression only. The findings supported Jull et al. (2018) that combining the interventions improves the patient's outcomes. However, a difference was identified in the significance of using compression with physical activities. No difference was identified in the quality of life, but physical activities with compression increased the peril of adverse events. Smith et al. (2018) recommended the need for consensus on wound healing.

Yim et al. (2015) provided a recommendation similar to that of Jull et al. (2018) on the need for studies related to the impact of exercise on VLU healing and quality of life. Yim et al. (2015) conducted a systematic literature review and found 10 articles in which patients suffering from VLUs used exercise or physical therapy as a treatment intervention. The researchers found that there was sufficient evidence that exercise strengthens the calf muscle pump and enhances the ankle range of motion. There is limited research on the impact of the intervention on the wound healing process and quality of life.

Like Jull et al., Klonizakis et al. (2018), Smith et al. (2018), and Yim et al. (2015) assessed the effectiveness of using compression together with exercise. The study involved 91 studies that were randomized into experimental (compression and exercise) and control (compression only) groups. Qualitative data were collected, and the researchers found that there no adverse outcomes. The team concluded that the experimental group had a lower ulcer healing time (13 weeks) compared to 34.7 weeks for the control group. Klonizakis et al. (2018) supported the feasibility and acceptability of combining physical activities with compression therapy.

Jull et al. (2018), Klonizakis et al. (2018), Smith et al. (2018), and Yim et al. (2015) supported the use of compression together with physical activities. Jull et al. and Smith et al. (2018) differed on the significance of using compression with physical activities versus using physical activities alone. Klonizakis et al. (2018) and Yim et al. (2015) recommended more studies on the effect of compression and physical activities on patients' quality of life.

Strengths and Weaknesses of the Literature Review

The problem under consideration in the project was whether there was a lack of knowledge concerning the etiology of VLUs and EBP treatment guidelines among nurses in a WCC. Not understanding current guidelines affects patients' outcomes. The problem was selected because the prevalence of leg ulceration is anticipated to increase with the rise in both the aging population and vascular diseases. There are studies on techniques for treating VLUs and preventing their recurrence. However, there are limited studies on the knowledge of staff at an outpatient WCC. The project involved the assessment of nursing knowledge level before and after an educational intervention. Nurses in the WCC and HOPD for wound care perform most of the treatment modalities.

Summary

The project was guided by a clinical question formulated using the PICOT framework and Hall's care, core, cure theory. The identified guidelines emphasized the importance of considering the patient's wound characteristics and comorbidities such as obesity or diabetes, that could affect the healing of VLUs. In addition, the guidelines support the use of compression, dressing, topical agents, and physical activation. However, there are contradictory findings in the literature. Specifically, there is a limited understanding among patients of skin care, factors affecting adherence to compression therapy, and the appropriate period to apply maintenance

therapies. Thus, conducting the proposed project added to the existing literature of VLU treatment guidelines. Chapter 3 reviews the research design and discusses the methodology and design of the research tools used in the project.

Chapter 3: Research Method

Purpose

This study explored nurses' knowledge concerning VLU etiology and ICVUG treatment guidelines for wound care at a dedicated WCC. The ICVUG guidelines use the best evidence-based practices to treat wounds (Couch et al., 2017). If nurses in a dedicated WCC do not know ICVUG guidelines, it represents a failure to apply the best EBP to wound care treatment. Identifying a deficit is vital to ensure that educational interventions are a requirement for nursing staff in order to ensure patients receive the best possible treatment for their wounds. The methodology will enable other researchers to replicate the study if they desire (Bailey et al., 2015).

In this chapter, I described the methodology used to explore the research question and discussed the method's appropriateness for the research question. Also, there was a discussion of the feasibility of the design for this study. Next, there was a review of the IRB approval required for this project and the process taken to achieve it. The practice setting for this study was fully described, and the participant demographics were noted. Next, identifying the risks associated with the research and the ethical standards for data collection and maintenance were stated. The timeline of the study was given. Finally, there was an analysis of the data collected.

Project Design

The research study design for this project was a quantitative, quasi-experimental study. Creswell and Creswell (2018) wrote that an experiment is classified as quasi-experimental if there is a lack of random assignment to treatment groups. One of the concerns in using a true experimental design is that a control group would be required as Bailey et al. (2015) explained. However, there were only a few participants in this study, so it was not practical to have a

control group of one or two subjects. Thus, the quasi-experimental approach in this study was the most appropriate to secure answers to the research question.

IRB Approval and Process

This research study was scheduled to be conducted in a classroom setting in the hospital's education department. The research was eligible for exemption from review by the Institutional Review Board (IRB) and the informed consent documentation may be waived if the research only includes interaction with educational tests (cognitive, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (Office for Human Research Protections, 2020). Additionally, according to this rule, disclosing their responses outside the research setting can be done if it would not reasonably place the subjects at risk for criminal or civil liabilities or damage their financial standing, employability, educational advancement, or reputation. Despite the eligibility, the project site required IRB approval on all research and study projects.

The DNP chair and committee approved the project, and an IRB application was approved by Abilene Christian University (ACU) and the project site. Also, ACU required each DNP student to complete coursework from the National Institutes of Health’s Protecting Human Research Participants (PHRP) online training and coursework from the U.S. Department of Health and Human Services Office of Research Integrity (ORI). The PHRP course provided foundational training in human subject research and compliance. The ORI coursework provided graduate students exposure to various ethical issues and federal requirements they may encounter in research. Certificates of completion were granted after completing the courses before beginning the study.

Practice Setting for EBP

The practice setting for the research study was an outpatient wound care center in central Florida. The testing site was scheduled to take place in a classroom in the educational center of the hospital adjoining the practice building. However, due to COVID-19 restrictions implemented by the hospital, the study was converted to an online study. An online survey study allowed flexibility in participation and minimized hospital COVID-19 exposure to participants. The educational intervention was embedded at the end of the pretest survey and was downloadable and printable.

