Enhancing Advanced Practice Providers' Knowledge of Wound Care Protocol Through a Computer-Based Educational Intervention: A Quality Improvement Initiative Using Kotter's Change Model

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Table of Contents

Abstract

Wound management is increasingly becoming complex due to rising incidences of chronic non-healing wounds. Notably, the challenge has been exacerbated by inconsistent adherence to the protocol adopted by advanced practice providers (APPs) at the Woundtech facility, leading to disparities in patient outcomes. The computer-based educational intervention model provided a scalable and standardized solution to enhance protocol awareness. Therefore, this quality improvement initiative aimed to develop and assess a computer-based educational module to increase the knowledge of APPs in wound care at Woundtech by 25% within 6 months, ultimately addressing inconsistent care outcomes. The project employed a quasi-experimental study, including pre- and posttest design, conducted at Woundtech, a wound care organization with a robust healthcare workforce and telehealth capabilities. Participants included 11 APPs with at least 6 months of experience, regular computer users, and current patients in need of wound care. Kotter's 8-step change model guided the methodology and data collection, featuring pre- and post-intervention assessments. A paired *t*-test analysis of knowledge score changes and descriptive statistics analyses were conducted to explore the trends. Findings show a 69.7% increase in APPs' knowledge on wound care management and treatment protocol, surpassing the targeted 25% increase in mean knowledge scores. Participants were assessed using an 11-item survey. Scores rose from a pretest average of 6.27 to a posttest score of 10.64 during the 6 months of the intervention, achieving statistical significance at $p < 0.001$, where the *p*-value at $t = 10.63$. Some of the study's implications include reducing practice variability, improving wound care outcomes, and encouraging other healthcare organizations to adopt digital learning platforms to enhance wound care knowledge. Notable project conclusions were that the intervention is an opportunity to bridge the knowledge gaps in wound care management and

treatment among healthcare providers, such as APPs. Sustaining change requires integrating it into practice, securing fiscal support, and aligning policy. Finally, the practice change highlights the role of technology in practice, organizational improvement, and education, providing standardized wound care training.

Keywords: Wound care, Woundtech, quality improvement, advanced practice providers, computer-based education, wound care management, e-learning, chronic wounds, nursing, practice change, pre- and posttest assessments

Introduction

Problem Identification and Background

Effective wound care is fundamental in healthcare settings to prevent complications, such as infections, delayed healing, and increased healthcare costs, eventually improving patient outcomes. Therefore, wound management remains a critical and complex issue, primarily due to the increasing prevalence rates of chronic non-healing wounds. A standardized wound care protocol provides evidence-based guidelines for healthcare professionals, ensuring consistency in wound assessment, treatment, and documentation. However, studies have identified persistent gaps in staff knowledge, adherence to wound management and treatment protocol, inadequate training, high staff turnover, and limited access to ongoing education (Aune & Struksnes, 2019; Cross & Harding, 2022; Cox, 2017; Ma et al., 2023; Lee et al., 2021). Previous research has consistently revealed alarming discrepancies in the practices of advanced practice providers (APPs), with disparities in protocol compliance across multiple healthcare organizations (Rotenstein et al., 2023). Specifically, Woundtech has observed significant disparities in care that APPs provide, resulting in inequitable patient outcomes. Therefore, the quality improvement (QI) initiative aimed to create a computer-based educational module to enhance training and achieve a 25% increase in APPs' awareness of wound care guidelines within 6 months. Woundtech can implement knowledge deficits, minimize practice deviations, and enhance patient care, specifically promoting standardized computer-based education. The initiative integrates Kotter's 8-step change model to perform pre- and post-knowledge assessments to measure the degree of change and resulting improvements to APPs' wound management knowledge.

Problem Statement

Wound management is a critical component of healthcare, yet the rising incidences of chronic non-healing wounds pose significant challenges, potentially increasing the demand for effective and standardized care. However, at Woundtech, the APPs present inconsistent practices, meaning the organization fails to provide consistent care. APPs at Woundtech exhibit alarming discrepancies in adherence to wound care protocol, leading to inequalities in patient care outcomes. The variations stem from a lack of uniform educational methods to manage wounds and challenges in complying with protocols (Yan et al., 2022; Olsson et al., 2019). Knowledge deficits and inadequate training are outright issues among Woundtech's APPs. Studies emphasize that such inconsistencies in APPs' knowledge deficits and training contribute to prolonged healing times, higher infection rates, and elevated healthcare costs, ultimately compromising the quality of care and patient safety (Callende et al., 2021; Ding et al., 2023; Miles et al., 2023; Tegegane et al., 2022). Conventional training approaches, such as in-person workshops, are costly, time-intensive, and difficult to standardize across diverse teams. Conclusively, the lack of a targeted, accessible educational strategy at Woundtech undermines APPs' ability to apply the wound care protocol, consistently worsening care disparities.

Significance of the Problem

The problem is crucial because it clearly defines the issue, justifies the study's purpose, and highlights its urgency. For example, the problem of inconsistent APP practices highlights knowledge and inconsistent protocol adherence among Woundtech's practitioners, linking them to poor patient care outcomes, increased costs, and compromised safety. Importantly, by identifying the gap in effective and scalable training, the study underscored the need for a computer-based solution. Besides a decline in the quality of life, Nussbaum et al. (2018) noted

that chronic wounds of all types are mainly associated with a substantial financial impact on the healthcare system. Therefore, with Medicare spending on all types of wounds ranging exorbitantly from $28.1 to $96.8 billion annually and individual costs estimated at $3,415 to $11,781 per wound, creating awareness among healthcare providers about wound care management is imperative for reducing costs (Nussbaum et al., 2018). Focusing on a computer-based solution drives research and guides methodology while emphasizing the potential to enhance care disparities and improve patient outcomes at Woundtech.

Scope of the Problem

Although estimates of chronic wound incidences vary significantly, current evidence suggests that the different types of injuries from the wounds impact a huge portion of the patient population, especially older people. Notably, Martinengo et al. (2019) explained that the prevalence rate of chronic wounds ranges from 1.51 to 2.21 per 1000 people in the United States, Europe, and Canada. Similarly, Nussbaum et al. (2018) noted that the prevalence rates range between 1% and 2% in developed countries. Contextually, the American Academy of Home Care Medicine (AAHCM, 2024) emphasized that chronic wounds present a significant burden to patients, caregivers, and the entire healthcare system. For example, approximately 6.5 million people in the United States are affected by chronic wounds each year, translating to 1 in 38 adults (AAHCM, 2024). Furthermore, it is estimated that at least 3 million people worldwide experience venous leg ulcers, a staggering statistic mainly driven by rising incidences of risk factors, such as diabetes. With people living with diabetes estimated at 463 million globally having foot ulcers at some stage in their lives, the situation could exacerbate if drastic actions are not undertaken. In essence, creating awareness by educating healthcare providers on wound care is a critical strategy for addressing chronic wounds.

