**Improving Diabetic Foot Ulcers Using a Management Protocol for Home Health Nurses**

by

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**Abstract**

**Background:** Poor management of diabetes mellitus leads to complications such as diabetic foot ulcers (DFU). DFUs are associated with high costs of medical care, limb amputation, and increased length of stay in the hospitals or even death. The patient's quality of life is also affected because DFU causes reduced mobility and depression. The negative impact of DFU can be prevented by following DFU prevention and management protocol.

**Purpose**: This quality improvement project aimed in creating a DFU protocol on prevention and treatment of DFU, increasing nurse's knowledge in DFU management and evaluating participant compliance with the DFU management protocol by performing a chart audit.

**Methodology**: The project utilized quality improvement design and was guided by The Stetler Model of Research Utilization that offers a framework used in assessing healthcare services and the facility's understanding of how to integrate the new practice into the current healthcare practice safely.

**Results**: The project led to an increase knowledge and compliance with the protocol, which are significant towards producing effective results when offering care to the DFU patients.

**Conclusion:** Training nurses in DFU prevention and management can help to increase knowledge of DFUs and improve compliance with the use of DFU protocol.

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**Improving Diabetic Foot Ulcers Using a Management Protocol for Home Health Nurses**

Diabetes mellitus (DM) is a non-communicable disease affecting more than 170 million people worldwide (Standl et al., 2019). According to the Centers for Disease Control and Prevention (CDC), there were 34.2 million diagnosed DM cases in the United States in 2018, representing approximately 10.5% of the population (Mendola et al., 2018). Based on Americans' sedentary lifestyles and consumption of processed and fast foods, the CDC predicts that number will double by 2030, making DM a national epidemic (Saeedi et al., 2019). In addition to dietary causes, a potential environmental contributor to the rising number of DM diagnoses is toxins, such as bisphenol and polychlorinated biphenyls, which can disrupt blood sugar control. DM is a progressive, chronic disease that requires significant health care resources, as complications occur without proper management.

As primary caregivers, nurses are responsible for actively preventing and managing DM and, failure to do so can lead to complications (Saeedi et al., 2019). A diabetic foot ulcer (DFU) is one of the most common complications of this disease process (Standl et al., 2019). Preventing DFUs entails early identification of high-risk individuals and the implementation of preventive measures. Poor DM management often results from limited nurse competency and the absence of standardized foot ulcer prevention and management protocols to guide nurses in the home health setting (Harding et al., 2019). To deliver quality management of DFU complications, nurses must be competent in preventing and treating DM. This Doctor of Nursing Practice (DNP) project will create a DFU management protocol for home health nurses providing DM prevention, early detection, and treatment guidelines.

**Background**

A DFU is an open sore or wound below the ankle, either on the foot or plantar surface of toes, that develops as a result of DM (Harding et al., 2019). A diabetic wound can be

neuropathic, ischemic, or neuroischemic, each with a prolonged healing period. Almost 15% of

DM patients develop a foot ulcer during their lifetime (Harding et al., 2019). DFUs are the

leading causes of hospitalization and can lead to infections, gangrene, amputations, mortality,

prolonged hospital stays, increased health care costs, and loss of income (Standl et al., 2019).

Due to these complications, patients can expect a lengthy hospital stay and significant quality-of-

life repercussions. Individuals who have undergone an amputation of the lower extremity require

costly prolonged hospitalizations, rehabilitation, and home care, along with an increase in social

support. When patients require amputation, they face a 50% risk of re-amputation and mortality

in 2 years (Armstrong et al., 2017).

Inadequate management of DFUs in home health care is the greatest contributor to the

growing incidence of DFU complications. Jeffcoate et al. (2018) found that in-home health care

providers do not adequately manage DFUs. Due to the absence of a standard protocol for DFU

care, home health nurses often use the injury wound protocol (Jeffcoate et al., 2018). However,

more than 80% of DFUs are preventable through quality nursing intervention (Armstrong et al.,

2017). Factors that increase DFU development and impair the healing process include peripheral

neuropathy, ischemia, limited joint movement, poor foot hygiene, improper toenail trimming,

fungal infection, and inappropriate footwear (Hicks et al., 2016). Nurses must be knowledgeable

about DFU risk factors to implement appropriate prevention and management strategies.

Providing home health nurses with standard protocols and guidelines for DFU assessment,

prevention, and treatment is one way to reduce DFU development, partner with the patient in

promoting self-care, and reduce hospital transfers for DFU complications (Sanz-Corbalán et al.,

2018).

**Problem Identification**

Home health nurses are frontline care providers, spending most of their time interacting with patients in their homes and communities. In these roles, home health nurses are an integral component in managing DM and its complications (Mendola et al., 2018). Home health nurses are strategically positioned to offer DFU prevention, diagnostic, and management services during routine interactions. Because of the absence of a standard protocol for DFU prevention and management in the home health setting understudy, home health nurses default to basic wound care training (Warfield, 2019). Due to this lack of knowledge, it is necessary to procure consultations from home health nurses certified in DM prevention and DFU care to educate home health nurses on DFU wound care (Joyce et al., 2018).

Home health nurses provide general services such as wound care, intravenous medication administration, and catheter changes (Jones et al., 2017). However, when faced with a DFU requiring specialized care, they cannot deliver appropriate services (Jeffcoate et al., 2018). Developing and implementing a DFU management protocol is necessary for home health nurses to provide quality patient care (Kaya & Karaca, 2018).

**Project Question**

Will implementing an evidence-based DFU management protocol improve nurses' knowledge, reduce complications, and decrease hospitalizations of patients with DFUs in the home health setting within four weeks of project implementation?

- Population (P): home health nurses
- Intervention (I): development and implementation of a management protocol
- Comparison (C): the absence of a DFU management protocol

- Outcome (O): increased nurses' knowledge about DFU management and reducing DFU occurrence

- Time (T): 4 weeks of project implementation

## Search Methods

The literature search provided a review of research on DFU wound care. Sources used include CINAHL, PubMed, Jay Sexter Library, and Google Scholar. The keywords searched were: *diabetic foot ulcers*, *diabetic foot ulcer management, prevention of diabetic foot ulcers*, *diabetic wound care*, and *emerging technologies in DFU*. The term *diabetic foot ulcers* yielded 132,000 results, *diabetic wound care* produced 799 results, *prevention and management of diabetic foot ulcers* returned 78 results, and *emerging technologies in DFU* yielded two results.

Reviewing the abstracts enabled the determination of which articles were relevant to diabetic wound care. The application of inclusion and exclusion criteria narrowed the results and increased the reliability of the findings. The inclusion criteria included peer-reviewed articles written in the English language, published within the last five years (2015–2020), and available in full text. Exclusion criteria removed studies without control groups, written by medical students or nonphysician health care workers, or not available in the English language. Applying inclusion and exclusion criteria and careful review of the abstract left 20 highly relevant articles for review. All articles were published between 2015 and 2020 and addressed different aspects of DFU, including prevention, treatment, emerging technologies in DFU management, and the latest diabetic foot care guidelines.

## Review Synthesis

Of the 20 scholarly articles reviewed, nine were specific to DFU prevention and management opportunities, including current technology. Five of the sources were specific to

DFU complications and prevention, three focused solely on DFU management, and three pertained to different aspects of DFUs. The themes identified in the reviewed literature were emerging technologies and therapies in DFU management, home health nurses' evidence-based practice (EBP) knowledge, and DFU management protocol. All the reviewed studies were relevant to the DNP project topic and provided research between nurse knowledge and the risk of DFU occurrence.

## Review of Literature

Despite growing research and technological advancements that have led to various evidence-based DFU management approaches, the literature shows DFUs are still the leading cause of hospitalization and the most frequent complication among individuals with DM. There is a need to implement DFU management protocols to help nurses adequately translate current research and technology into practice.

Historically, the most prevalent treatment approach to DFUs was prolonged bed rest (Schaper et al., 2020). However, subsequent studies have led to the discovery of more effective treatment approaches. Modern DFU management is based on the principles of sharp debridement, offloading, and diabetic foot education. Guidelines for DFU treatment in the United States include local wound care with surgical debridement, dressings that promote a moist wound environment, wound offloading, vascular assessment, active infection treatment, and glycemic control (Schaper et al., 2020). Meeting these guidelines requires adopting a multidisciplinary approach to DFU prevention. Despite the revolution in management and care, DFUs account for significant morbidity, mortality, and health care expenditures in DM patients (Schaper et al., 2020).

A significant number of patients have resistant DFUs, which take prolonged periods to heal; others suffer subsequent DFUs after successful initial treatment (Schaper et al., 2020). Within the first year of treatment, the DFU recurrence rate is roughly 40% (Chatwin et al., 2020), indicating that, despite well-established principles to managing DFUs, administration of the treatment interventions is often challenging. Part of the problem is the providers' lack of training on national guidelines. Negative consequences, such as increased health care costs, are greater in-home health nursing, owing to the early discharge of DM patients to create more room for critically ill patients (Schaper et al., 2020). As primary care providers, nurses are increasingly engaging in community and in-home nursing to facilitate a smooth transition of care after discharge.