Target Population

There was one target population for this EBP study, which was nurses working in the WCC. The results section fully presented demographic information on the population of nurses working in the WCC. Since the population groups is a convenience sample, the identity of the participants required masking. Demographic data collected included the number of years' experience as a nurse and the number of years in wound care. The analysis was the pretest and posttest scores of the participants. There was no analysis based on education or the participant demographics. The study was promoted in morning huddles with employees and with a bulletin posting in the employee breakroom. The sample size for this project consisted of a convenience sample from the target population who work in the WCC. The hospital employs approximately 495 registered nurses who work in a clinical capacity. Therefore, it would be impractical to test the entire target population. Convenience sampling is a non-randomized selection and is appropriate for this study. According to Etikan et al. (2016), convenience sampling is helpful for participants who are easily accessible and willing to participate in a study.

Risks and Benefits

Research involving human subjects often presents unintended risks to participants. The two main risks associated with the study included loss of confidentiality and economic risks. According to Baez (2002), confidentiality means protecting the privacy of all persons, building trust and rapport with study participants, and maintaining ethical standards and the integrity of the research process. If posttest scores do not improve, a breach of confidentiality could create fears of retaliation or employment loss in this study. The fear of retaliation or job loss could create a hostile work environment. In addition, job loss can create adverse economic conditions for participants.

There are considerable benefits that could happen because of this intervention. In a systematic literature review, Cheng et al. (2018) found that following evidence-based guidelines resulted in better wound management. The benefits for the patient would be far more valuable than the cost of the intervention. Providing training for the nurses in a WCC setting about the ICVUG will expose them to a considerable body of EBP that has proven, through vast experience, to improve patient outcomes. Applying this new knowledge can enhance patient outcomes due to a higher standard of care.

Instrument/Measurement Tools

The only instrument for this study was the knowledge pretest/posttest given to the nurses (see Appendix D). The pretest and posttest are part of the NetCe continuing education unit. Also, the educational intervention is part of the NetCe continuing education unit, which granted permission for use in the study(see Appendix C).

Data Collection/Management

The single research question asked whether the training provided for the nurses regarding venous ulcer treatment guidelines improved their knowledge of evidence-based guidelines, as demonstrated by changes in pretest and posttest scores. This section discussed the pretest/posttest methodology used to gather information about the training's effectiveness.

Yegidis et al. (2002) noted that a pretest/posttest design collects information on key variables twice. The pretest measurement used for this intervention was a test of wound care knowledge (see Appendix D). I used this test (see Appendix D) to evaluate the change in knowledge between the initial testing and after the nurses' training. According to the venous ulcer continuing education unit, nurses' knowledge of wound care practices will increase after training. If the knowledge of the nurses does not increase as expected, this could indicate a problem with the design or delivery of the training program. If it is determined that the training was flawed, then a Plan-Do-Study-Act cycle will be done to find any flaws in the design or presentation of the training. The test will be redeployed to determine if the desired improvement was achieved (Donnelly & Kirk, 2015). Permission to use the test from a recognized continuing education provider, NetCE, is shown in Appendix B.

Data collected in this project were stored in a secure university learning management system under my name. The university owns the collected data to provide access if needed in the future. The online graduate school provided this secure system storage for doctoral student research data and supported by the university's informational technology (IT) department for security purposes. All data obtained during implementation were maintained on a password-protected computer, and only the project implementor had password access. Data are kept for 3 years according to federal regulations to protect and sustain human research participants' data.

The saved data will be shredded and destroyed after 3 years. After completing data collection, I file a data collection inactivation form to alert the university IRB of the completion of the study.

Demographic data were collected using the mode, mean, and mode of information collected regarding nursing experience, years in wound care, and nursing education level. Participants provided demographic data in the online survey before the pretest. Pretest and posttest scores were analyzed at the completion of the study.

Methodological Appropriateness

The use of nurse education with a pretest and posttest to establish knowledge is a well-established approach to collect data regarding the effectiveness of nurse education, which is designed to increase nurses' use of EBPs (Wu et al., 2018). Wu et al. (2018) explained that descriptive quasi-experimental, pre-/post- surveys are one of the most common ways to measure nurses' learning in such interventions. However, effective nurse education can contribute to a range of clinical outcomes. Therefore, it is generally possible to only indirectly measure outcomes through the clinicians' quality of care after the training.

Feasibility and Appropriateness

Initially, the WCC was provided access to a room to be used for training. However, the site no longer allowed physical space due to changing COVID-19 restrictions and social distancing requirements. The project was converted to an online survey because of the restrictions imposed by the site location.

Utilizing an online survey allowed the participants to complete the study at their convenience without workplace interference. The online research was hosted on the Survey Monkey website (https://www.surveymonkey.com). Survey Monkey provides an optional feature to block participants' IP addresses and email to provide anonymity. I chose this anonymity

option. The Intellectus website (https:\\www.analyze.intellectusstatistics.com) was used to process the data and write the reports. In addition, I backed up data on two purchased flash drives.

Timeline

The timeline (see Appendix A) represents the time spent on this project since the beginning of this year. Work started on the planning of this project in February 2020, with investigating topics, selecting a topic, and creating a dissertation proposal. During this time, meetings were held with facility stakeholders on the educational needs of the nursing staff. After the proposal was reviewed, revisions were made in March. During April and May of 2020, I contacted various WCCs and met with the nurses of the WCCs who conditionally agreed to participate in the study. Verbal approval was received for the study site location; however, corporate approval was required. I completed a required class. Corporate approval was obtained in 2022.

In November/December of 2020 approval for educational materials were obtained from NetCe. The nurses would access the pretest, educational intervention, and posttest via the Survey Monkey website. Chapters 1 and 2 were written in May 2020; Chapter 3 started in August 2020 and was completed in October 2020. The chapters were submitted to the committee chair for multiple revisions from November 2020 through October 2021. Chapters 1–3 proposal was successfully defended in January 2022. Also, a required class by the corporate office was completed in January 2022. The site location corporate approval to conduct the research was granted in March 2022. The clinical affiliation agreement between ACU and the site location was received in June 2022. The research was conducted in August 2022. Chapters 4 and 5 were

completed after the data were collected and analyzed in August 2022. The final version of the dissertation was reviewed in March 2023.