The demographic breakdown of prevalence rates of chronic wounds reveals a significant concern. For example, Sen (2019) observed that approximately 3% of the U.S. population over 65 years of age experience an open wound. With more elderly patients at greater risk of developing chronic wounds, targeted interventions should be explored. The increasing prevalence rates of chronic wounds have contributed to a substantial rise in healthcare expenditures. For example, AAHCM (2024) noted that the annual cost estimates of managing wounds range from $28.1 billion to $96.8 billion. In perspective, the devastating impacts of chronic wounds are particularly observed in the AAHCM (2024) assessment that "every 20 seconds of every day, someone, somewhere, loses a leg because of diabetes." The impact on older adults is devastatingly huge, such that 14.5% of the 8.2 million beneficiaries of Medicare experience at least one type of wound with or without infection (Nussbaum et al., 2018). Prevalence rates are disproportionately high among individuals aged between 70 and 80 years, which mainly emanate from infections from surgical, surgical site, and diabetic (Martinengo et al., 2019). As a result, patients treated for chronic wounds are more likely to be older adults, female, and non-ambulatory or paralyzed.

While prevalence rates of chronic wounds are reportedly elevated among older adults, all segments of the population are impacted. For instance, Sen (2019) notes that at least 2.5 million individuals of all ages develop pressure ulcers yearly. Furthermore, it is estimated that up to 10% of the diabetic population is diagnosed with foot ulcers, representing a 6.3% global prevalence rate (Sen, 2019). Although chronic wounds negatively affect a significant portion of the population, healthcare providers may lack adequate knowledge to implement initiatives, such as evidence-based guidelines to address chronic wound treatment. Kapp et al. (2018) noted that the issue of chronic wounds is significant, particularly due to the negative impact it has on physical,

social functioning, and emotional well-being. Conclusively, addressing this challenge requires a comprehensive wound care educational intervention to increase the knowledge of healthcare providers concerning wound care.

Impact of Not Addressing the Problem

Failing to address the issue of chronic wounds can lead to several consequences across the economic, social, and healthcare spectrum; therefore, exacerbating an already public health challenge. The clinical consequences include serious complications, such as infections like cellulitis and osteomyelitis, which can develop rapidly. Untreated cases can evolve into sepsis, a condition that has a high mortality rate, affecting three in 1000 people yearly. Next, amputations are a strong consideration when the condition worsens, with approximately 30% of untreated cases, especially for diabetic foot ulcers. Interestingly, at least 70% of the lower-limb amputations are performed on people aged over 65 years. Finally, delayed healing tends to prolong pain, impair mobility, and reduce social function, eventually compromising the ability of the patient to perform daily activities and increasing dependency.

The economic consequences are equally significant. Chronic wounds add a substantial financial burden to patients, families, and the healthcare system. For example, AAHCM (2024) estimated the annual healthcare costs for wound care treatment and management to be between $28.1 billion and $96.1 billion. Furthermore, untreated wounds drive higher costs through prolonged hospital stays, emergency interventions, and expensive treatments such as surgery and grafting. Patients and families will also contend with productivity losses as they miss work, straining families and the economy. Besides the economic consequences of not addressing chronic wounds, social impacts are equally monumental. For instance, unaddressed wounds diminish the quality of life, causing persistent pain, limited mobility, and social isolation

(AAHCM, 2024). Patients with chronic wounds are likely to experience depression, reduced self-esteem, and anxiety, further straining relationships and mental health. Conclusively, rising prevalence rates, fueled by aging populations, possibly amplify costs over time.

Without implementing an intervention to address chronic wounds, the entire healthcare system faces overwhelming pressure. Besides accounting for 3% of total healthcare expenditure in developed countries such as the United States and the United Kingdom, the problem also adversely affects individual hospitals and healthcare organizations (Jarbrink et al., 2017). For instance, hospitals experience higher admission rates, longer stays, and increased demand for specialized wound care, thereby further stretching already limited resources. Additionally, inconsistent protocol adherence from healthcare providers, as observed at Woundtech, perpetuates poor outcomes, hence undermining care quality. The growing prevalence signifies the worsening of the crisis, especially if the current knowledge gaps and training deficits are unaddressed. Finally, failing to tackle chronic wounds risks lives, escalates costs, and erodes well-being, underscoring the need for urgent, standardized, and effective interventions, such as Woundtech's computer-based educational module.

Review of the Literature

Search Strategy

Inclusion Criteria

Articles were included if they met certain conditions. First, the articles should be published within the last 8 years to ensure the findings are relevant and updated. Second, selected articles are published in English to eliminate possible translation issues, such as misinterpretations. The articles were also available in full text. Third, the articles were expectedly peer-reviewed studies, including randomized controlled trials, quasi-experimental

studies, observational studies, and systematic reviews. Lastly, it was conditional that the focus of the selected studies is relevant to the current study. For example, the articles must focus on healthcare providers, wound care protocols, healthcare providers' knowledge on wound care management and treatment, and computer-based or web-based educational interventions in healthcare settings.

Exclusion Criteria

Literature was excluded if it did not meet the outlined criteria. Articles with only an abstract or not available in full text were eliminated. Next, articles published outside the 8-year timeline were also excluded. Editorials, opinion pieces, or non-scholarly sources were excluded altogether. Articles outside of clinical or healthcare contexts, as well as studies not addressing wound care or educational interventions, were also excluded. Conclusively, although there was an overlap among the three databases regarding the articles returned from the search, the inclusion of all three databases helped to ensure comprehensive coverage of the topic.

PRISMA

The literature search was conducted based on the study's PICO question and purpose. Therefore, relevant keywords, such as wound care, chronic wounds, wound management, computer education in wound care, and pressure ulcers, were input to obtain peer-reviewed articles and publications, which constituted the inclusion criteria. The keywords and phrases were used in the Boolean search string, with the characters "AND" and "OR" to connect them. Limiters included articles published within the last 8 years, in English, and peer-reviewed. Four databases were searched, including PubMed, Google Scholar, CINAHL, and ProQuest. The search generated 522 articles. When the inclusion and exclusion criteria were applied and repeat articles removed, 75 (n = 75) articles were identified to develop a comprehensive literature

review—specifically, PubMed (*n* = 38), Google Scholar (*n* = 18), CINAHL (*n* = 12), and ProQuest (*n* = 7).