Nurses coordinate care as part of a multidisciplinary care team (Martinson & Martinson, 2016). As such, nurses are the leading users of DFU management guidelines and those most affected by the lack of a standard implementation protocol. Because home health nurses must safely integrate novel research into existing interventions, there is a need for a standard protocol and nurse education in the home health setting. Adiewere et al. (2018) found that increasing home and community visits by home health nurses significantly reduced hospital readmission rates among DFU patients. Visiting patients at home to provide DFU care or to supplement the health care regimen contributes to improved quality of life and fewer complications, hospital readmissions, and deaths (Zhong et al., 2017). Patients released from rehabilitation centers and hospitals need quality nursing management at home, which family members might not be able to provide; thus, the home health nurse's role is essential (Mavrogenis et al., 2018).

In a descriptive study, Abdullah et al. (2017) sought to determine whether nurses' knowledge resulted in better foot screenings and prevented DFUs and other foot complications.

The researchers identified a significant positive correlation between nurses' knowledge and the overall score regarding proper diabetic foot care, early recognition, and risk factors management. The findings also showed that developing a structured educational program for nurses caring for diabetic foot disorders increases their knowledge of the condition.

Adiewere et al. (2018) conducted a systematic review to more broadly investigate the effect of implementing a DFU management protocol for nurses to provide quality DFU management education to patients. The findings showed the DFU management protocol improved nurses' knowledge and ability to offer foot care education, thus significantly reducing DFU incidence. According to Boulton et al. (2018), DFU complications, such as amputations, result from poor diagnosis and management and can lead to infected DFUs. Therefore, a DFU management protocol is essential in increasing nurses' knowledge of diagnosing, assessing risk factors, determining the need for referral, and providing patient education.

Despite current and emerging therapies and technologies, DFUs are the primary cause of mortality in diabetic patients (Karri et al., 2016). Treatments for managing DFUs include antibiotics, neuropathic drugs, wound dressings, skin substitutes, growth factors, and inflammatory modulators (Schaper et al., 2020). The challenge remains on how to increase nurses' treatment knowledge to enable safe application. Overall, the literature review showed a connection between implementing an evidence-based DFU management protocol and nurse knowledge on DFU management, complications, and patient hospitalizations.

## Impact of the Problem

DFUs substantially impact a patient's quality of life and are associated with depression and reduced mobility. DFUs affects approximately 15% of all DM patients (Harding et al., 2019), and patients hospitalized with DFUs are at a 50% risk of mortality (Armstrong et al.,

2017). DFUs can decrease quality of life due to associated infections, gangrene, amputations, mortality, prolonged hospital stays, increased health care costs, and loss of income (Standl et al., 2019). Additionally, DFU complications have significant financial impacts on individuals, society, and the U.S. government. It costs $7,000 to $10,000 to treat a single DFU case (Schaper et al., 2020), imposing a heavy financial burden on federal (Medicare and Medicaid) and individual insurers. DFU treatment accounts for approximately one-third of the total cost of diabetic care (Schaper et al., 2020). Some DFU complications significantly increase treatment cost, including leg amputation ($65,000) or osteomyelitis ($60,000)(Schaper et al., 2020). Inpatient treatment is expensive, as patients may require specialized care and long-term medications.

DFU complications, such as leg amputation and disability, result in reduced productivity, decreased quality of life, and impaired national economic growth (Zhong et al., 2017). Health care providers must familiarize themselves with DFU prevention and management principles to reduce amputation and infection (Bus & van Netten, 2016).

## Theme Development

### Risk Factors

DFUs are preventable when nurses properly screen and identify high-risk patients and provide proper foot care education (Chatwin et al., 2020). Common risk factors include peripheral vascular disease, neuropathy, poor glycemic control, cigarette smoking, diabetic nephropathy, previous foot ulcerations, and amputations (Standl et al., 2019). These factors affect the nervous system's autonomic, sensory, and motor components, compromising the foot's innervation of muscles and facilitating pressure points and bony prominences (Karri et al., 2016). They also cause autonomic dysfunction, with diminished sweating and dry skin leading to

cracks. Diabetic neuropathy is a significant risk factor for DFU development, with ulceration triggered by cold feet. Patients are not aware of the early stages of DFU because they do not feel the pain caused by the inflammation (Nather et al., 2018). Home health nurses must be aware of these factors to determine which patients are at high risk of DFUs. If identified early and with appropriate care applied, DFU development is preventable (Abdullah et al., 2017).

**Prevention Protocols**

The International Working Group on the Diabetic Foot (IWGDF) presents evidence-based DFU prevention and management guidelines (Schaper et al., 2019). Under these guidelines, health care providers should provide DM patients with annual DFU screenings and educate and encourage those with high DFU risk to perform daily foot inspections (Shahbazian et al., 2013). Among individuals with diabetes at increased risk for DFU, IWGDF guidelines require integrated foot care, including professional treatment, quality footwear, and structured education about the lower extremities' self-care. Education should be updated every three months, as needed, for both patients and family members (Schaper et al., 2019).

**National Guidelines/Initiatives**

In its DFU prevention and management guidelines, the National Institute for Health and Care Excellence (2015) recommends screening for DFU risk upon diabetes diagnosis and at a minimum annually after that or if any foot problems arise. The guidelines direct health care providers to assess specific risk factors, such as neuropathy, limb ischemia, ulceration, callus, infection, inflammation, deformity, gangrene, and Charcot arthropathy. Nurses should also refer any high-risk individuals to a foot protection service for risk management education and treatment (Cowan et al., 2019). Home health nurses must receive instruction on these elements as part of integrated care for people with high ulceration risks (Schaper et al., 2020).

**Management of DFU**

Proper management of DFU can reduce associated complications, such as infections, gangrene, amputations, and even death (Everett & Mathioudakis, 2018). The use of antimicrobial therapy, mechanical debridement, and ionic silver Hydrofiber dressing (AQAg+) in the management of DFUs promotes effective wound healing, reduces the spread of infection while ensuring responsible use of antibiotics, and limits the progression from wound development to lower-extremity amputation (Torkington-Stokes et al., 2016). The primary goal of DFU management is to achieve wound closure as soon as possible. Because diabetes is a multi-organ systemic disease, it is essential to have a multidisciplinary team managing the comorbidities that affect wound healing (Jeffcoate et al., 2018). Examples of such comorbidities are end-stage renal disease, arterial hypertension, cardiovascular diseases, dyslipidemia, and cerebrovascular disease (Everett & Mathioudakis, 2018).

*Education*

Since the identification of DFUs in the 19th century, studies have been ongoing to find evidence-based management interventions. However, new interventions and protocols have not yet become a part of the nursing curriculum (Mavrogenis et al., 2018). Also, home health nurses trained before the definition of DFUs might lack the appropriate education required for proper DFU management (Rice et al., 2014). Therefore, training in established, evidence-based DFU management interventions is necessary to adequately prepare all home health nurses to care for DFU patients (Mavrogenis et al., 2018). Facility leaders should provide training to the health care team on DFU prevention, including general practitioners, educators, nurses, orthotic specialists, and podiatrists. Proper team training will reduce the rates of amputation, lower the

costs of DFU-related health care services, and lead to a better quality of life for patients with DFUs.

*Healing Strategies*

According to the American Diabetes Association (ADA), prevention and management of DFUs by care teams can reduce DM patients' risks of developing a DFU by 50% to 85% (Boulton et al., 2018). The ADA recommends annual foot inspections by a physician to facilitate early DFU detection. Other suggestions include regularly assessing wounds for infection, dressing products to keep the wound moist, and adjusting treatment after four weeks with no noticeable progress (Everett & Mathioudakis, 2018). Some of the evidence-based strategies that have been identified to be effective in DFU management include blood sugar control, wound debridement, offloading and advanced wound care (Yazdanpanah et al., 2015).

**Blood Sugar Control.** Patients have successfully managed DFUs with blood sugar control, which is essential in preventing infection and improving healing. Research has shown that insufficient control of blood sugars is the leading cause of DFUs (Boulton et al., 2018). A hemoglobin A1C (HgA1C) level is the best indicator of glucose control over time. Increased glucose levels in the blood lead to suppressing the inflammatory responses and reducing the host response to infection (Yazdanpanah et al., 2015).

**Wound Debridement.** Home health nurses should incorporate debridement into DFU management. Debridement involves removing necrotic and senescent tissues and foreign and infected materials from a wound (Karri et al., 2016). This process can lead to faster wound closure and lowers the chances for leg amputations in patients with DFU. Debridement can also reduce the bacteria count and stimulate the production of local growth factors. The method also lowers pressure, allows the nurse to evaluate the wound bed, and facilitates drainage. There are

multiple types of debridement, including autolytic, enzymatic, biological, and mechanical, but surgical debridement is the most effective for healing DFUs (Boulton et al., 2018; Yazdanpanah et al., 2015; Zhong et al., 2017). Surgical debridement involves cutting away the infected and dead tissues, followed by applying a saline-moistened cotton gauze daily. Sharp debridement is linked to the rapid healing of ulcers than less frequent debridement (Yazdanpanah et al., 2015). In a retrospective cohort study, Wilcox et al. (2013) reported that recurrent debridement healed wounds in a short time ($p < 0.001$). The more frequent the debridement, the better the healing outcome. It is essential to repeat surgical debridement as often as needed if new necrotic tissue forms.