Data Analysis Plan

As discussed in the data management and collection section, years in wound care, education level, gender, and test results were recorded. Pretest/posttest results from the nurses' wound care training were stored in numeric form for statistical analyses. A Shapiro-Wilk test was used to determine the normality of the pretest and posttest scores. Levene's test was utilized to determine if the homogeneity of variances was met.

In this study, the Shapiro-Wilk test determined whether the differences in pretest and posttest scores could have been produced by a normal distribution (Razali & Wah, 2011). The null hypothesis is that the sample originates from a normal distribution and the alternative hypothesis is that it does not. The test "has been shown to be an effective measure of normality even for small samples ($n < 20$) against a wide spectrum of non-normal alternatives" (Hershbarger, 1975, p. 522). Levene's test was conducted to assess whether the variances of pretest and posttest scores were significantly different (Razali & Wah, 2011).

This study includes and analyzes a small sample of nurses, similar to the population that Gosset (Student, 1908) envisioned when he created the *t* test. A sample data table (Table 1) illustrates the type of data analyzed using *t* tests.

Table 1

Sample Data Set

Nurses	Pretest score	Posttest score
1	34	79
2	68	88
3	84	97

The test ran with an alpha value of .05. In this scenario, if the calculated value of t exceeded the theoretical value of t, this would indicate that the null hypothesis for the research question being considered must be rejected. Using a *t* test allows a statistical analysis of the data to determine if the variation in data distribution can be assumed to be due to the training provided or whether the distribution is random and caused by any number of different causes. As Bailey et al. (2015) pointed out, if the researcher has determined. the influence could be positive or negative, then a two-tailed test would be appropriate. The small sample size of nurses made the *t* test particularly valuable in this situation.

Summary

In this chapter, I reviewed the study's design. This study was a quantitative quasi-experimental research study. I provided details about the research tool to test nurses, data collection, and data analysis. The appropriateness and feasibility of the data collection and analysis methods were considered. Details about the practice setting and target population were provided. The benefits of educating nurses and having them apply EBPs to wound care patients were explored. The relevance of the data collection and analysis methods was established. Finally, there was a detailed discussion of the analysis plan for the study, including applying independent *t* tests to establish the statistical significance of the information in the study. Chapter 4 will detail the study's findings.

Chapter 4: Results

The project was a quasi-experimental design to study the impact of a continuing education course on venous leg ulcer assessment and treatment with nurses who provided wound care at an outpatient-based wound clinic. There was not a randomly assigned experimental and control group. The increasing capacity of healthcare institutions to collect routine clinical data has led to the growing use of quasi-experimental study designs in the field of medical informatics as well as in other medical disciplines (Harris et al., 2006). A two-tailed paired samples *t* test was conducted to examine whether the mean difference between pretest and posttest scores differed significantly from zero. The primary concept behind the pretest/posttest research design was chosen because a causal relationship was to be established between the intervention and the posttest.

The research study satisfied three assumptions of the paired *t* test. The assumptions are normal distribution, and independent data, and the variances within each group are usually similar. In a similar medical study, the main assumption is that the differences (for paired data) or the observations in each have an approximately normal distribution utilizing the Shapiro-Wilk test and an F-test for the homogeneity of variance (Moussouli et al., 2014). The dependent variable is the NetCe online continuing education pretest/posttest that was measured at the ordinal level. The independent variable consisted of two categories: participants taking both the pretest and posttest (i.e., same participants in each group). The data analysis was carried out through univariate descriptive analyses. Calculations were performed with the software on the Intellectus statistical analysis website. The analysis involved summarizing the data collected from the total sample by determining the mean value and standard deviation of each set of scores. The pre- and posttest values of the variables were compared with the use of paired *t* tests.

Data Collection

Data collected in this project were performed using Survey Monkey. The sample size for this project consisted of a convenience sample from the target population who work in the WCC. Convenience sampling is a non-randomized selection and is appropriate for this study. According to Etikan et al. (2016), convenience sampling is helpful for participants who are easily accessible and willing to participate in a study. Interested participants were introduced to the project via morning huddles and a posted informational announcement in the employee breakroom (see Appendix E). Also, the breakroom posting included copies of the consent form for prospective participants to review. The consent form was a duplicate of the online consent form on Survey Monkey that required an acknowledgment as a signature before proceeding to the survey questions (see Appendix F). Hyperlinks were provided on the consent and bulletin to access the pretest and posttest online survey. Upon accessing Survey Monkey on the pretest hyperlink, the participants review the online information bulletin. and the online consent form for acknowledgment and consent. Once consent was obtained, the participant initiated the pretest. At the end of the pretest, the site redirected to the online continuing education course. The separate hyperlink for the posttest was provided on the bulletin online and posted in the breakroom. The project time frame began on 8/8/2022 and ended on 8/29/2022. Data were retrieved from Survey Monkey and input to Intellectus Statistics for analysis.

Data Analysis

A Shapiro-Wilk test was conducted to determine whether the differences in pretest and posttest scores could have been produced by a normal distribution (Razali & Wah, 2011). The results of the Shapiro-Wilk test were not significant based on an alpha value of .05, $W = 0.90$, $p = .362$. The null hypothesis that the data are normally distributed is rejected if the *p*-value is

greater than .05. This result suggests the possibility that a normal distribution produced the differences in pretest and posttest scores cannot be ruled out, indicating the normality assumption is met.

Levene's test was conducted to assess whether the variances of the pretest and posttest scores were significantly different. The result of Levene's test was not significant based on an alpha value of .05, $F(1, 12) = 0.04$, $p = .854$. This result suggested that pretest and posttest scores were produced by distributions with equal variances, indicating the assumption of homogeneity of variance was met. The congruence in the etiology and pathophysiology of VLU denotes the intervention could make it possible for the participants to effectively assess the condition.

Results

The result of the two-tailed paired samples *t* test was not significant based on an alpha value of .05, $t(6) = -1.11$, $p = .309$, indicating the null hypothesis cannot be rejected (Intellectus Statistics, 2022). This finding suggests the difference in the mean of the pretest and the mean of the posttest scores was not significantly different from zero.