Synthesis of the Evidence

Home Healthcare

Previous research has explored the role of home healthcare intervention in addressing chronic wounds. The high prevalence rates mean that chronic non-healing wounds can lead to adverse outcomes for patients and the entire healthcare system (Nussbaum et al., 2018). Aune and Struksnes (2019) concurred with Nussbaum et al. (2018) about the impact of chronic wounds but broadened it to include impaired physical functioning, poor mental health, and social functioning. However, Padula and Delarmente (2019) emphasized that the financial impact of chronic wounds is more pronounced due to the lasting impacts on the healthcare system and rising healthcare costs. As healthcare systems evolve, coupled with increasing healthcare costs, healthcare interventions to address chronic wounds must also capture a patient's holistic needs, including emotional, physical, and mental aspects.

With rising healthcare costs, it is essential to explore more cost-effective approaches to managing chronic wounds. One notable approach is to explore home care for chronic wounds. Home healthcare offers convenience and comfort, potentially reducing stress and the need for frequent hospital visits. Besides comfort and convenience, home healthcare providers can tailor treatment plans to specific patient needs by factoring in home environment and lifestyle when designing patient plans. The rising healthcare costs make home wound care a wise choice because it is cost-effective rather than prolonged hospital stays, especially when long-term wound care and management are required. Kapp et al. (2018) viewed home care for wound treatment and management as preferable because it fosters a sense of independence and control

over health. Similarly, Huang et al. (2023) noted that home-based interventions for patients with chronic wounds may effectively improve patient outcomes while equally changing behaviors. Better patient outcomes reflect a more collaborative effort within the family, as they consistently support the patient in adhering to the medication regimen. Overall, literature indicates that home care for patients with chronic conditions not only promotes healing but also enhances overall well-being by integrating medical care into daily lives.

Although home healthcare nurses have a positive impact on chronic wounds, barriers to effective wound management exist in the community setting. Aune and Struksnes (2019) and Moran and Byrne (2018) noted that barriers to wound management within the community setting included failure to apply evidence-based practice in home health facilities and lack of knowledge and confidence in wound care. Therefore, healthcare providers can implement necessary strategies to treat patients, rather than resulting in poor outcomes and complications. Mervis and Philips (2019a) noted that a significant proportion of complications from wound care result from inadequate provider knowledge. Nonetheless, Moran and Byrne (2018) emphasized that although a lack of confidence in wound care and failure to apply EBP in home facilities are challenges undermining wound treatment and management, a lack of wound management education and wound care experience are the most significant barriers. Without the requisite wound care experience and management education, patients and caregivers are often limited in their ability to care for chronic wounds properly. Patients may be treated incorrectly, leading to delayed healing and increased risk of infections, highlighting the need for improved training and support in home healthcare settings.

Types of Digital Education

Previous research has also explored the various types of education to adopt when teaching nurses on wound care protocols, treatment, and management. Tudor Car et al. (2018) note that digital education offers a wide variety of interventions, including offline and computer-based digital education, as well as local area network-based (LAN) education. An offline computer-based module refers to using applications that do not require an internet connection to deliver learning activities, thereby significantly reducing the cost of digital education. However, online-based systems utilize web-based education, implying that they depend on an active network connection to deliver content, such as tutorials, discussions, and live conferencing. Martinengo et al. (2019) agreed with Tudor Car et al. (2018) regarding the benefits of web-based learning modules, such as providing lessons with standardized content, which health care professionals globally accept. Although offline-based learning is cheaper, it is limited in engagement between the learner and the tutor. However, Olsson et al. (2019) recommended the adoption of digital-based learning, irrespective of the type, due to the immense economic and psychological burden that chronic wounds pose. The prevalence rates of chronic wounds are rapidly rising, underscoring the need for a holistic solution.

Besides offline and computer-based online learning, the other types of digital learning include massive open online courses (MOOCs), virtual patient simulations, and mobile learning, also known as m-learning. Martinengo et al. (2019) explained that MOOCs are provided online to a large number of participants, whereas virtual patient simulations refer to a first-person, active learning experience. Finally, m-learning is a digital educational intervention that uses mobile devices to deliver content. The availability of multiple digital platforms for nurse education enables flexibility, accessibility, and up-to-date learning. Advanced practice providers

can access training anytime, anywhere, hence accommodating different learning styles and schedules. Martinengo et al. (2019) emphasized that MOOCs, m-learning, offline, and online learning help standardize knowledge, promote evidence-based practices, and, more importantly, keep nurses informed about the latest advances in wound care. Ultimately, the digital avenues lead to improved patient outcomes, faster healing, and, more importantly, reduced healthcare costs.

Effectiveness of Computer-Based Education

Recent literature demonstrates strong evidence supporting the effectiveness of computer-based education in enhancing APPs' knowledge of wound care management. First, several studies emphasized that participants' knowledge of wound care management increased during the intervention (Lee et al., 2021; Ma et al., 2023). Improved knowledge encompasses the development of interpersonal relationships for efficient decision-making, understanding the environmental context, and, more importantly, having integrated thinking when evaluating and monitoring wounds to improve patient outcomes. Lee et al. (2021) and Saghaleini et al. (2018) noted that a web-based educational program increased participants' knowledge, attitude, and clinical management judgment ability. Although Bambi et al. (2022) and Finlayson et al. (2024) concurred with Ma et al. (2023) and Lee et al. (2021) about increased knowledge from the computer-based educational program, the factors contributing to the effectiveness of this model were explored. Notable factors determining the effectiveness of computer-based wound care education programs included the healthcare worker's ability to access educational materials at the point of care and computer-based clinical decision support systems (Kim et al., 2020). In essence, the computer-based educational program enhanced practitioners' knowledge of wound management.