**Offloading.** Offloading techniques, often referred to as pressure modulation, are essential for neuropathic ulcer management in diabetes patients. Martinson and Martinson (2016) found that appropriate offloading promotes DFU healing. With offloading, a reduction in the weight placed on the foot helps to prevent and heal ulcers, especially those caused by poor circulation to the feet because of diabetes. Offloading can include using crutches, wheelchairs, or other practical means, such as total contact casts. The idea is to protect the wound from worsening or becoming infected because of added pressure to the area.

**Advanced Wound Care.** Another approach to DFU management that has proven effective is advanced dressing. Advanced wound care involves conferring moisture balance, protease sequestration, growth factors simulation, antimicrobial activity, oxygen permeability, and the promotion of autolytic debridement, which facilitates granulation tissue production and the re-epithelialization process (Martinson & Martinson, 2016). Conferring moisture balance involves maintaining a warm and moist wound bed, removing the excessive enzymes and growth factors to hasten healing**,** and correcting biochemical imbalance (Martinson & Martinson, 2016).

**Emerging Technologies**

Technological advancements will allow home health nurses to offer novel interventions to prevent and treat DFUs. Emerging technologies can facilitate early and accurate diagnosis of DFUs, thus allowing for early interventions. Among the cutting-edge technologies are: (a) laser Doppler flowmetry, used to assess plantar tissue viability; (b) infrared thermography, used for early detection of plantar tissue inflammation and plantar pressure; (c) pressure gradient systems, used to identify specific sites at risk for DFUs; and (d) ultrasound indentation tests (elastography), used to quantify plantar tissue mechanical property. Technology can also facilitate patient access and adherence to physical activity, another effective diabetes management strategy (Lung et al., 2020). Technology can improve commitment to physical activity by reducing perceived barriers to exercise, such as lack of time, accessibility, boredom, and fear of falling (Rimmer et al., 2016).

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**Review of Study Methods**

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The literature review included integrative reviews, randomized controlled trials, mixed methods, comparative studies, and retrospective cohort studies. All the reviewed articles used different study methods. Abdullah et al. (2017) used a descriptive study methodology to determine whether nurses' knowledge resulted in better foot screenings and prevented DFUs and other foot complications, while Adiewere et al. (2018) used a systematic review study method to investigate the effect of implementing a DFU management protocol for nurses to provide quality DFU management education to patients. Boulton et al. (2018) applied a randomized controlled study method to determine the causes of DFUs and their complications. Karri et al. (2016) used a mixed method to investigate the impacts of DFUs on diabetic patients, while Schaper et al. (2020) used comparative studies to explore the most effective treatments for managing DFUs.

Chatwin et al. (2020) used retrospective cohort studies to determine the DFU recurrence rate and

prognosis. Martinson & Martinson (2016) used integrative reviews while Adiewere et al. (2018)

used comparative studies to determine nurses' role in DFU management. Zhong et al. (2017) and

Mavrogenis et al. (2018) used integrative reviews to assess the impact of home visitation by

home health nurses on DFU prevention and management.

## Project Aim

The overarching aim of this DNP project is to prevent and reduce DFUs and the

complications associated with this condition. The growing prevalence of DFUs and associated

complications corresponds with limited knowledge of DFU prevention and management among

home health nurses (Warfield, 2019).

## Project Objectives

The host site participants will complete the following objectives within the timeframe of

the 4-week DNP project. The objectives include:

1. Create an evidence-based DFU management protocol.

2. Educate home health nursing staff on the new DFU management protocol.

3. Assess knowledge of DFU treatment and prevention by using pre-and posttests.

4. Evaluate participant compliance with the DFU management protocol by performing a

    chart audit.

## Theoretical Framework

The Stetler Model of Research Utilization (Damschroder et al., 2020) will serve as the

theoretical framework for implementing the proposed evidence-based DFU management

protocol (see Appendix A). Under the model, health care practitioners can assess medical

evidence and research findings, thus understanding how to integrate the results into health care

practice safely. The model provides a guide for health care practitioners with a framework to apply the best existing evidence to lead formal or informal organizational changes, such as critical thinking and reflective practice for personal and professional growth (Nilsen, 2020).

The Stetler Model links the concepts of evidence-informed practice by establishing research as the first step in developing EBP (Damschroder et al., 2020). The model serves as a guide for health care practitioners to apply research in three forms while they practice. The first form is instrumental that entails the direct application of knowledge; the second form is conceptual use that involves using research changes to understand an issue; and the third form is symbolic use that incorporates using research to justify a decision or influence behavior (Nilsen, 2020). The model consists of five phases of integrating evidence into practice: preparation, validation, comparative evaluation, application, and evaluation (Nilsen, 2020).

<div align="center">**Application of Major Tenets to the DNP Project**</div>

**Phase 1: Preparation**

The first phase entailed identifying the priority problem in the project site organization and pinpointing the EBP project (Nilsen, 2020). The project lead identified the project site's priority issues as a high rate of DFU-related complications, DFU patient hospitalization, and limited DFU management knowledge among home health nurses. The organizational gap contributing to these issues was the absence of an evidence-based DFU management protocol. Based on the problems identified, the DNP project's purpose is to implement an evidence-based DFU prevention and management protocol to improve nurses' knowledge, prevent and reduce complications, and decrease hospitalizations of patients diagnosed with DFUs in the home health setting. The selected sources of evidence were peer-reviewed journals, health care industry guidelines, and diabetic and wound specialty association journals.

**Phase 2: Validation**

The validation phase included the critical appraisal of peer-reviewed literature to understand the issues surrounding DFUs in DM patients in a home care setting. Validation also included identifying studies published between 2016 and 2020. The studies retrieved from the literature search underwent critical appraisal to determine whether they were significant to the current project using inclusion and exclusion criteria.

**Phase 3: Comparative Evaluation**

Phase 3 involved comparing and contrasting the evidence sources to determine their feasibility and suitability for the research problem. The chosen literature underwent systematic review and summarization to allow for easier comparison. This evaluation helped to identify the similarities, differences, strengths, and weaknesses of the research. Implementing an evidence-based DFU management protocol emerged as the most viable solution to reduce DFU complications and hospital readmissions and improve home health nurses' knowledge of DFU management.

**Phase 4: Implementation**

Phase 4 involved applying the research findings to address the identified problem. The review of the research led to the development of a proposal for practice change. The proposed practice change was implementing an evidence-based DFU management protocol to improve nurses' knowledge, reduce complications, and decrease patient hospitalizations from DFUs. To promote adherence to this best practice protocol, the home health nurses will receive training before initiating the project site protocol.

**Phase 5: Evaluation**

Phase 5 will involve identifying the expected outcomes of the project and assessing the

EBP project goals. The expected outcomes evaluated are improved nurses' knowledge of DFU

management, reduced complications of DFUs, and decreased patient hospitalizations due to DFU

complications in the home health setting. The evaluation will show the intervention's

effectiveness, indicating the need to modify the implementation process or replace the

intervention. A pre and posttest will enable evaluation of home health nurses' knowledge of

DFUs and the proposed protocol. The tests will be based on the DFU management protocol

education materials used to educate home health nurses.

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**Setting**

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The DNP project implementation will occur in a home health care agency in Los Angeles

County, one of California's most populated counties, with an estimated population of 10.6

million and significant ethnic diversity (Population of Los Angeles, 2019). The agency is located

in a highly populated and underserved area. The most common diagnosis among this population

is DM and its complications, such as DFUs, primarily due to inadequate disease management

(Standl et al., 2019).

**Project Site**

The practice site is a nursing practice located in Manhattan Beach, California,

specializing in Family Medicine and is open seven days per week. The facility serves 20 patients

per day, and employs one physician, one advanced practice registered nurse (APRN), four

nurses, and four certified nursing assistants (CNAs). The facility offers long-term care and

transitional care services. The facility's electronic health record (EHR) will indicate whether a

patient meets the inclusion criteria. The participants will need to document the care provided in the EHR later used to determine compliance with the protocol.

<div align="center">**Population of Interest**</div>

The direct population of interest is the home health nurses, including advanced practice registered nurses (APRNs), registered nurses (RNs), and licensed vocational nurses (LVNs). In California, APRNs provide advanced primary care in collaboration with physicians. RNs deliver direct patient care as specified in a patient's medical plan and are supervised by other medical staff, including APRNs. LVNs provide basic hygienic and nursing care, such as measurement of vital signs and documentation directed by APRNs. Four home health nurses (two RNs and two LVNs) from the project site will participate. Their role in the project will be providing direct patient home health care as directed by APRNs and physicians. One physician and one APRN nurse will also take part in the study. Because this will be a mandated practice change for the facility, all nurses' participation will be mandatory.

**Inclusion Criteria**

The inclusion criteria for participating in this project consist of nurses who fulfill the California State Board of Nursing licensing requirements to practice nursing in this state and those employed by the project site and involved in direct patient care as full-time employees.

**Exclusion Criteria**

Exclusion criteria will entail per-diem, part-time, or contracted home health nurses, physical therapists, occupational therapists, speech therapists, certified nurse assistants, and those awaiting certification from the State Board of Nursing. The rationale for excluding part-time and contracted employees is to prevent disruption of the project implementation during the scheduled

period. The medical assistants and CNAs are ineligible because they are not licensed nor have

the training to assess patients.