Table 2

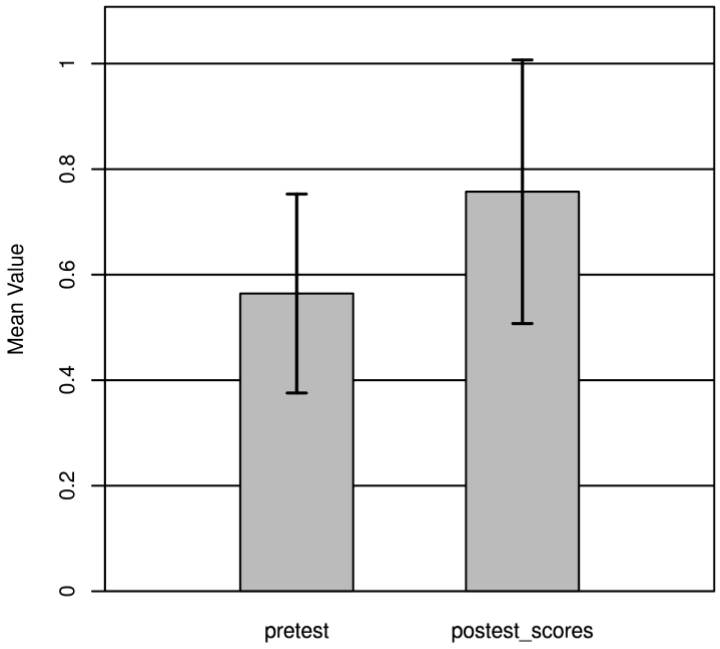
Two-Tailed Paired Samples t *Test for the Difference Between Pretest and Posttest Scores*

Pretest		Posttest scores		df	Probability	Cohen's *d*
M	*SD*	*M*	*SD*	*t*	*p*	*d*
0.56	0.25	0.76	0.34	-1.11	.309	0.42

Note. $N = 7$. Degrees of Freedom for the *t*-statistic = 6

Figure 2

The Means of Pretest and Posttest Scores With 95.00% CI Error Bars



Not rejecting the null hypothesis indicates that our sample did not provide sufficient evidence that the effect of the intervention exists. As demonstrated by (Table 2 and Figure 1), the findings of the *t* test determined a significant difference between the pre- and posttest scores. The pretest mean for the participants was 0.564. and posttests had a mean score of 0.757. In addition, the standard deviation during the pretest was 0.254, while the posttest value was 0.337 (Intellectus Statistics, 2022). It denotes that being subjected to the online course may enable the nurses to better understand the assessment and management of VLU. Despite the gains in the median scores of posttest scores, the gain was not proven to be causally related to the online educational intervention.

A first argument against interpreting non-significant *p*-values as evidence in favor of the null hypothesis comes from scholars who note that studies with sample sizes that are common practice in psychology and education often lack statistical power and may therefore frequently fail to reject the null hypothesis even if it is not true (i.e., Type II error) per Leppink et al. (2017). Alpha is defined as the probability of making a Type I error when the null hypothesis is true. Beta is defined as the probability of making a Type II error when the null hypothesis is false. Null hypothesis sensitive testing (NHST) can only measure if the groups are different. NHST does not measure the similarity or degree of similarity. Barchard (2015) suggested using statistical analysis that measures the degree of similarity in lieu of measuring differences because analysis that measures differences are not likely to find significance. Failing to reject the null hypothesis does not mean there is no evidence of truth. Failure to reject the null means there is not enough evidence present to support the hypothesis even when it is true. In other words, "absence of evidence is not evidence of absence" (Klein, 2004, p. 67, as cited in Barchard, 2015).

Demographics

There were a total of 10 participants. Only seven completed the pretest and posttest. The nurse participants in the survey were either registered nurses or licensed practical nurses. All the nurses who participated in the survey provided care for patients within the WCC setting. The participating nurses chose not to answer the survey question regarding their nursing years of experience. Convenience sampling utilizing members of a small hospital department can be challenging to provide anonymity. It was important to conceal most of the demographic data to maintain the anonymity of the participants.

As part of the intervention material, the nurses learned the need to document patient history while undertaking physical evaluation. Documentation should capture the condition of the patient and their history of DVT, pulmonary malignancy, ulcer, and treatment history (Lim et al., 2018). In addition, the assessment should capture the medication that is often administered to patients and any surgical procedure s The evaluation is instrumental and enables the participants to recognize any form of delayed healing in case the patient exhibits potential risk factors (Melikian et al., 2018). Based on the online course, the risk factors that nurses should seek include the existence of the VLU for a period that exceeds 6 months, a history of having undergone vascular surgery, and continuous damage to the venous system (Melikian et al., 2018). Another risk factor nurses are encouraged to look out for is being more than 50 years old and nutritional deficiency, as observed through the BMI data.

Before the intervention, only three nurses could provide correct answers regarding the assessment and management of VLU. However, 99% of the nurses responded correctly to the questions posttest. The posttest scores were above 80% for most participants, which denotes that they had broadened their understanding of the context (Parker et al., 2017). As such, the study has concluded that adequate knowledge among nurses provides the framework for better management of VLU. It would be reasonable to assume improved patient outcomes if the online course improved nursing skills on risk factors, prevention approaches, and strategies for managing diseases.

The study equally determined that the confidence interval based on the alpha was 0.500 with a lower limit of -0.618 and an upper limit of 0.232. The mean difference between the two limits was -0.193. Understanding etiology and pathophysiology means that the participants could effectively assess the patients suffering from VLU (Couch et al., 2017). Some of the delayed

healing symptoms include increased dermal thickness exceeding 1.985 mm. The assessment should be done with the use of ultrasounds of higher frequencies or any other technique that has been documented clinically (de Leon et al., 2016). Another symptom that the participants learned to take note of is stasis dermatitis. It is primarily characterized by the existence of a red-brown or tun skin color. It majorly impacts the medial ankle with the presence of small erosions that are likely to be open or crusted.