Research identified the need to tailor educational content to individual needs and practice settings of APPs. Finlayson et al. (2024) cited terminologies frequently used in wound care management settings and case studies as critical in enhancing knowledge acquisition and general learning. Using relevant terminology from wound care management and incorporating case studies can significantly improve the overall learning outcomes of APPs, ultimately leading to better patient care outcomes. Besides customized educational content, current research emphasizes the importance of assessing the impact of the intervention by measuring the knowledge of healthcare providers. Measuring knowledge improvement is essential because it establishes whether the educational intervention is effective and if the intervention has achieved its goals. For healthcare professionals like APPs, improved knowledge directly translates to better clinical decision-making and patient care outcomes, which remain key pillars and indicators of successful educational programs. Ma et al. (2023) cited pre- and post-intervention assessment outcomes as the most convincing evidence of knowledge gain, measured at different points after the intervention. Conclusively, Woundtech must adopt similar procedures for the assessment as a strategy to achieve the targeted 25% improvement in APPs' awareness of the company’s wound care protocol.

Integrating Web-based Education and Practice

Current research has equally explored the possibility of integrating web-based education and practice. Luo et al. (2024) demonstrated the potential of linking computer-based education with practical practice, specifically in the context of home care for diabetic foot ulcers. Notably, the strategy offers multiple benefits, providing providers with a wealth of knowledge, enhancing patient treatment effectiveness, and reducing healthcare expenses. In contrast, Finlayson et al. (2024) observed a shortage of effective and inclusive wound care education for primary care

personnel, encompassing a wide range of wound types, with a particular emphasis on preventive care. Literature has also demonstrated that educational interventions can enhance wound care knowledge and skills within 6 months, aligning primarily with Woundtech's goal of increasing wound care awareness by 25%. Taidouch et al. (2021) emphasized that APPs can manage intricate wounds if adequately trained or supported. Management can also improve if the existing knowledge inadequacies are filled. More importantly, Ma et al. (2023), Ntshwarang et al. (2021), and Lee et al. (2021) noted that the lack of standard assessment tools to assess the effectiveness of educational awareness can be averted by considering technology access to promote fair use of computer-based educational programs. Conclusively, diverse experiences in wound care specialties suggest that educational programs should incorporate the efforts made by various specializations to provide holistic and practical training.

Pressure Ulcer Presentation Strategies

Research has also explored wound prevention strategies, often conceptualized as pressure ulcer management approaches. Awoke et al. (2022) recommended upgrading the educational level of the nurses by ensuring there are continuous professional development opportunities. Notably, advanced knowledge can significantly improve the preventive practice of pressure ulcer injury, thereby enhancing the skills gained during vocational training. Edsberg et al. (2022) agreed with Awoke et al. (2022) about the benefits of improved knowledge on wound care treatment and overall management. However, Edsberg et al. (2022) viewed potential for improvement by implementing basic prevention strategies, such as repositioning, heel elevation, and nutritional support. The strategy reduces the risk of complications by addressing key aspects, including mobility limitations, skin status, perfusion, and nutrition. Cox et al. (2017) emphasized that prevention strategies have been developed to specifically mitigate modifiable risk factors,

such as age or life-saving measures like mechanical ventilation. Minimizing the impact of risk factors prevents possible complications, which contribute to significant mortality and morbidity outcomes among patients with non-healing wounds. Kandula (2025) concurred with Cox et al. (2017) about the impact of education in enhancing nurses' knowledge and practices, especially on wound care protocols. Nurses become more equipped to prevent and manage wounds more effectively.

Addressing the risk factors of pressure ulcers requires an understanding of patients who are at risk of developing these conditions. According to Lima et al. (2017), patients in critical care settings are at an increased risk of developing pressure ulcers. Notable risks include hypotension, prolonged admission in a critical care unit, diabetes mellitus, cardiovascular disease, and sedation (Albert et al., 2021). These factors decimate the quality of life and increase healthcare costs, making access to requisite healthcare services a significant challenge. Therefore, it is imperative to implement multifaceted interventions, including education and care bundles. Kandula et al. (2025) noted that positioning strategies, care bundles, and education are highly effective in reducing pressure ulcers and further improving nursing practices. For example, Kandula et al. (2025) found that care bundles were associated with a 90% reduction in pressure ulcers among sampled patients, while injuries were reduced by 50%. The changes aligned with the goal of this study, which was to improve healthcare outcomes for wound care patients, including enhancing adherence to wound care protocols. Introducing comprehensive prevention strategies is crucial for mitigating the risk of pressure injuries in diverse healthcare settings.

Mervis and Philips (2019b) concurred with Kandula et al. (2025) about adopting frequent repositioning and maintaining a low angle of elevation due to their effectiveness in preventing

pressure ulcers among bed-bound patients. Repositioning the patient reduces pressure on vulnerable areas of the body; hence, improving blood flow and minimizing skin damage. More importantly, using specialized support surfaces means conforming the body to shapes, such as foam mattresses, providing a steady flow of air over the skin. Saghaleini et al. (2018) identified preventive measures for wound prevention, such as prophylactic dressings like hydrocolloids, to reduce friction on skin surfaces and maintain skin integrity. Dressings reduce friction and pressure on the skin, hence preventing wounds from forming, especially in high-risk areas. Hydrocolloid dressings provide a smooth, cushioned barrier that reduces friction. Tidhar et al. (2017) viewed maintaining moisture balance as a critical strategy in creating a healing environment that generally supports skin integrity. The moisture equally prevents the patient's skin from becoming too dry, which makes it susceptible to breakdown. Conclusively, applying appropriate dressing proactively rather than waiting for signs of skin damage allows providers to preserve skin integrity and reduce the risk of developing non-healing wounds.

Role of Nutrition in Preventing Chronic Wounds

A robust body of current literature has consistently explored the role that nutrition plays in preventing chronic wounds, especially pressure injuries and venous leg ulcers. Adequate protein intake, vitamins, and overall nutritional status play a key role in preventing non-healing wounds. According to Siregar and Hidayat (2023), vitamin D helps maintain homeostasis of the body's biological systems, such as the immune system. A stronger immune system accelerates wound healing while helping bone and skin formation by modulating proliferation and local immune responses. Similarly, Chen et al. (2023) viewed an individual's nutrition status as a predictor of wounds, pressure ulcers, and injuries. Malnutrition is associated with an increased incidence of pressure injuries; therefore, there is a need to implement specific nutritional

interventions. Chen et al. (2023) found a significant association between protein-energy malnutrition and an increase in the risk of chronic wounds. Conclusively, the findings highlight the fundamental role that nutrition, and specifically proteins, play in tissue integrity and immune function.