**Indirect Population of Interest**

The indirect populations of interest are home health patients diagnosed and admitted with

DM and those afflicted with or at high risk of DFU development. This population includes those

patients residing in homes, apartments, condominiums, assisted living facilities, and board and

care homes. The project will indirectly impact this population through improved DFU prevention

and management provided at the point of service by home health nurses (Jones et al., 2017).

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**Stakeholders**

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The project stakeholders include the selected home health facility director, the RNs and

LVNs who have met inclusion criteria, and two supervisors. The health facility director's role

will be to provide permission to complete the project at the sites and provide essential support

such as a favorable work schedule for the participants, communication resources among

participants, meetings, and training venue. The supervisor's role will be to oversee the activities

of the project lead to ensure adherence to organizational regulations and to assist in obtaining

participant buy-in. The project lead will oversee the DFU prevention and management protocol

implementation, provide support, answer questions, and offer guidance during the

implementation period. Patients will also be significant stakeholders as they will receive

improved quality care through the implemented protocol.

The home health nurses' role will be to implement the DFU prevention and management

protocol within the stipulated project timeline. They will also participate in training and adhere

to the protocol to promote the expected outcomes. The home health agency directors authorizing

implementation of the project granted permission to conduct this project at the project site (see Appendix B).

## Intervention

Various interventions will facilitate the successful implementation of the evidence-based DFU protocol. A strict timeline will be created and followed during the implementation process for the purpose of a smooth transition of practice.

### Week One

In the first week of implementation, an educational training session will be performed that will include all stakeholders who are integral to project success. The educational training will occur for four days and consist of a two-hour session every day to capture all the participants in the first week.  The educational training sessions will include an introduction to the DFU prevention and management protocol and the participants will familiarize themselves with new roles for the practice change. The pre-test will be administered prior to the educational training to evaluate the participants' knowledge of the DFU disease process, preventive measures, and how to identify and manage DFUs. A posttest will be administered immediately after the educational training to assess the effectiveness of the training session. The educational training will consist of a PowerPoint presentation with the protocol and presentation handed out for reference materials.

### Week Two

The DFU prevention and management protocol will be initiated into practice by the participants. The project lead will be present at the project site to be available for any questions and provide support to ensure the implementation process runs smoothly. The project lead will also input the results of the pre and post-tests into the Statistical Package for Social Sciences

(SPSS) software to assist with analyzing the knowledge of participants before and after the educational training.

**Week Three and Four**

The DFU prevention and management protocol will continue to be implemented at the project site. The project lead will be present at the project site part time during the implementation phase but will leave contact information for the participants if questions or concerns arise. The project lead will begin the chart auditing data collection process to determine participants' compliance with the protocol. This is completed in the chart only for patients diagnosed with DM. There is no electronic document system in place; therefore, all chart audits will be completed using EHR charts.

**Week Five**

This week is the final week of project implementation. The participants will continue to utilize the protocol as they have been for the past few weeks. At the end of week five, final data collection will be concluded and compiled with the rest of the data already collected. The results will be imputed into the SPSS software to assist the project with analysis of the data. The project lead will move toward analyzing all the data retrieved.

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**Tools**

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Several tools will be necessary to carry out the project interventions. The project tools will help with the implementation process. The tools include a DFU protocol, education presentation, pre and posttests, content validity index, and chart audit tool.

**Diabetic Foot Ulcer Prevention and Management Protocol**

The DFU prevention and management protocol was developed to meet the gap created by

an absence of a guide to best practices in the care of patients diagnosed with DFUs (see

Appendix C). The protocol is separated into two sections. The prevention section focuses on

preventing DFUs and management, which focuses on how to treat DFUs if present during the

assessment. This protocol will enable participants to identify a DFU early, detect the patient's

risk factors for developing a DFU, and prescribe prevention measures to improve outcomes

(Yazdanpanah et al., 2015). Included in the prevention management protocol are step-by-step

instructions that provide the home health nurse easy-to-follow prevention measures. The DFU

prevention and management protocol will also provide the participants with evidence-based

guidelines on the treatment of a DFU already present in the assessment. The International

Working Group on the Diabetic Foot (IWGDF) and the National Institute for Health and Care

Excellence guidelines are integrated into the protocol to comply with national DFU prevention

and management standards (Game et al., 2016). Consequently, the project is expected to reduce

DFU rates through prevention and identify and manage DFUs to reduce complications.

**Educational Presentation**

A PowerPoint educational presentation will be the means used to train participating home

health nurses in the proposed DFU prevention and management protocol (see Appendix D). The

training will take place in two to three days during a two-hour session the first week of

implementation. The training will cover DFU prevention measures such as risk identification,

foot assessment, early identification of DFUs, performing a wound assessment, and treating or

managing the wounds to prevent further complications appropriately. Also provided in the

education is an introduction to the dressing supplies and equipment that will be utilized in the

protocol. The participants will be able to ask questions regarding the training.

**Pre and Post Tests**

Pre- and posttests will assess the training session's effectiveness (see Appendix E). Both

tests will contain identical questions. The tests will consist of ten multiple-choice questions

based on the DFU of the proposed protocol. Multiple choices are widely used as an effective

summative assessment tool (McKenna, 2019). The questions will assess participants' basic

knowledge for prevention and managing DFUs, identifying risk factors for developing DFUs,

and treatment or management of DFUs. The tests will also assess nurses' knowledge of the

medical supplies used in the protocol. The pre and posttest findings will be compared to

determine whether the training resulted in an improvement in nurses' knowledge of DFU

prevention and management. The tests were created by the project lead using the evidence-based

national guidelines provided by IWGDF. To validate if the test is appropriate, a content validity

index (CVI) will be completed.

**Content Validity Index**

The CVI is the most commonly used method to calculate content validity of test items

quantitatively. Experts will use a CVI tool to assess the validity of the pre-and posttest questions

(Rutherford Hemming, 2015) (see Appendix F). The course instructor, academic mentor, and

project mentor will evaluate and rate test item questions for validation. Once the experts rate the

test questions, the scores will be calculated and plugged into an equation to determine if test

questions are appropriate and valid.

**Chart Audit Tool**

The project will utilize a chart audit tool to assess home health nurse compliance with the DFU prevention and management protocol (see Appendix G). The project lead will utilize the audit tool to collect the data from the patient charts. One of the objectives of this quality improvement project is to determine whether the home health nurses can comply with the use of the DFU protocol to prevent complications.

## Study of Interventions/ Data Collection

Home health nurses' knowledge regarding the prevention and management of DFUs will be measured through pre and post-implementation tests. Prior to the educational training, a pre-test will be administered to determine baseline knowledge levels of DFU prevention and management. After the training, the training program's success will be evaluated by administering a post-implementation test, which is identical to the pre-implementation test. The results of the two tests will be compared to determine if knowledge was gained in DFU treatment and prevention through the training. The data from both tests will be recorded on an Excel sheet for easier comparison of the scores. The participants will be identified using number codes to ensure confidentiality.

The evaluation of the participant compliance with the protocol will be assessed through a patient chart audit. Sixty patient charts equally divided among the four participants will be used. The DFU patient charts will be filtered from the project site EHR using DFU as the key search term. The charts will be reviewed to determine compliance of nurses in the implemented DFU management protocol (Warfield, 2019). The data will be collected using an Excel sheet. During data collection, confidentiality and privacy of the collected project data will be maintained by using a data codebook. No personal health information will be extracted from the patient charts.

Health Insurance, Portability, and Accountability Act (HIPAA) standards will be adhered to during the chart audit. The same number assigned to the participants will be used to identify the participants in the chart audit. Only the project lead will know the numbers assigned to each participant.

<p style="text-align:center"><strong>Ethics/ Human Subjects Protection</strong></p>

The project lead ensured all participants' protection from harm by adhering to the ethical standards that protect human subjects' rights, dignity, and welfare during project implementation. This DNP project is considered a quality improvement project; therefore, it should be exempted from Institutional Review Board (IRB) review (Rumbold & Pierscionek, 2017). The project lead will adhere to the Touro University Nevada policy regarding IRB submissions by presenting the Project Determination Form along with the entire project proposal and appendices. The project team will then determine if IRB review is required for this DNP project. Participants will be assigned random numbers for the tests to protect their privacy, confidentiality, and anonymity (Korstjens & Moser, 2017).

Additionally, data related to the project will be stored in encrypted files in a password-protected laptop that only the project lead can access. The project has minimal risks to the participants associated with learning and implementation of the proposed protocol. Potential benefits to the participants include improving the quality of DFU management and outcomes and reduced risk of DFU complications. This DNP project is considered a quality improvement intervention and a facility-wide practice change. Participation in the project will be mandatory, although participation is not a condition in employment. The participants will not be compensated for taking part in the project (Zook et al., 2017). However, the participants will be paid their hourly wage to attend the educational session.