From the online training, it is equally apparent that the participants understood the role of growing hair follicles in the diagnosis. In case of poor VLU healing, the growth patterns of the hair will exhibit inadequate arterial supply. Likewise, the participants are advised to make sure that they take note of venous insufficiency, which is primarily characterized by atrophic plaques of white skin along with telangiectasias. The online program further provided the participants with knowledge and skills on measures of undertaking differential diagnosis (Andriessen et al., 2017). Differential diagnosis provides the framework for determining the causes of ulceration and significantly impacts the patient management approach. For the participants to rule out arterial disease in patients without a palpable pedal pulse, they will be required to divide the ratio of the ankle systolic blood pressure by the brachial systolic blood pressure index (Weller et al., 2018). In case the analysis arrives at an ABI ratio that exceeds 0.8 and falls below 1.2, the patient needs to be referred to a specialist to facilitate further assessment of the arterial condition.

Once the condition is assessed, the extensive detail of the interventions further outlines guidelines that can be used in managing the condition. For the ABI level >0.8, the participants will implement venous insufficiency and undertake compression. The interventions are likely to lower edema (Weller et al., 2018). In the case of ABI that ranges between 0.6 and 0.8, the input of a vascular specialist should be recommended. The approach will help in determining the

severity of arterial occlusion. Another element that the practitioners will factor in moving forward is ensuring that they understand arterial calcification's impact (Andriessen et al., 2017). In cases where ABI exceeds 1.2, the participants acknowledged the fact that arterial calcification may contribute to the inaccuracy of the ABI value. Subsequently, it is recommended that other alternative forms of testing such as the use of brachial systolic blood pressure (TBI). Another aspect of care that should be taken into consideration is the recognition that venous ulcers are likely to exist in the presence of mixed pathology.

Summary

The study hypothesis was that there is congruence between theoretical knowledge among nurses who are routinely receiving eVLU as compared to those who are not exploring new mechanisms of managing the condition. The pretest and posttest analysis have determined that the null hypothesis could not be rejected. The analysis did not support a causal relationship between the educational intervention and the posttest scores.

One of the benefits of the pretest was the analysis of the current knowledge level of the nurses who currently work in the wound care center. If the educational intervention did not improve the posttest scores there could not be congruence between the theoretical knowledge and capability of nurses in occasions where they are trained. Indeed, previous studies have determined that nurses are likely to overestimate their capabilities. It means that they may only have a moderate understanding of the situation.

The insight that the nurses obtain from the online program denotes that they will be able to understand the role of risk factors in the development of venous ulcers, the signs, and symptoms of venous ulcers, and the strategies that should be used in examining patients and diagnosing the condition. Likewise, the participants will be able to understand some of the health

promotion interventions that should be adopted when attending to the patients. These include urging them to quit harmful practices such as smoking and refrain from wearing tight-fitting pants to avert the development of VLU wounds. Another major component of managing the condition is adequate nutrition.

Nutrition is important given that relying on a healthy diet is likely to promote the healing of wounds. A healthy diet comprises iron and protein foods that facilitate the repair of tissues. In this case, meatless sources of proteins such as beans, soy, and peanut butter are encouraged. The patients should further be trained on some of the ways through which they can manage the pain that they are dealing with. For example, being active is essential and averts any complications that may be developed. Likewise, the knowledge will provide guidelines on strategies for enhancing cleanliness among patients.

One of the benefits of the pretest was the analysis of the current knowledge level of the nurses who currently work in the wound care center. The educational intervention did not improve the posttest scores could not be congruence between the theoretical knowledge and capability of nurses in occasions where they are trained. Indeed, previous studies have determined that nurses are likely to overestimate their capabilities. It means that they may only have a moderate understanding of the situation.

Chapter 5: Discussion, Conclusions, and Recommendations

This study aimed to evaluate the knowledge level of VLU etiology and EBP treatment of the clinical nursing staff at the proposed outpatient wound care department. Preevaluation of an online education course helps the wound center determine if the clinical nursing staff has knowledge deficits. In contrast, postevaluation can help determine the efficacy of online education in maintaining and increasing the knowledge levels of clinical nursing staff regarding VLU. Therefore, the VLU knowledge questionnaire administered before and after the VLU online education course is considered an important screening tool to determine the efficacy of clinical nursing staff in preventing and managing VLU to improve the quality of life of immunity-compromised patients. This chapter aims to conduct an extensive discussion with the interpretation and inference of the findings, leading to limitations, implications, and relevance to the essential doctoral education for advanced practice nurses. It concludes the study with recommendations and directions for future research.

Interpretation and Inference of Findings

The research questions addressed in this study aimed to determine whether the online training regarding venous ulcer treatment among the nurses was efficacious in improving their knowledge level and whether there was a difference in the pre- and posttest score following the online training. The findings indicate a significant improvement in the knowledge level of nurses following the online training that provided them with adequate information to understand and assess the prevalence of venous ulcers and engage in effective prevention and treatment interventions to reduce its incidence rate and improve the quality of life of patients.

The predetermined research questions were examined by developing a hypothesis that stated that there is no congruence between the pre- and posttest scores of nurses regarding

venous ulcer treatment. The hypothesis was examined by conducting an empirical analysis using the paired sample *t* test, and the findings could not reject the null hypothesis, suggesting that the pre- and posttest scores of nurses' knowledge regarding venous ulcer treatment were not the same. The findings indicated a positive change in scores. It is expected that a person would not score less on a repeated test. The scores may have improved because of test familiarity from the pretest. Nurses' theoretical knowledge and capabilities continue to increase with training opportunities due to the effective acquisition and retention of knowledge during academic activities. These findings are consistent with the study conducted by De Carvalho et al. (2018) in which increasing the knowledge and capabilities of nurses has a strong association with improving patient outcomes in wound care departments.

In comparison, previous studies have indicated that nurses are most likely to overestimate their capabilities, resulting in erroneous assessment and inadequate treatment interventions. The current study provides empirical evidence suggesting that nurses' pretest scores regarding venous ulcer treatment were lower than the posttest scores, which suggests the prevalence of overestimation of capabilities among the clinical nursing staff. It eventually suggests that the prevalence of training programs can help overcome the knowledge gaps that keep the nursing staff from providing adequate healthcare services while effectively addressing health concerns early to improve patients' quality of life.