Research has also investigated the preventive potential of specific micronutrients. Yap and Holloway (2021) found the link between nutrient supplements like proteins, amino acids, and antioxidants with reduced risk of pressure ulcers and the overall development of wounds. Malnourished individuals are more vulnerable to pressure ulcers, and patients with wounds are likely to experience lengthy healing periods. However, Langer et al. (2024) explained that it is unclear which nutrients help prevent and treat pressure ulcers. Although Langer et al. (2024) agreed with Yap and Holloway (2021), Chen et al. (2023), and Siregar and Hidayat (2023) about how adequate nutrient intake can reduce the risk of malnutrition and enhance wound healing process, no evidence suggests, which specific nutrient achieves these outcomes. Determining the most appropriate nutrients to reduce the risk of pressure ulcers is an evolving research area that requires further investigation.

Research has equally integrated nutrition within the larger context of comorbidities and systemic inflammation. Ju et al. (2023) recognize nutrition as a modifiable risk factor that is intertwined with other conditions, therefore predisposing people to chronic wounds. Therefore, this implies that nutritional interventions for preventing non-healing wounds cannot be isolated, especially in populations with conditions such as renal failure, diabetes, and peripheral artery disease. Similarly, Langer et al. (2024) advised that optimal nutrition helps mitigate underlying pathologies, such as chronic inflammation and endothelial dysfunction, thereby creating a much-needed environment for wound healing. In essence, preventing chronic wounds demands

integrating nutritional assessment and tailoring dietary strategies within holistic management plans. The main objective of the plan is to address comorbidities, therefore positioning nutrition as an equally indispensable component of multifactorial risk reduction.

Current literature has examined the guidelines that healthcare providers must follow when treating and managing patients with diabetic foot ulcers. Ju et al. (2023) recommended the need to evaluate a patient's basal metabolic index, unintentional weight loss rate, and the frame of decreased nutritional intake. Conducting a nutritional assessment is crucial in evaluating wound healing stages, determining the patient's nutritional status, and providing the necessary nutrients. However, Yap and Holloway (2021) argued that nutritional assessment is imperative because, more often, nutritional factors are overlooked when caring for patients with an elevated risk of developing pressure ulcers, which can lead to diabetic foot ulcers. EBP management plans are recommended by focusing on individualized nutritional interventions to prevent skin damage, such as limiting calories to 30-35 kcal/kg per day for patients with stage 1 pressure injuries and 1.2-1.5 g/kg per day of protein (Ju et al., 2023). Proper protein calories increase skin elasticity, leading to risks of pressure injuries and the development of wounds. If nutritional protein calories cannot be obtained through meals, it is important to offer high-calorie, high-protein nutritional supplements. The supplements are provided in addition to the usual diet. Notable supplements include arginine and zinc. Proper nutrition not only reduces the risk of developing diabetic ulcers but also improves the overall health of the patient.

Nurses' Wound Care Knowledge

Since the literature on wound care by advanced practice nurses (APPs) was found to be limited. This paper focused on previous research that has also examined the impact of educating nurses on wound care management. Goudy-Egger and Dunn (2018) found that educating nurses

on wound care protocols and management improves the nurses' home healthcare knowledge, hence leading to better adherence to treatment protocols and increased knowledge. The use of evidence-based practice improves patient knowledge of wound treatment. Awoke et al. (2022) contended that educating nurses on wound care protocol is recommended because they play a critical role in identifying patients at risk and administering preventive care. With chronic wounds estimated at 12.8% and further hospitalized patient population in intensive care unit approximately 14%-42%, educating healthcare providers, especially nurses, is an opportunity to reduce such high prevalence rates and possible mortality and morbidity rates (Awoke et al., 2023). Nurses' close engagement with patients makes them a critical resource in managing wounds and pressure ulcers. Zuniga et al. (2024) emphasized the importance of having nurses tailor, test, and disseminate findings from EBP projects on pressure ulcers, rather than only focusing on education. The goal is to ensure nurses apply the knowledge from educational initiatives. Additional resources are needed to complement the training of teaching nurses in wound care management protocols and treatment. It is imperative to expand the staff, including a team of specialist healthcare providers, equipment, and funding, to scale the project and enhance benefits for a large healthcare provider population.

Studies on the importance of educating nurses on wound care management and treatment protocols have also explored knowledge gaps and the value of foundational education (Monaco et al., 2021; Padula & Delarmente, 2024; Welsh, 2018). First, Welsh (2018) advocated for a structured wound care education program, specifically at both undergraduate and professional development levels. The prevalence of ritualistic practice is evidence that there are shortfalls underpinning wound care practice. The current wound care practice reveals inadequate formal instructions at both pre- and post-registration levels. Similarly, in a descriptive study involving

400 surgical nurses, study participants reported inconsistent adherence to proper wound care practices (Harrison et al., 2021). The findings underscored the need for a clear and structured educational intervention. The inconsistent application of evidence-based protocols, coupled with poor health outcomes, highlights the existing gap between current practice and daily clinical practice. The identified foundational gaps contribute to suboptimal patient outcomes, emphasizing the importance and urgency of integrating comprehensive wound care training into both ongoing professional development and nursing curricula.

Structured Educational Intervention

Research indicates that structured educational intervention significantly enhances a nurse's wound care competencies. For example, a recent meta-analysis of randomized controlled trials evaluating the impact of educational training on nurses' knowledge to address pressure injuries found that training and skill classification were relatively effective in improving nurses' handling of wound care (Yuan et al., 2022). More importantly, the findings indicate that e-learning and computer-based modules have substantially improved nurses' knowledge of pressure injuries and clinical skills. Therefore, there is a need for ongoing reinforcement and refresher training. Similarly, the Wound Healing Society (2018) found that simplified guides and practical training significantly increased nurses' confidence, critical thinking, and decision-making abilities in wound care management and treatment. Practical training and simplified guidelines contribute to more timely referrals and broader use of EBP. However, Welsh (2018) and Callender et al. (2021) presented a significant concern that undermines wound care management: wound care specialists are scarce in community settings, a problem exacerbated by insufficient training and experience. The challenges lead to a lengthy healing period, more visits, and inflated healthcare expenditures. Ultimately, structured educational interventions enhance

nurses' clinical skills and adherence to wound care protocols, thereby improving patient care outcomes.