**Measures/ Plan for Analysis**

A statistician was consulted to ensure the appropriate statistical testing will be utilized to analyze the project results. A paired t-test will be utilized to analyze the results of the pre and post-education tests to determine if meaningful changes in nurses' knowledge accrued regarding DFU prevention and management (Xu et al., 2017). T-tests are commonly used in statistics to establish if the values of two outcomes are different from one another and the difference is statistically significant (Kim, 2017). The t-tests will compare the mean change (SE) before and after education is implemented. The analysis using t-tests will be based on the assumption that participants are an accurate representation of the total population. The sample size is reasonably large, and there may be homogeneity of variance (Derrick, Russ, Toher & White, 2017). SPSS version 26 program will analyze and compare the pre-and post-test results. The analysis will be based on the assumption that the chosen sample will represent all home health nurses. A chart audit tool will enable manual data extraction after implementing the DFU management protocol. Fifty-two patient charts, four charts for each of the six participating nurses, will be analyzed. A simple percentage of nursing compliance will be determined and a 95% confidence interval (CI) will be used. External statistical experts will be sought to assist with the statistical analysis and interpretation of the findings.

**Analysis**

One objective for this DNP QI project is to assess participants' knowledge utilizing a pre and post-educational test. The test is a multiple-choice test consisting of 10 questions. The pre and post-educational test scores will be analyzed using a paired t-test. The test was administered immediately before and immediately after the educational session.

The second objective for this DNP QI project is to assess participants' compliance with a DFU

prevention and management protocol. A post protocol implementation assessment was

performed using the chart review tool during weeks three, four, and five of project protocol

implementation. The post protocol assessment will be analyzed using a simple percentage with a

95% confidence rate.

**Nursing Knowledge**

The knowledge of the DFU disease process, preventive measures, and identifying and

managing a DFU will be statistically analyzed using a paired t-test. This test can be used when

the assumptions are met. There are two paired measurements of the characteristic of interest, one

pre-test and one posttest measurement on the same person; the two measures that are compared

are normally distributed, or there are at least 30 pairs and a distribution that is not badly skewed,

and the measurement scale is either interval or ratio (Kellar & Kelvin, 2013). All assumptions

were met; therefore, a paired t-test is appropriate for this analysis. A paired t-test was performed

to determine if the pre intervention knowledge scores are significantly different from the post

assessment knowledge scores.

**T-test for Knowledge**

A paired t-test analysis was performed to assess the educational intervention on the

knowledge of the six participants pre and post sample at $\alpha = 0.05$ significance level. There was a

significant difference in the pre-test scores for knowledge (M=83.33, SD=8.16) and post-test

scores (M=100.00, SD=0); t (5) =5.00, d = 2.04, p = 0.004 (Table 1). Posttest scores are

significantly higher than pre-test scores. This supports the assertion that the education

intervention would increase the nursing staffs' knowledge of the DFU disease process,

preventive measures, and how to identify and manage a DFU when present.

**Table 1**

*Paired t-Tests*

| | Post | | | Pre | | | | | | 95% CI | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | M | SD | n | M | SD | n | t | df | p | Lower | Upper |
| Knowledge | 100.00 | 0.0 | 6 | 83.33 | 8.16 | 6 | 5.00 | 5 | .004 | 8.10 | 25.24 |

**Provider Compliance**

The second objective is to determine the compliance by the staff in the use of the protocol. Data were collected through retrospective chart audits utilizing an audit tool. The data collected was placed in a binary format for easy identification. The audit tool asks the question, "Is the staff compliant with the chart audit, Yes or No?" Descriptive statistics indicated that compliance with the DFU management protocol was 95%; the compliance population mean lies within the confidence interval of 82% and 97% for the assessment period of week three, week four and week five. The six nurses completed 52 charts during the post protocol assessment period: week three, week four, and week five. Compliance was calculated as 48 charts compliant and four charts not compliant. Ninety two percent of the nurses were compliant.

**Table 2**

*Protocol Compliance*

| Nurse | Week3 | | Week4 | | Week5 | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Compliant | Not | Compliant | Not | Compliant | Not | Compliant | Not |
| Nurse1 | 4 | 1 | 2 | | 2 | | 8 | 1 |
| Nurse2 | 4 | | 2 | 1 | 2 | | 8 | 1 |
| Nurse3 | 4 | | 3 | | 2 | | 9 | 0 |
| Nurse4 | 2 | | 3 | | 2 | | 7 | 0 |
| Nurse5 | 3 | 1 | 2 | | 2 | | 7 | 1 |
| Nurse6 | 3 | 1 | 4 | | 2 | | 9 | 1 |
| Totals | 20 | 3 | 16 | 1 | 12 | 0 | 48 | 4 |

**Table 3**

*Compliance proportion*

| | Compliant | | Proportion | 95% CI[1] | |
|---|---|---|---|---|---|
| | Yes | No | | Upper | Lower |
| Total | 48 | 4 | 48/52=.92 | .97 | .82 |

[1] The Wilson procedure without correction for continuity was used.

## Discussion of the Findings

The project sought to examine if training in DFU protocol increased nurses' knowledge about DFU management. The project was necessitated by high DFU prevalence and its impact on patients' quality of life. DFU complications can cause amputation, high costs of treatment and even death. Hurlow et al., (2018) performed a study that suggests DFU impacts both the financial and wellbeing of the patient and their families (Hurlow et al., 2018). A standard practice of decreasing and managing complications would significantly improve DFU outcomes. The

national guideline for intervention recommends screening DFU risk upon diabetes diagnosis as well as patient education to empower them to reduce DFU risk.

The project utilized a pre-and posttest assessment strategy to evaluate participants' knowledge before and after training on DFU management. The intervention involved training nurses on DFU prevention and management. In the pre-test, the project revealed that majority of nurses were unaware of DFU management (Garcia-Klepzig et al., 2018). Nurses demonstrated how to manage diabetes and its related complications but revealed a gap in DFU management protocol. The project deduced that the high rate of DFU complications was attributable to a lack of knowledge among home-based nurses (Garcia-Klepzig et al., 2018). A paired t-test analysis revealed a significant difference between pre and posttest scores. For the pre-test, the mean score was 83.33, with a standard deviation of 8.16. However, after the intervention, nurses demonstrated a comprehensive understanding of DFU management protocol (M=100, SD =0). The findings suggest the intervention was effective in equipping nurses with DFU protocol management knowledge. The high posttest scores demonstrate the efficacy of the training program.

The results show a significant difference in pre and posttest scores, as shown in the pre-test scores for knowledge (M=83.33, SD=8.16) and posttest scores (M=100.00, SD=0); t (5) =5.00, d = 2.04, p = 0.004, which means the training in prevention and management of DFU was effective. This DNP project has significantly improved knowledge in the home health nurses. The nurse's knowledge and skills are fundamental to conducting foot assessments and providing foot care to diabetic individuals (Abate et al., 2020). Nurses with knowledge of DFU can identify etiology and assess the comorbidities to offer the proper therapeutic approach to reduce the risk of amputation of legs.

Abate et al. (2020), in the study to assess nurses' knowledge and attitude towards diabetic foot ulcers in Ethiopia, found there were significant gaps in nurses' knowledge and attitude towards diabetes foot care. Insufficient knowledge among the nurses towards diabetic foot care compromises the health care standards provided in diabetic foot ulcers. In an attempt to assess the knowledge of nurses in DFU disease and their attitude towards the individuals suffering from it, Sriyani, Hettiarachchi & Wasalathanthri (2017) found that gaps in core knowledge and negative attitudes were attributed to inadequate training, suboptimal update of knowledge and lack of interest in research on wound care. These findings show a need to train nurses in the prevention and management of DFU to reduce complications.

Another area of interest with the project was assessing provider compliance. After collecting data, a proportion of charts in compliance was calculated to establish if nurses utilized DFU protocol during the assessment. There was a 92% compliance rate in this project. The findings suggest nurses were quick to adapt to the DFU management protocol. The high efficacy rate is attributable to the need to manage DFU related complications and reduce hospitalization rates stemming from DFU. With compliance, nurses are likely to provide uniform care, improving DFU outcomes (Everett & Mathioudakis, 2018). Uniform care promotes the standard practice, as demonstrated in American Diabetes Association's assertions.

The 92% compliance rate indicates that nurses used the protocol in the prevention and management of DFU, which is likely to improve patient outcomes. Despite how effective the protocol would be, healthcare results would not be effective if the instructions were not followed adequately (Fielding & Duff, 1999). Compliance with the protocol is critical in improving the outcome of patients with DFU. During the assessment, each nurse's performance was analyzed in regards to the compliance with the protocol. The patient charts were not evenly distributed

among the nurses; during week three; five nurses had four charts and one nurse had two charts. In week four, one nurse had four charts, three nurses had three charts, and two nurses had two charts. In week five, each nurse had two charts. After calculating the nurse's compliance, it was found that during week three, 20 out of 23 were compliant. In week four, 16 out of 17 were compliant, and week five, 12 out of 12 were compliant. Noncompliance resulted from failing to address all areas in the DFU Prevention and Management Protocol.

## Significance of Findings to Nursing Profession

Patients diagnosed with DFUs can experience debilitating and devastation due to life altering complications. If DFUs are not addressed, can cause death. People with diabetes has a significant effect on their quality of life. Complications can lead to amputation, high costs of healthcare or even death. Prevention and management of DFU are some of the most important challenges in delivering optimal DFU care. The project results show that training nurses in DFU improves their knowledge and these nurses are likely to deliver better quality care than untrained nurses. Optimum knowledge and compliance with the protocol are significant towards producing effective results when offering care to the DFU patients (Gagliardino et al., 2007). Therefore, designing formal training courses would be important for all nurses caring for DFU patients; continuous professional development, evidence-based practices and wound care research should be encouraged and rewarded for improvements in the quality of care.  Education on wound care should be incorporated into the curriculum of nursing schools. Scholarly doctorate prepared nurses have to change the nursing profession by taking the lead in creating a nurse-led evidence based protocols to improve patient outcomes is an asset for the nursing profession.