The new knowledge presented in this study contributes to the current nursing body of knowledge about the selected population of interest in determining the current knowledge level and the efficacy of online training in improving the knowledge level regarding venous ulcers. Previous studies have indicated that online training helps individuals develop knowledge and capabilities to improve the effectiveness of tasks and duties necessary to improve the quality of

care in the outpatient setting. Also, previous studies have indicated that learning and development opportunities enable healthcare staff to understand trends in healthcare and attain knowledge about the practice and implications of evidence-based practice to improve patient outcomes.

The findings from this study integrate with Hall's (1964, as cited in Sumarno, 2019) nursing theory, which includes care, core, and cure, in which care accounts for providing comprehensive care to address the needs of patients. The core aspect accounts for the nurses' effective utilization of clinical knowledge and expertise. In contrast, the cure encompasses the effective management of medical approaches to address the health outcomes of patients. In this study, Hall's aspects integrate with the clinical nursing staff's ability to provide comprehensive care to patients with venous ulcers while utilizing adequate knowledge and expertise to prevent and manage their prevalence among patients. Thus, the outcome of this study determined the knowledge gap existed among nurses; however, the online and identified the significance of online training in improving the knowledge and capabilities of nurses in preventing and managing venous ulcers.

Limitations

In this study, the small sample size is considered the major limitation because it inhibits the generalization of findings. In addition, the sample size represented only one hospital, which makes the results inadequate enough to represent other healthcare facilities. Moreover, the sample size was selected using a non-probabilistic convenience sampling method, which did not provide an equal chance to each participant in the population during sample selection. It was also observed that the participants had varying levels of education and experience, which could have affected their knowledge levels regarding venous ulcers. The data analysis did not indicate the

causal relationship between the knowledge levels of clinicians and patient outcomes, making the findings limited in determining the efficacy of online training courses in improving the quality of healthcare services.

Implications of Analysis for Leaders

This study has provided evidence regarding the knowledge gap among the clinical nursing staff, which affects patient outcomes. Nursing professionals should be able to prevent and treat venous ulcers and implement evidence-based practices to improve patients' quality of life. However, the overestimation of knowledge and capabilities among the clinical nursing staff increases the risk of misdiagnosis, resulting in poor patient outcomes. Assessing bedridden and immunity-compromised patients for venous ulcers can help address their occurrence while ensuring that the nursing staff remains proactive in implementing adequate treatment interventions.

This study contributes to the nursing science by indicating that nurses, irrespective of differences in qualification and experience, are prone to incorrect assessments due to overestimating their skills and knowledge. Furthermore, misdiagnosis and late diagnosis increase the cost of healthcare services, due to which assessing at-risk patients for venous ulcers before their occurrence can improve their quality of life while reducing the cost of healthcare services in the long term. Hence, continuous engagement in developing professional knowledge and skills can ensure that nursing staff remains highly competitive in the effective assessment of at-risk health concerns while implementing adequate evidence-based practices.

Recommendations to clinical nursing practitioners account for undergoing evaluation tests to determine gaps in knowledge and capabilities and attending online training programs to ensure that knowledge gaps are effectively addressed. Moreover, training sessions that focus on

introducing evidence-based practices should be conducted at the organizational level to ensure that the nursing staff remains knowledgeable about the recent advancements in nursing practice. The development of a learning environment in the healthcare organization can promote online training courses to ensure that the clinical nursing staff is equipped with knowledge, skills, and expertise to provide quality care services in outpatient facilities.

Essentials for Doctoral Education for Advanced Practice Nurses

Essentials I: Scientific Underpinnings

Misdiagnosis, knowledge gap, inadequate practical training, and lack of structured care delivery procedures increase the risk of venous leg ulcers in elderly, physically inactive, and obese patients, which inhibits their quality of life in the long term. Early diagnosis, prevention intervention, and evidence-based practices can reduce the incidence and recurrence rate of venous leg ulcers in high-risk patients. The findings from this study provide generalized results regarding the prevalence of the knowledge gap among nurses regarding venous leg ulcers and the significance of online training programs in improving the knowledge and capabilities of clinical nursing staff. The theoretical framework in this research encompasses Hall's Three Aspects of Nursing, in which care, core, and cure account for the fundamental components of improving the quality of care. The component of care ensures that nurses utilize their knowledge and expertise. The current research measures the knowledge gap to promote online training courses to increase the professional knowledge and capabilities of nursing staff necessary to prevent, diagnose, and treat venous leg ulcers in high-risk patients.

Similarly, the component of core is addressed in this study as the nurses develop skills and knowledge to manage the health concerns of high-risk patients. In contrast, the cure component ensures adequate treatment plans to treat venous leg ulcers and deliver a

comprehensive care model to patients. Therefore, this study contributes to addressing the wellbeing of a large population and utilizes an adequate theoretical framework to disseminate information and develop nursing professionals as nursing scientists to support changes in practices to ensure effective implementation of health promotion, prevention, and management interventions at the organizational level.

Essential II: Organizational and Systems Leadership

Knowledge and expertise of clinical nursing staff improve patient outcomes, leading to a better quality of life in elderly, obese, and physically impaired or inactive patients. Developing an adequate healthcare delivery approach based on the findings from the current study can help enhance the quality of life of patients with chronic health conditions while ensuring that the risk of venous leg ulcers in patients can be inhibited to improve their health outcomes. In addition, improving the knowledge and capabilities of clinical nursing staff can increase the efficiency and effectiveness in assessing, preventing, and treating venous leg ulcers, improving the quality of healthcare services. Thus, integrating online training courses into the professional training and development plan of clinical nursing staff can help improve their knowledge and expertise in providing adequate care to at-risk patients and reduce the incidence and recurrence of venous leg ulcers, which can reduce the cost of healthcare services in the long term while improving patient outcomes and quality of healthcare services.