Literature has also explored the relationship between ongoing training in wound care and advanced certification. According to Corbett (2012), advanced training is associated with enhanced patient outcomes and professional growth. Certified wound care nurses more often demonstrate more accurate wound staging and superior clinical assessment compared to their non-certified counterparts. The findings highlight the potential of the QI intervention to address knowledge gaps in wound care and reduce existing variations in practice. Research shows that when specialists lead care, it reduces the incidence of pressure ulcers, accelerates healing, and substantially decreases healthcare costs. Despite the reported benefits of advanced education in improving healthcare outcomes for patients with chronic wounds, well-meaning, but under-certified nurses face frustrations in trying to meet challenges in the current regulatory environment. Notably, ongoing professional education not only empowers healthcare providers with the requisite knowledge and skills but also enhances the standard of care, highlighting the critical role a nurse's knowledge and skills play in ensuring effective wound management and patient safety.

Impact of Training on Performance

Several studies have investigated the impact of training nurses on wound care performance (Tidhar et al., 2017; Sardari et al., 2019). In Sardari et al. (2019), the findings showed that training nurses on pressure ulcers can enhance their knowledge and skills related to this condition. Sardari et al.'s (2019) experimental study included 66 intensive care unit nurses, who were randomly assigned to either a control or an intervention group. Similar to the current study, the intervention lasted 2 weeks and included an educational workshop on skin care,

pressure ulcer risk factors, and their prevention, whereas the control group did not receive an intervention. Findings showed that the intervention group demonstrated a statistically significant increase in scores from the pretest to the posttest. Tidhar et al. (2017) evaluated the effectiveness of training workshops for wound care nurses with minimal experience in using compression bandaging for venous leg ulcers. Findings indicated that the percentage of nurses who bandaged within the optimal pressure range significantly increased by 50% immediately after the workshop. Importantly, the improvement was maintained at 37% of the nurses within the 6-month follow-up. Tidhar et al. (2017) concluded that educational workshops involving the application of pressure bandages for venous leg ulcers and the overall measurement of such bandages are practical for nurses' skills in these areas.

Primarily, e-learning programs have emerged as a critical tool to narrow the existing gap between practice and performance in treating and managing chronic wounds and pressure ulcers. Ntshwarang et al. (2021) noted that e-learning platforms are promising tools for delivering educational interventions to nurses tasked with addressing pressure injuries, mainly due to their overall ability to adapt to changing circumstances and leverage technology. E-learning tools offer convenience, efficiency, and urgency. Furthermore, the utility of these tools in diverse settings is a crucial aspect in managing chronic wounds and pressure injuries. However, Kim et al. (2020) and Yan et al. (2022) viewed the current research on the effectiveness of e-learning platforms in improving nurses’ knowledge of wound treatment as limited. For example, the majority of studies focusing on the effectiveness of e-learning programs are single-group, pre- and post-design investigations, which lead to shortcomings in the depth and breadth of the data (Kim et al., 2020; Ntshwarang et al., 2024). Natural processes, characteristics, and study settings mainly influence such studies. As a result, these studies are unlikely to provide accurate

assessments of the effectiveness of e-learning programs. Yan et al. (2022) questioned the structure of a single-group, pre- and posttest design investigations, viewing them as unsuitable for meta-analysis due to the potential for bias, which impairs the ability to offer concrete recommendations that nurses and administrators can use to improve healthcare practices, including chronic wound treatment and pressure ulcers. In essence, although e-learning platforms show potential to improve healthcare providers' knowledge on wound management and treatment, current research offers little avenue to maximize this potential.

Research reveals contracts regarding training recipients and scope. First, Chen et al. (2023) found a direct link between training healthcare providers on pressure ulcers and their performance, as evidenced by improved adherence to prevention practices. For example, while focusing on the interprofessional training of nurses, physicians, and aides in a hospital system, the research found that training led to a 25% improvement in treatment adherence, coupled with a 19% decrease in pressure ulcer incidences (Chen et al., 2023). However, Rajhathy et al. (2020) study on the average healing time for patients with venous leg ulcers found that when patients received standard care that included compression and advanced wound dressing, there was a decline in surface area by 30%, offering a baseline healing rate for VLUs with compression therapy. Implementing advanced wound dressing requires skilled healthcare providers, ensuring that patients receive the requisite care that addresses their needs. Conclusively, integration of training with system-level support plays a significant role in the successful implementation of the intervention.

Gaps in Knowledge

Company-Specific Wound Care Protocol

Synthesis of evidence from the limited available literature on chronic wound management among advanced practice providers (APPs) reveals several gaps in adhering to wound care treatment and management protocols. The identified gaps justify the need for a computer-based educational intervention to improve Woundtech's staff's knowledge of wound care protocol. The gaps are derived from the existing research. First, there is limited focus on company-specific wound care protocol. Although several studies address general wound care protocols, such as those for venous leg ulcers and diabetic foot ulcers, research on organization-specific protocols is scarce (Awoke et al., 2023; Chen et al., 2023; Rajhathy et al., 2020; Ntshwarang et al., 2021;). Most available literature examines standardized bodies, such as the Centers for Disease Control and Prevention [CDC] (Jarbrink et al., 2017). Focusing on protocols from established bodies leaves a gap in understanding how to train providers on organization-developed protocols that account for a specific patient population.

Insufficient Focus on Advanced Practice Providers

Most of the literature on wound care knowledge targets registered nurses or physicians. As a result, there is insufficient focus on advanced practice providers, especially nurse practitioners, the healthcare workforce that this study targets. Since APPs at Woundtech are tasked with managing complex wound cases, the lack of extensive research on their specific knowledge deficits to adhere to wound care protocol or general training needs limits the applicability of existing findings to this population of healthcare providers. Besides limited focus on APPs, an in-depth synthesis of current literature reveals a lack of long-term knowledge retention data. A few studies that have explored the role of nurses' knowledge in wound care

have not examined the long-term retention of this information (Tidhar et al., 2017; Welsh, 2018). Most studies examine short-term posttest data but rarely assess long-term knowledge retention, such as between 6 and 12 months. Narrowing this knowledge is important for Woundtech because sustaining protocol adherence is crucial in improving the quality-of-care delivery, reducing infections, and promoting faster healing.