In conclusion, the project findings are consistent with the literature, demonstrating training successfully integrated DFU management protocol knowledge in nurses, equipping them

with the needed evidence-based interventions for addressing DFU. With this knowledge, nurses will likely reduce complications associated with DFU along with providing better quality care. The intervention will also help reduce healthcare costs related to the DFU complication. Increased compliance with DFU management protocol promotes uniformity in care delivery.

## Limitations

### Project Design

The project lead chose a quality improvement design utilizing evidence-based guidelines to improve outcomes for patients diagnosed with DM. This QI design presented numerous limitations such as, the DFU protocol was implemented in one home health agency, which limits the generalization to other settings such as acute care facilities and long-term care or large health care facilities. Therefore, there is no guarantee the DFU protocol will produce the same results in a different setting.

The short implementation timeline was another project design limitation that has potentially negatively impacted the outcomes. More time would have allowed evaluation of the DFU protocol in reducing DFU rates.

### Data Collection

The assignment of diabetic patients to the nurses was not evenly distributed; therefore, the chart audits was inequitable, which made comparisons between nurses unattainable. As a result, the nurse who had less patients diagnosed with DM assigned, did not have the amount of practice with incorporating the protocol into the workflow. This nurse may struggle with application of the protocol after the project is completed.

### Data Recruitment

Another limitation of the project was the small participant sample size of six home health nurses. A small sample size can affect the reliability of the project results and leads to a higher variability, which may lead to bias (Nickel & Thomalla, 2017). Additionally, there was not enough time to determine if the protocol was successful in preventing the reduction of readmission rates, reduction in DFU complications, and improvement in the prevention of DFUs.

## Dissemination

Dissemination of the project findings increase and spread the knowledge in the effectiveness of educating home health nurses in the prevention and management of DFUs. Touro University Nevada (TUN) encourages students to submit their DNP projects in the online DNP repository, promoting the sharing of the knowledge. The project will also be disseminated to the faculty and students of TUN. DNP student's projects are written to satisfy program requirements, meet specific assignment guidelines, and evaluate the program rubrics, and are hence appropriate for publication (Sebach & Shellenbarger, 2020). A poster presentation will be conducted in a wound care facility and wild on wounds conference (WOW) in June 2022.

The sustainability of the protocol is assured after completion of the project due to the project's alignment with the current patient health needs, and provides evidence-based practices to improve the quality of life by reducing DFU complications. Also, the DFU protocol will be integrated into the workflow of the home health agency's nurses by designating it as a policy. The cost-effectiveness of the protocol fosters sustainability because staff training is negligible when compared to the costs of DFU complications. The stakeholders have agreed to continue this protocol and education for this practice the change will be offered with new hire orientation and annual competencies.

**Conclusion**

The complications associated with DFU are detrimental to patient's health as they can cause amputation, length of stay in hospital or even death. The purpose of this project was to implement a DFU prevention and treatment protocol and increase nurses' knowledge and compliance with the protocol through training. The nurses who participated in the training demonstrated increased understanding of evidence-based approaches in the prevention and treatment of DFU and compliance with the protocol. This protocol may serve as a guide to the current and future health care professionals in their practice. Although the project may seem successful and has improved outcomes by increasing nurses' knowledge and compliance, there is a need for further research to determine the effect of the protocol on reducing DFU rates.

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**Appendix A**

**Theoretical Framework /Stetler Model**

**Appendix B**

**Permission to Conduct This Project at the Project Site**

*Genesis Concierge Medicine* Inc.

1230 Rosecrans Ave Suite 300, Manhattan Beach, California 90266

August 4, 2020

To Whom It May Concern:

Kim Geiger has permission to complete her Doctoral project at Genesis Concierge Medicine. No clinical affiliation and or clinical agreement is needed.

Thank you,

Dr. Brittani Hicks, DNP, FNP

Contact: 562-661-9104      Email: Genesisconciegemed1@icloud.com

**Appendix** C

**DFU Prevention and Management Protocol**

| DFU Assessment | Check after Completion |
|---|---|
| **Intake Preventive measures**<br>• Take vital signs (T, P, R, BP)<br><br>• Document blood sugars report any abnormal range.<br><br>• Document number of Protein servings.<br><br>• Does patient take a daily Multi-Vitamin?<br><br>• Complete a foot assessment daily.<br><br>**\* If patient has fever and chills (Report to NP ASAP)** | ☐<br>☐<br>☐<br>☐<br>☐<br>☐ |
| **Subjective Assessment -Obtain History**<br>• Have your blood sugars been controlled?<br><br>• Last HgA1C.<br><br>• Last visit with podiatrist?<br><br>• Last visit with dietician?<br><br>• Have you had DFU is the past?<br><br>• How was it treated? how long ago? How long until it healed?<br><br>• Smoker? If so, how much?<br><br>• Do you inspect your feet daily?<br><br>• Do you utilize assistive devices for walking?<br><br>• Do you wear specialty shoes? | ☐<br>☐<br>☐<br>☐<br>☐<br>☐<br>☐<br>☐<br>☐ |
| **Physical Assessment**<br>1. Do you feel numbness or tingling sensations in your feet?<br>2. Pain- (numeric pain scale 1-10)<br>3. Pain type, location, duration, what makes it worse and what it better? | ☐<br>☐<br>☐<br>☐<br>☐<br>☐ |

| | |
|---|---|
| 4. Foot positioning while sleeping.<br><br>5. Do you experience anxiety, jittery, restlessness?<br><br>6. How many hours do you sleep? | ☐ |
| **Objective Findings**<br>1. Remove shoes and socks.<br><br>2. Inspect if there is drainage on the socks. | ☐<br>☐ |
| 3. **Assess feet for open wounds**<br><br>   • Assess between toes, ankles, heels, plantar, and dorsal areas.<br><br>   • Assess for calluses.<br><br>   • Assess for deformity.<br><br>4. **Assess for sensation.**<br>   • Assess pedal and post tibial pulses<br><br>   • Assess for sensation with blunt tool (dull end of pen).<br><br>   • Assess color, warmth, or coolness.<br><br>   • Redness and swelling.<br><br><span style="color:red">**Swab for culture and sensitivity for all *open wounds that are discovered* during assessment. Then notify provider.**</span> | ☐<br><br>☐<br>☐<br><br>☐<br>☐<br>☐<br>☐ |
| **Wound Assessment**<br>If wound is present assess<br>  1. Location<br><br>  2. Measurements<br><br>    A. Length<br><br>    B. Width<br><br>    C. Depth<br><br>    D. Does the wound Tunnel/Undermining?<br><br>  3. Does wound have drainage<br>    A. Color<br>    B. Amount<br>    C. Odor | ☐<br>☐<br>☐<br>☐<br>☐<br>☐<br>☐<br>☐<br><br>☐<br><br>☐<br>☐ |

| | |
|---|---|
| D.  Consistency (thick or thin) | ☐ ☐ ☐ ☐ ☐ ☐ |
| 4.  What is the characteristic of the wound? (peri wound bed) | |
| **Notify NP immediately if patient experiencing any of these symptoms.** | |
| **5.** Assess for S/S of infection | |
|     a.  Warmth around the wound | |
|     b.  Redness | |
|     c.  Odorous drainage | |
|     d.  Possibly red streaks | |
|     e.  Large amount of pus-like drainage | |
|     f.  Fever | |
|     g.  Pain | |
| **Post Assessment Care** <br> • After completing foot assessment do the following: <br> • Cleanse feet with soap and water and dry well. <br> • Provide skin hydration using emollient cream. <br> • Educate the patient in DFU prevention measures to include: <br>   o  Daily foot inspection <br>   o  Cleanse daily with soap and water <br>   o  Dry thoroughly. <br>   o  Apply hydrating creams. <br>   o  Do not walk bare-footed. <br>   o  Wear proper fitting shoes. <br>   o  Cut toenails straight across <br>   o  Notify NP if S/S of open wound. <br>   o  Glucose control <br>   o  Annual podiatrist appointment <br>   o  Consult with dietician for maintenance of ADA diet. | ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ |

| | |
|---|---|
| Types of off-loading boots and shoes<br><br><br><br>**Does patient have off-loading boot or shoe (notify NP if patient does not have and would benefit in having).**<br><br> | ☐<br><br>☐ |
| **DFU Management**<br><br>• Obtain pictures of the wound.<br><br>• Wound Measurements.<br><br>• Refer to the Wound Care Specialist Nurse.<br><br>• Treat according to protocol. | ☐<br>☐<br>☐<br>☐ |

**Wound Management Protocol**
**Dry wounds with eschar cap on the heel:**

- Keep dry.

- Paint with Betadine/Barrier Film.

- Wrap with gauze dressing.

- Float heels while in bed.

- Educate patient in self-wound care.

- Refer to Wound Specialist Nurse.

- DO NOT REMOVE ESCHAR (black part of wound).

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**Wounds with Small amount of drainage (superficial/mild) DFU:**



- Clean the wound with wound cleanser and apply gauze dressing after every 3 days.