Essential III: Clinical Scholarship and Analytical Methods

Determining the knowledge gap among the clinical nursing staff regarding venous leg ulcers and the efficacy of online learning courses in addressing the knowledge gap contributes to improving the quality of healthcare services. The utilization of NetCE in the pretest and posttest helps determine whether the knowledge and capabilities of clinical nurses meet the standard

guidelines and suggests the importance of continuing education among healthcare professionals. This survey can be incorporated into nurses' assessment to determine whether their knowledge and expertise account for effective assessment of at-risk health concerns and encompass evidence-based practice in healthcare. It can significantly help determine training needs among healthcare professionals, enhancing their knowledge and capabilities with training and development programs that eventually contribute to a better quality of healthcare services at the organizational level.

Essential IV: Information Systems and Patient Care Technology

In this study, the utilization of information technology in nursing practice helped collect and analyze data that made the research process efficient. The data were organized and analyzed via the online software Intellectus Statistics, which helped testify the hypothesis necessary to determine findings and draw conclusions to address the research objectives. Moreover, the utilization of online training programs in enhancing the knowledge and capabilities of clinical nursing staff reduced the cost of training and development and overall research, which has several implications in practice. However, the research design could have been improved by incorporating electronic health records to determine the prevalence of venous leg ulcers in patients during pre- and posttraining months to determine the effectiveness of training and development of nurses in improving patient outcomes. I intend to incorporate this research design and protocol into my practice to identify knowledge gaps, implement online training programs, implement evidence-based practices, and assess patient outcomes to determine improvements in the quality of healthcare services.

Essential V: Health Care Policy

As a nurse practitioner in the wound care department, knowledge and capabilities regarding the effective prevention, diagnosis, and treatment of venous leg ulcers significantly contribute to improving patient outcomes and quality of life. Increasing knowledge and capabilities is key to enhancing the quality of healthcare services. Moreover, early diagnosis and adequate treatment can reduce the cost of healthcare services in the long term by avoiding complex health conditions among elderly and physically inactive patients. Hence, demonstrating leadership by identifying knowledge gaps among clinical nursing staff can help implement training and develop programs necessary to enhance their knowledge and capabilities to implement adequate evidence-based practices.

Essential VI: Interprofessional Collaboration

Nurse practitioners must be provided with a learning environment and engage in effective communication to learn and implement evidence-based practice necessary to enhance the quality of healthcare services. The findings from this study support the identification of knowledge gaps among the nursing staff and the implementation of online learning programs to enhance their knowledge and capabilities. It eventually leads to implementing evidence-based practices that depend on effective communication and collaboration to share learned skills and deploy necessary information and interventions in clinical practice to reduce the occurrence and recurrence of venous leg ulcers among high-risk patients.

Essential VII: Clinical Prevention and Population Health

In nursing practice, using quantitative data to conduct statistical analysis helps develop evidence-based findings that lead to implementing policies and procedures that help improve the quality of healthcare services. This context integrates with the core component of Hall's (1964)

Three Aspects of Nursing, in which the skills and expertise of nurses are assessed to identify knowledge gaps and address them accordingly to achieve patient outcomes with improved quality of healthcare services. Similarly, the component of care and cure also helps effectively diagnose at-risk health concerns, leading to adequate treatment interventions. Hence, this study focuses on improving patient outcomes by identifying knowledge gaps among nursing professionals and providing them with online training programs to enhance their knowledge and capabilities in clinical practice that eventually helps in the effective prevention, diagnosis, and treatment of venous leg ulcers among high-risk patients.

Essential VIII: Advanced Nursing Practice

As a nurse practitioner in the wound care department, prevention, diagnosis, and treatment of venous leg ulcers by using evidence-based practice helps improve the quality of life of elderly, obese, and physically inactive patients. The findings from this study indicate that online training courses can rejuvenate the knowledge and capabilities of nurses and introduce evidence-based practices to improve the quality of healthcare services. Furthermore, this study aimed to determine the differences in knowledge levels among nurses regarding venous leg ulcers in the pre- and postonline training program. Thus, the findings indicate that knowledge gaps prevail irrespective of differences in academic and experience levels, suggesting the significance of training and development opportunities for nursing professionals to contribute to improving the quality of healthcare services.

Recommendations for Future Research

Knowledge and capabilities of clinical nursing staff in the effective prevention, assessment and treatment of venous leg ulcers are necessary to improve patient's quality of life. Measuring quality of life can help determine the effectiveness of training and development

programs that aim to enhance nurses' professional knowledge and skills. Utilizing NetCE evaluation survey can help assess knowledge gaps; however, determining the effect of NetCE scores on nurses and patient outcomes can determine whether professional knowledge and capabilities are adequate in addressing the health outcomes of patients. Moreover, increasing the sample size in future studies can increase the generalization of findings and provide insights into the prevalence of the knowledge gap among nurses in wound care departments. Similarly, data analysis focused on determining the causal relationship between online training programs and patient outcomes can help identify the efficacy of training and development opportunities in improving the quality of life among patients.

Conclusion

This study aimed to determine whether nurses' knowledge gap exists regarding venous leg ulcer etiology and evidence-based treatment in outpatient wound care departments. The findings indicated significant differences in knowledge levels, suggesting that nurses tend to overestimate their capabilities, inhibiting the quality of life of elderly, obese, and physically inactive patients. Hence, the null hypothesis could not be rejected indicating a significant unity in the knowledge levels of clinical nursing staff in the pre- and posttest scores following the online training program. It eventually suggests the efficacy of online training programs in improving nurses' clinical knowledge and expertise regarding venous leg ulcers and evidence-based practice, which can improve prevention, diagnosis, and treatment, leading to improved quality of healthcare services. The dissemination of this study may assist in evaluating nurses' expertise to identify knowledge gaps that can be addressed by implementing online training programs that can increase patient outcomes and quality of life in the long term. The findings from this study

can be disseminated in the target hospital by conducting a formal discussion with leaders. Publishing this research can increase access to this study's knowledge of the nursing practice.