Impact of Computer-Based Care on Protocol Adherence

Although computer-based education is well-documented in healthcare, its application in wound care is less explored. Research has explored computer-based education in various topics, including medication safety and infection control. Studies such as those by Martinengo et al. (2019), Ding et al. (2023), and Tudor et al. (2018) highlight the effectiveness of e-learning in general. However, few studies address its impact on wound care protocol adherence, especially for chronic or non-healing wounds. Consequently, the lack of studies specific to chronic wounds leaves a massive gap in evidence for technology-driven solutions in this domain. Ding et al. (2023) and Boersema et al. (2021) noted that there are limited interventional trials with comparison groups that evaluate the impact of computer-based programs on nursing practices and overall knowledge of nurses managing pressure injuries, which also includes wounds. Additionally, there is a notable lack of pooled evidence that evaluates the impact of computer-based programs. Conclusively, this study seeks to address these gaps by ascertaining the impact of training on advanced practice providers' knowledge of adherence to wound care protocol.

Telehealth-Driven Wound Care Capability

Telehealth is a potential approach to addressing Woundtech’s wound care challenges, particularly in terms of overall adherence to treatment and management protocol. Notably, the company has not comprehensively implemented a telehealth wound care module. Current studies

highlight the need for telehealth in addressing wound care, despite its proven effectiveness. However, few studies explore knowledge gaps or training effectiveness in telehealth-driven wound care settings. Most studies tend to focus on in-person care, leaving a gap regarding how digital platforms, such as Woundtech's, influence provider knowledge and protocol application in remote environments (Jensen et al., 2024; Ju et al., 2023; Paden et al., 2024). Additionally, current literature inadequately addresses practice variability and patient outcomes. While knowledge gaps are documented in each study, only a few studies connect knowledge deficits directly to practice variability among advanced practice providers and patient outcomes, in terms of complication and healing rates (Awoke et al., 2022; Huang et al., 2023). The gap undermines understanding how addressing knowledge deficits, as in Woundtech's intervention, translates to consistent practice and measurable improvements in care quality. Finally, the current literature has a limited application of change management frameworks. Most studies focused on intervention design without using a structured change management framework (Kapp et al., 2018; Yuan et al., 2022). Consequently, these interventions are not adequately adopted and sustainable, leaving gaps in how to implement and scale initiatives such as Woundtech's effectively. Conclusively, the unexpected gaps identified in the literature synthesis emphasized the novelty of the study on Woundtech, which aims to address an organization-specific protocol targeting APPs, leveraging an e-learning-based model, and utilizing Kotter's model for implementation.

Relevance to Practice

This quasi-experimental study was relevant to clinical practice, especially in wound care management. Therefore, by addressing the identified knowledge gaps among APPs, the study has a direct impact on practice in several ways. First, the findings from this study will reduce

practice variability. Currently, Woundtech is experiencing inconsistent adherence to protocol, which may contribute to varying patient outcomes. The focus on standardized training using computer-based modules allows advanced practitioners to apply practices uniformly, minimizing variations in wound care treatment and management and fostering consistency and high-quality care across diverse patient populations. Second, study findings will improve clinical competency. With a better understanding of wound care protocol and treatment, APPs will be better equipped; hence, understanding Woundtech's care protocol. Consequently, better clinical competency means improving the ability of APPs to accurately assess wounds, select appropriate treatments, such as dressings, and document accurately, thereby minimizing errors and enhancing patient safety.

The study has the potential to enhance patient outcomes. With 8.2 million reported wound cases in the United States accounting for up to $96.8 billion in healthcare costs, improved APP knowledge will reduce complications and promote faster healing (Woundtech, n.d.). The findings from this study will help reduce complications such as amputations and infections, potentially improving patients' quality of life. The benefits of this study align with Woundtech's objective of improving patient outcomes and potentially lowering healthcare costs. The computer-based module, which utilizes Woundtech's information technology, provides a scalable and cost-effective training solution. The project's success, despite its limitations, such as a small sample size, suggests a possible application to other staff, including case managers, for example, and in other settings or facilities. This allows Woundtech to standardize education across the entire organization, particularly.

Project Purpose and Clinical Question(s)

Purpose Statement

The project aimed to determine whether a computer-based learning tool improves knowledge of wound care management standards among advanced practice providers at Woundtech. The project aimed to achieve this objective by ensuring a proper understanding of wound care protocol among Woundtech's APPs by increasing pre- and post-assessment scores to 25% within 6 months. The strategy entailed implementing an accessible, standardized, interactive training module to capture wound care guidelines. Conclusively, the project integrated Kotter's 8-step change model to address knowledge deficits, reduce practice variations, and improve patient care outcomes at Woundtech through pre- and post-knowledge assessments.

PICO or PICOT Question

In advanced practice providers providing care for patients with advanced wounds (P), does the implementation of a computer-based module on wound care management company protocol (I) show improved knowledge in posttest assessment (C) compared to pretest assessment (O)?

Project Objectives

Primary Objective

1. The overarching objective is to successfully implement a computer-based educational module at Woundtech that will improve APPs' knowledge of wound care protocol by 25% within 6 months.

Secondary SMART Objectives

1. Achieve a 90% participation rate among eligible APPs within 3 months of implementation.
2. Establish baseline wound care knowledge scores for all participating APPs within the first month.
3. Develop and validate assessment tools within 2 months of project initiation.
4. Develop a standardized wound care computer-based module pilot based on the company's protocol within 4 months.
5. Achieve 85% participant satisfaction with the educational module after the 6-month implementation period.

Organizational Assessment/SWOT Analysis

Strengths

Woundtech has wound care specialists who offer deep knowledge in managing chronic and non-healing wounds. The organization's expertise ensures high-quality and evidence-based care. Woundtech pioneered a patient-centered care approach 25 years ago, which has strengthened its evidence-based treatment pathways. Furthermore, the organization has paired evidence-based treatment with proprietary wound care products and delivers comprehensive treatment (Woundtech, n.d.). The organization has expanded care for patients in underserved areas, reducing travel burdens, which contribute to accessibility concerns. Woundtech utilizes its digital infrastructure to support efficient data tracking and protocol compliance, overall staff training, and eventually operational effectiveness. For example, Woundtech (n.d.) emphasizes that it reports a 53% faster wound healing rate than the industry average – the healthcare facility heals wounds on average in 51 days, compared to the 107-day national average. Conclusively, Woundtech offers multiple service models to address the varied needs of patients.

Weaknesses

Dependence on the existing staff at Woundtech and technology can potentially strain resources, especially when scaling services or training for additional facilities nationwide. Straining resources can affect the quality and timeliness of the service. The facility faces a high staff workload due to a small pool of APPs managing high volumes of complex wound cases. A high workload places additional pressure on advanced practice providers (APPs), leading to potential burnout and a decline in care quality, particularly if not effectively addressed. The integration of EHRs and training healthcare personnel leads to additional finances. Although it is essential to follow current market trends, it is costly, as healthcare personnel must receive training to operate medical devices, computer software, and equipment properly.