☐

- Dress the wound with antibacterial sorbact mesh and gauze dressing.

☐

☐

- Offload pressure points correctly.

- Apply moisturizing cream.

- Notify the Nurse Practitioner for any open wounds noted in wound assessment.
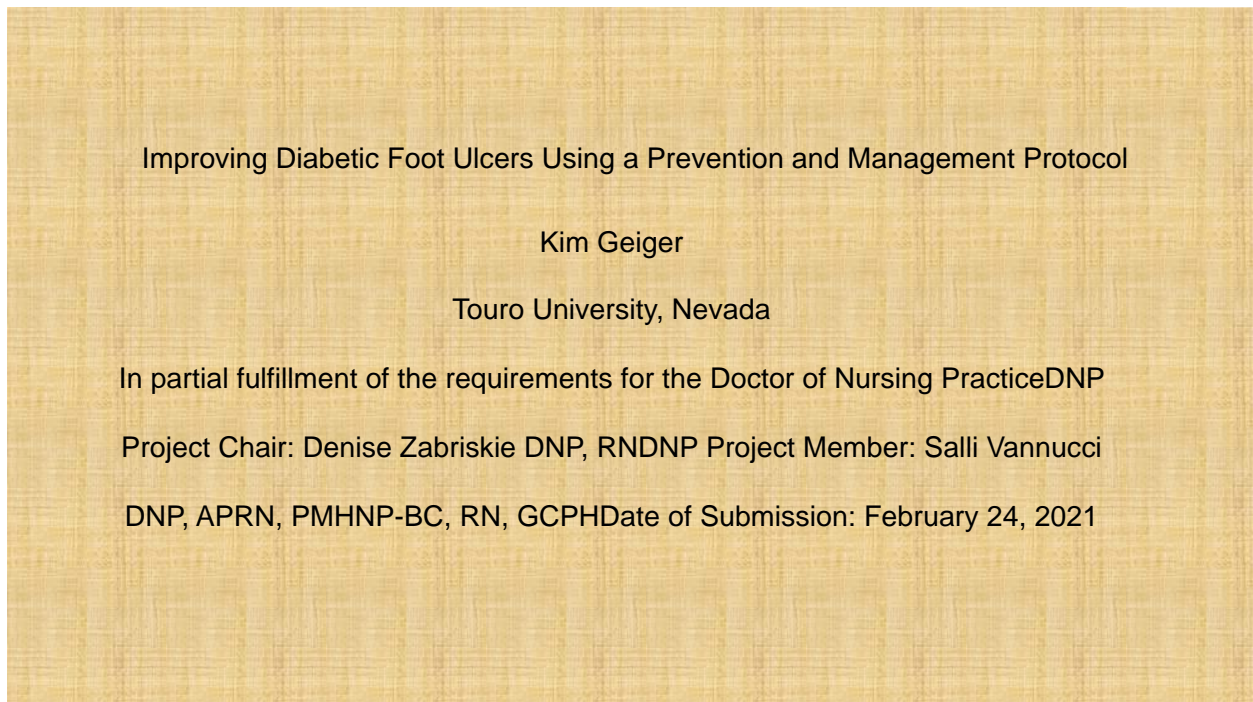
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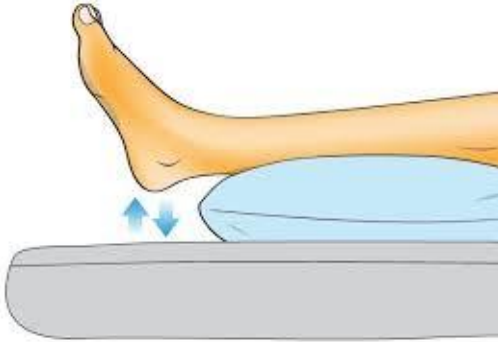


Example of Offloading

**Moderate Amount of Drainage and Wounds with large or copious amount of drainage.**



- Cleanse the wound with wound cleanser.

- Obtain wound culture, if not done.

- Treat patient with a silver alginate dressing

- Notify the provider if abnormal lab results.

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| This DFU Management Protocol ends when the Provider orders specific wound care treatment. | |
|---|---|

**Appendix D**

**A PowerPoint Education Presentation**



Improving Diabetic Foot Ulcers Using a Prevention and Management Protocol

Kim Geiger

Touro University, Nevada

In partial fulfillment of the requirements for the Doctor of Nursing PracticeDNP

Project Chair: Denise Zabriskie DNP, RNDNP Project Member: Salli Vannucci

DNP, APRN, PMHNP-BC, RN, GCPHDate of Submission: February 24, 2021

## What is diabetic foot ulcer (DFU) prevention and management protocol?

▶ A guide for health care providers in treatment DFU patients.

▶ The protocol contains procedures that are employed for prevention and management of DFU.

## Overview

▶ The number of people living with diabetes s is likely to increase by 2030 affecting 439 million .

▶ The normal blood sugar in a person is 70 – 130 mg/dL (7.8 mmol/L) .

▶ DFU is one of the most common complications of DM.

▶ Preventing DFUs entails early identification of high-risk individuals and the implementation of preventive measures.

(Shaw, Sicree, Zimmet, 2010).

## What is a DFU?

➤ An open sore or wound below the ankle, either on the foot or plantar surface of toes, which develops as a result of DM (Harding et al., 2019).



## Characteristic of Diabetic Foot Ulcers

Characteristics
➤ Shape-rounded or oblong
➤ Wound bed –pink, red, or necrotic
➤ Edges-well defined, regular, smooth
➤ Periwound- callus
➤ Exudate-small-moderate, serous
➤ Pain-neuropathic, or insensate
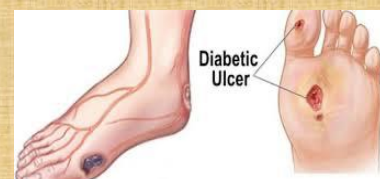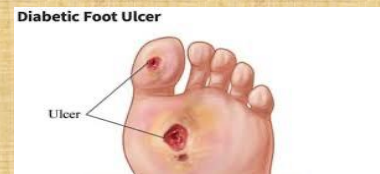
## Disease Process

➤ Patient diagnosed with DM.

➤ The disease is poorly managed.

➤ Patient is exposed to risk factors such as treading on something, wearing tight shoes, cuts, blisters and bruises.

➤ A wound develops.

➤ There is reduce blood flow to the feet due to diabetes.

➤ There is impaired ability  of the wound to heal properly.

➤ A foot ulcer can develop.

(Michigan Medicine University of Michigan, n.d.).

## Current rate of hospitalization

➤ Diabetic foot infections are the leading cause of hospitalization.

➤ After years of decline the amputation rates were reported to upsurge by 50% in the United States population between 32009 and 2015 (Thewjitcharoen et al 2020).

.

## Usage of the DFU Protocol

- Poor management and prevention strategies of DFU is the greatest contributor of the growing DFU complications.

- Home health nurses lack the standardized protocol to guide them.

- Providing the home health nurses with standard protocol for prevention and management of DFU will help improve quality of care for the DFU patients.

- (Jeffcoate, et al., 2018)

## Preventive Measures



- Document the labs and blood sugars
- Complete the foot assessment on the heel, between the toes, on the Achilles, and for deformities.
- Clean and dry the wound well with soap and water
- Educate the patient on DFU prevention measures such as inspecting the foot daily, cleaning, drying thoroughly, applying hydrating creams, Wearing the proper fitting shoes, cutting toe nails straight across and visiting the podiatrist annually.

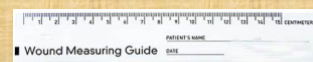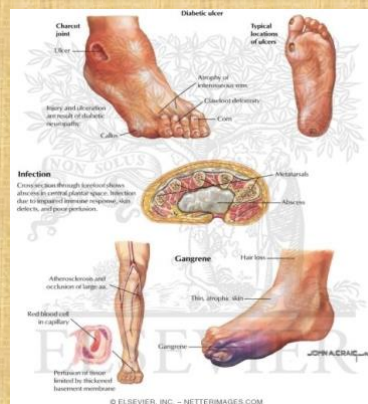(Iraj, Khorvash, Ebneshahidi & Askari, 2013).

## NURSING ASSESSMENT

➢ Obtain Medical History
➢ Observe general appearance
➢ Remove socks
➢ Look between toes
➢ Skin Integrity
➢ Temperature-warm/cold
➢ Pulses/Capillary refill
➢ Sensation
➢ Mobility
➢ Pain

## Diabetic Foot Ulcer Characteristics that should be documented

▶ Size
▶ Location
▶ Wound-bed
▶ Depth

## Supplies needed for the protocol

➢ Antiseptic solutions, such as iodoform, medihoney, xeroform, Gauze.

➢ Kerlix wraps and skin barrier protectant.

➢ Foams or alginates wound dresser.

➢ Iodoform, Hydrogel to keep wound bed hydrated (Best practice guidelines: Wound Management in Diabetic Foot Ulcers, 2013).

➢ Silver.

(Wound Source, 2020)

## Wound Care Products

▶ Wound Cleanser

# Wound Care Products - continued

▶ Painting with povidone-iodine helps to keep the eschar dry and bioburden controlled.



# Wound Care Products - continued

▶ Types of gauze dressings.