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Appendix A: DNP Project Timeline

Task Date	Project Task
12/2019	Email correspondence to hospital officers to identify IRB board members
1/16/2020	Manager of IRB phone call to identify the type of research allowed at Hospital
1/17/2020	Written confirmation from Julie Pepe outlining the type of project allowed and noting no IRB approval required on education projects for nursing staff
2/1/2020	PICOT formation
3/5/2020	Project update with Dr. Sawyer-McGee
4/29/2020	Submission review with Dr. Sayer-McGee
6/10/2020	Revision to project after further clarification from IRB board member
8/7/2020	Submission review #2 with Dr. Sawyer-McGee
10/1/2020	Resubmission review 3# with Dr. Sawyer-McGee
10/25/2020	Submission of the project to DNP portal for review
11/14/2020	Completion of Protecting Human Subjects Participants Online training
11/19/2020	Received Permission for use of Exam from NetCE
11/22/2020	Completion of Online Research Ethics Course

2/4/2021	Submission #4 to Dr. Sawyer McGee with revisions
4/12/2021	Meeting with Dr. McGee with revisions to paper #5
8/18/2021	Edited revisions complete and submission to Dr. McGee
10/30/2021	Permission to defend signed by project chair
1/18/2022	Proposal defense completed
1/31/2022	IRB required class for onsite location completed
3/2022	Site approved for research
6/2022	Received affiliation agreement from site. It was approved in February but was not released until June
7/24/2022	ACU IRB approval for research to begin
8/2022	Research initiated on 8/11/2022 for two weeks and inactivated on 8/29/2022
9/2022-12/2022	Revised Chapter 1-3 to past tense and prepared Chapters 4-5

Appendix B: Protecting Human Subject Research Participants Training Completion Certification

CERTIFICATE

OF COMPLETION

PHRP Online Training, Inc. certifies that

shelia miller

has successfully completed the web-based course "Protecting Human Research Participants Online Training."

Date Completed: **2020-11-15** Certification Number: **2860013**

PHRP
Protecting Human
Research Participants
Online Training

Appendix C: Author Permission for Material Use

NetCE
Continuing Education

November 19, 2020

Shelia Miller
[redacted]

Dear Ms. Miller,

Publication Details: Course 38631 Venous Disease and Ulcers ©2020 NetCE.
Proposed Use: Presented to nurse participants in wound care center to measure knowledge for DNP research project.

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Sincerely,

SARAH CAMPBELL
Director of Development

Appendix D: Pretest and Posttest

1. The middle layer of the epithelial tissue in the veins is referred to as
   a. Tunica media
   b. Tunica intima
   c. Tunica externa
   d. Tunica intermedia

2. The common iliac veins are part of the
   a. Superior vena cava
   b. Deep venous system
   c. Perforator vein system
   d. Superficial venous system

3. Which of the following muscle pumps is responsible for the greatest pressures in the lower extremities?
   a. Toe muscle pump
   b. Calf muscle pump
   c. Foot Muscle pump
   d. Thigh muscle pump

4. Chronic venous insufficiency is more common in which of the following racial groups
   a. Black patients
   b. White patients
   c. Asian patients
   d. Hispanic patients

5. All of the following are risk factors for lower extremity venous disease, EXCEPT:
   a. Older age
   b. Overweight
   c. Multiple pregnancies
   d. Leg surgery or trauma

6. Which of the following findings on physical examination is typical of advanced venous disease?
   a. Sudden unilateral edema
   b. Bilateral edema of the thighs
   c. Non-pitting edema that gradually lessens throughout the day
   d.
7. What is often the first and most common skin change associated with venous disease
   a. Venous ulcer
   b. Stasis dermatitis
   c. Atrophie blanche
   d. Hemosiderin staining

8. Lipadermatosclerosis presents as
   a. Atrophic areas of white or pale skin
   b. An open wound on the lower extremities
   c. Brownish or grayish discoloration of the skin
   d. Hard, waxy, hyperpigmented tissue with swelling of the surrounding areas

9. Which of the following statements regarding assessment of the pulses and temperature of the lower extremities in patients with suspected venous idease is TRUE?
   a. The pedal pulses are more likely to be palpated in older patients
   b. Individuals with venous disease have lower skin temperatures around the ankle than the general population.
   c. A sudden elevation in ankle or leg temperature more than 4 degrees Fahrenheit may be indicative of a developing leg ulcer
   d. All of the above

10. What is the most reliable noninvasive test for diagnosing venous insufficiency?
    a. Duplex ultrasound
    b. Air plethysmography
    c. Photoplethysmography
    d. Magnetic resonance venography

11. An ankle-brachial index (ABI) value of 0.9 indicates
    a. Flexing their legs
    b. Who are ambulatory
    c. In a standing position
    d. Who are relaxed in a supine position

12. The most accurate ABI results are obtained from patients
    a. Flexing their legs
    b. Who are ambulatory
    c. In a standing position
    d. Who are relaxed in a supine position

13. According to the CEAP classification system, C2 is assigned to patients with
    a. Varicose veins
    b. Telangiectasias
    c. Lipodermatosclerosis
    d. A healed venous ulcer

14. Venous ulcers normally develop in all of the following locations, EXCEPT:

    a. Above the knee
    b. Over a perforating vein
    c. On the medial malleolus
    d. Along the route of the great saphenous vein

15. If a venous ulcer has not yet developed, a primary goal of treatment of chronic venous insufficiency is to

    a. Prevent ulceration
    b. Promote venous stasis
    c. Increase venous pressure
    d. Decrease arterial pressure

16. The compression provided by an Unna Boot is

    a. Inelastic
    b. Adapted to changes in the patient's leg size
    c. Low when walking but high when the patient is resting
    d. More effective for non ambulatory patients than multilayer compression bandages

17. The most appropriate level of compression for venous ulcer wound healing is

    a. Less than 10 mmHg
    b. 8-18 mm Hg
    c. 20-30 mm Hg
    d. 35-40 mm Hg

18. What is the major drawback of compression stockings?

    a. Patients may find them difficult to don
    b. They must be replaced every three weeks
    c. They are only available from specialty stores
    d. They cannot be worn with the patients normal footwear

19. Bioengineered therapy in conjunction with compression therapy is an option for the treatment of

    a. Edema of the lower extremities
    b. Mild chronic venous insufficiency
    c. Venous ulcers with closed wound edges
    d. Venous ulcers that have not healed after 30 days

20. Patient education for individuals with venous disease and /or ulcers should include

    a. Concrete suggestions for physical activity
    b. An honest discussion of what treatment will entail
    c. instructions

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