# Wound Care Products - Continued

▶ Skin Protectant



# Wound Care Products - continued

▶ Alginates used for wounds with heavy exudate.

## Uninfected dry foot wound



From Lancet 2003; 361: 1545–51 paper on diabetic foot ulcer

## Wounds with Small amount of drainage (superficial/mild) DFU:

## Management of DFU

▶ Obtain a culture of the wound

▶ Refer to the Wound Care Specialist Nurse

▶ Treat according to protocol

▶ **For dry wounds with eschar cap on the heel**

  ❑ Keep dry

  ❑ Paint with Betadine/Barrier Film

  ❑ Float heels while in bed

  ❑ Educate patient in self-wound care

  ❑ Refer to Wound Specialist Nurse

  ❑ Never remove eschar from heel



(IWGDF Guidelines on the prevention and management of diabetic foot disease, 2019).

# Heavy Exudate Wound



- Clean the wound with wound cleanser.
- Treat patient with a silver alginate dressing
- Notify the care NP of abnormal lab results.
- Follow recommended treatment plan directed by the NP.

## Prevention and management of DFU: Step 1: Assess on history of DFU

▶ Assess whether the patient has any attempted home /self-treatment of the DFU.

▶ Inquire as to any symptoms of DFU.

▶ Ask the patient whether they have received any treatment before.

## Step 2 Visual Inspection Of DFU

▶ Drainage on the socks

▶ Redness and swelling

▶ Discoloration around the wound.

▶ Thickened skin around the ulcer

▶ Fever and chills

(IWGDF Guidelines on the prevention and management of diabetic foot disease, 2019).

## Foot Assessment

▶ Comprehensive foot examination is important to determine the risk for developing DFU.

▶ One should determine

  ▶ size,

  ▶ Depth

  ▶ Color

  ▶ Position of the a DFU

  ▶ **Exposed Bone-** are the most important findings for the Home Health Nurse to evaluate due to the probability of Osteomyelitis.

  All these assessments are important to determine the risk of infection , and signs and symptoms of DFU.



## Steps in how to preforming a wound culture

▶ Cleanse wound with normal saline.

▶ Pat dry wound bed with sterile gauze.

▶ Culture the healthiest looking tissue, excluding exudate, purulent, devitalized tissue.

▶ Spin the end of the sterile applicator over a 1cm x 1cm area for at least 5 seconds.

▶ Apply sufficient pressure to swab, causing tissue fluid to be expressed.



Shallow Wound Culture    Deep Wound Culture

## Management of wounds with small amount of drainage

▶ Clean the wound and change dressing after every 3 days.

▶ Dress the wound with iodine to control the microbes.

▶ Administer systematic antibiotics.

▶ Offload pressure correctly.

▶ Skin care for fast healing using moisturizing cream and daily cleaning.

▶ Obtain wound culture.

▶ Notify the Nurse Practitioner for all wounds discovered during assessment.

(IWGDF Guidelines on the prevention and management of diabetic foot disease, 2019).

## Management of wounds with large amounts of exudate

▶ Treat wound according to the protocol or in accordance with provider's treatment orders.

▶ Obtain wound culture if not already done.

▶ Administer a broad- spectrum of antibiotics as directed by provider.

▶ Notify the care provider of all abnormal lab results.

▶ The wound management protocol ends when wound treatment orders are obtained from provider.

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## Appendix E

## Pre- and Post-Educational Test

1) **Foot Assessment is an essential step in Diabetic Foot Ulcer prevention. What is most important for the home health nurse to assess during a diabetic foot exam? (Select all that apply)**
   A. Remove Shoes and Socks
   B. Assess the whole foot
   C. Musculoskeletal deformities
   D. Assess between the toes
   E. Exposed Bone
   F. Exudate
   G. Pain
   H. All the above

   *Answer:* H                   Comprehension - Assessment

   *Rationale:* To identify any potential risk, sign and symptoms of infection (IWGDF Guidelines on the prevention and management of diabetic foot disease, 2019).

2) **If a diabetic patient has an uninfected dry diabetic foot ulcer, what product should be used to keep the wound hydrated ?(Choose best possible answer)**

    A. Iodoform
    B. Hydrogel
    C. Alginate Rope

*Answer: B*                Comprehension – Wound Care product protocol

*Rationale*: To maintain moisture balance promote a healthy new tissue growth. (Best practice guidelines: Wound Management in Diabetic Foot Ulcers, 2013).

3) **Dressing changes should be cleaned every _____ days. (Choose best possible answer)**

    A. 5 days
    B. 7 days
    C. 3 days or as ordered

*Answer:* **C**     Application- Wound Care Protocol

*Rationale:* Too reduce risk of infection, maceration and to promote healthy wound healing (Best-Practice guidelines: Wound Management in Diabetic Foot Ulcers, 2013).

4) **A patient with an infected diabetic foot ulcer should be treated with a Silver product with an antimicrobial component . (Choose best possible answer)**

T/F

*Answer:* **True**   Knowledge-Continuum of diabetic foot care

*Rationale:* To help reduce infection and help absorb fluid, exudate and bacterial. (Best-Practice guidelines: Wound Management in Diabetic Foot Ulcers, 2013).

5) **Why is Off-loading important in patients with diabetic foot ulcers? (Choose best possible answer)**

    A. Too rest the patient foot.
    B. Too make sure the dressing does not come off.
    C. To help relieve pressure from the planter tissue.

*Answer:* **C**                    Knowledge -  Assessment

*Rationale:* Important to give rest to the wound area to aid in healing. (IWGDF Guidelines on the prevention and management of diabetic foot disease, 2019).

6) **What diabetic foot ulcer characteristics should be documented? (Choose best possible answer)**

    A. Size
    B. Location
    C. Wound-bed
    D. Depth
    E. All the above

*Answer:* **E**       Analysis-Continuum of care in diabetic foot ulcers

*Rationale:* To monitor healing process and to make sure treatment plan is appropriate for wound and consistency of care among healthcare providers. (Best-practice guidelines: Wound Management in Diabetic Foot Ulcers, 2013)

7) **Is determining the underlying cause of the wound is a priority step in wound care? (Choose best possible answer)**

    A. YES
    B.  NO
    C. Neither

*Answer:* A                 Assessment -   Knowledge - Continuum of diabetic foot care

*Rationale:* Too identify risk factors contributing to diabetic foot ulcers (IWGDF Guidelines on the prevention and management of diabetic foot disease, 2019).

8) **Which are the signs and symptoms of infection in a diabetic foot ulcer? (Choose best possible answer)**

    A. Pain, Fever
    B. Odor
    C. Redness
    D. Warm to touch
    E. Pus and/or greenish drainage

F. All the above

*Answer:* F        Analysis-Assessment-Knowledge – Diabetic foot Care

*Rationale:* Early detection of infection will help reduce risk of complication, and risk for amputation (IWGDF Guidelines on the prevention and management of diabetic foot disease, 2019).

9) **All are wound dressing materials that help prevent microbial infection except. (Choose best possible answer)**

A. Silver dressings
B. Island  dressings
C. Foam dressings
D. Fillers
E. Hydrogel dressing

*Answer:* E                Knowledge - Diabetic Foot Care

*Rationale:* To provide understanding and knowledge of appropriate dressing material to promote quality wound healing  (Best practice guidelines: Wound Management in Diabetic Foot Ulcers, 2013).

10) **What is the normal blood sugar range in a person with diabetes? (Choose best possible answer)**

A. 130 – 160
B. 60  – 176
C. 50 – 70
D. 70 - 130

*Answer:* D                Knowledge – Diabetic Foot Care

*Rationale:* To identify understanding and understanding of hypo and hyperglycemia (https://www.ncbi.nlm.nih.gov).

**Appendix F**

**Chart Audit Tool based on Electronic Health Record**

Participant's number: _____

Date of the home health visit: _____

Date of admission to home health: _____

Was the DFU present on admission Y/N _____

Was the DFU prevention and management protocol implemented Y/N

Did the home health nurse identified the signs and symptoms of DFU or its complications:

Y/N_____

**Appendix G:**

**Content Validity Index Table**

| Item | Expert 1 | Expert 2 | Expert 3 | Mean |
|------|----------|----------|----------|------|
| 1 | 4 | 4 | 4 | 1.0 |
| 2 | 4 | 4 | 4 | 1.0 |
| 3 | 4 | 4 | 4 | 1.0 |
| 4 | 4 | 4 | 4 | 1.0 |
| 5 | 4 | 4 | 4 | 1.0 |
| 6 | 4 | 4 | 4 | 1.0 |
| 7 | 4 | 4 | 1 | 1.0 |
| 8 | 4 | 4 | 4 | 1.0 |
| 9 | 4 | 4 | 4 | 1.0 |
| 10 | 4 | 4 | 2 | 1.0 |
| Total | 1.0 | 1.0 | 1.0 | 1.0 |

The procedure consists having experts rate the items on a four point's scale of relevance. For each item the item (CVI) (1-CVI) is computed as the number of experts giving rating of 3 or 4 divided by the number of experts-the proportion in agreement about the relevance. The formula for calculating CVI is $CVR=([(e-(n/2)) / (n/2)]$. E is the total number of experts and e is the number who rated the object as essential. The mean total was 1.00 which indicates that all the questions were relevant.