Opportunities

The growing demand for wound care services is an opportunity for Woundtech to expand services and market share. According to Woundtech (n.d.), prevalence rates of chronic non-healing wounds are rising, ranging from 6.5 million to 8.2 million in the U.S., mainly due to aging populations, diabetes, and obesity. Partnerships with hospitals, clinics, or wound care product firms could enhance Woundtech's resources and improve wound care delivery. Collaborations will also enhance referrals and innovation in treatment options. Implementing the intervention means Woundtech has an opportunity to scale training to other staff and facilities; hence, standardizing care. The integration of information technology increases data privacy risks. It is essential to safeguard patient data, primarily due to the increasing use of digital devices. Finally, policy advocacy is a possible avenue to explore by mandating technology-driven care training. Policy advocacy can strengthen Woundtech’s position as a leader in wound care

treatment and management, aligning with current healthcare trends toward evidence-based and digital solutions.

Threats

Although Woundtech has a significant market advantage due to its extensive investments in modern technology, evidence-based interventions, and collaborative engagement, it faces multiple threats. First, the economic pressures, such as rising healthcare costs, present a significant challenge because they limit the budget for training, technology use, and staff expansion. Economic pressures may limit the scalability and sustainability of initiatives aimed at improving wound care. Staff retention is another potential challenge, primarily due to competition for skilled APPs and attrition resulting from excessive workload. Better offers from competitors could threaten Woundtech's status as a market leader in wound care. With rising cases of chronic non-healing wounds, such as the reported 60% to 70% annual recurrence rate for diabetic ulcers, Woundtech may find it increasingly challenging to meet its core objectives of treating wounds and improving healthcare providers' knowledge of treatment and management protocol (Woundtech, n.d.). Regulatory changes, such as reimbursement policies for telehealth, may reduce funding or generally undermine service delivery, especially if not anticipated; hence, there is a need to expand it to improve healthcare outcomes.

Definition of Key Terms

Advanced Practice Provider (APP)

APPs are defined as healthcare providers who directly work with patients, within the limits of their scope of practice. They include nurse practitioners and physician assistants.

Wound Care Protocol

It is defined as evidence-based and standardized guidelines for wound care treatment and management, along with documentation of the different types of wounds (Taidouch et al., 2021).

Chronic Wounds

They are wounds that take a long time to heal, often beyond 3 months (MacLean et al., 2024).

Healing Rate

It is a key indicator of adequate wound healing, depicting the percentage of wound size reduction against a specific period (Taidouch et al., 2021).

Protocol Compliance

Denotes strict observation of established guidelines for wound assessment, treatment, and documentation (Huang et al., 2023).

Computer-Based Module (CBM)

CBM refers to an interactive digital learning platform that delivers educational content to users across multiple platforms, including presentations, assessments, and simulations (Martinengo et al., 2019).

Pretest

It is a baseline evaluation conducted before the computer educational intervention (Ma et al., 2023). Pre-assessment measures the initial knowledge of the APPs regarding Woundtech's wound care protocol through tools such as surveys.

Posttest

It implies an evaluation after the computer-based educational intervention (Lee et al., 2021; Ma et al., 2023). The post-assessment determines Woundtech staff's knowledge of wound care protocol to establish improvements compared to prior to the intervention.

Knowledge Retention

It alludes to the ability to maintain and recall information. Specifically, retaining information about wound care protocol over time indicates APPs' knowledge improvement.

Knowledge Gap

It implies comparing current knowledge levels and the required competency standards for wound care (Paden et al., 2024).

Educational Intervention

It refers to all learning activities structured to enhance clinical knowledge and skills.

Clinical Competency

This implies the ability to apply knowledge and skills gained in a particular activity in practical care situations.

Quality Metrics

Quality metrics collectively refers to measurable indicators applied to assess the effectiveness of wound care delivery and outcomes (Cross & Harding, 2022).

Implementation Strategy

Implementation strategy is the broader systematic approach to introducing and maintaining new educational programs and protocols within a healthcare organization.

Conceptual Underpinning and Theoretical Framework

Kotter's 8-step change model was selected as the framework to guide the implementation of a computer-based educational model aimed at enhancing APPs' knowledge of wound care treatment and management at Woundtech. The framework's steps align with project goals and context, ensuring effective implementation and sustainable outcomes. Miles et al. (2023) viewed Kotter's 8-step change model as appropriate because it preserves and institutionalizes the change process by initiating, mobilizing a coalition, creating a vision, and recruiting support. The framework sustains change, offers a win-win situation, and enables learning throughout the organization. Conclusively, the systematic approach of Kotter's model enables organizations to implement multi-phased change management mechanisms that engage stakeholders and align with defined objectives.

Conceptual Model or Framework Used

With an increasing focus on healthcare quality across various domains, including accessibility, safety, effectiveness, and patient-centeredness, healthcare organizations are exploring multiple avenues to adopt and sustain change. Harrison et al. (2021) emphasized that since contemporary healthcare systems thrive on efficient models of care to optimize resources, collaborative efforts are viewed as instrumental in maximizing positive patient care outcomes. Therefore, Kotter’s 8-step change model prioritizes measurable and collaborative change to accelerate improvement. Notably, the model has been applied in multiple settings in the healthcare system (Kotter, 1996). As a result, the selection of Kotter’s model in this QI project stemmed from its multiple success stories in diverse healthcare settings.

Adopting the computer-based educational module integrated all stages of change outlined in Kotter's framework. Walker et al. (2019) emphasized that directness is achieved by

introducing contemporary compliance figures and threats to patient outcomes. A guiding coalition entailed establishing regional medical directors and lead preceptors for APP champions. More importantly, the project initiated a strategic vision by focusing on better efficacy, reducing patient care variations, and improving caregivers' knowledge of protocols (Portela Dos Santos et al., 2022). The action aspect of the project involves identifying and overcoming technological constraints and availing the requisite resources. Acknowledging early endorsers and positive knowledge acquisition outcomes is crucial for solidifying short-term wins while promoting project sustainability. Pirani (2020) reiterated that sustainability necessitates ongoing review and the implementation of new and sustainable practices. Reis et al. (2023) shared a similar perspective to Pirani (2020) regarding the benefits of Kotter's model for clinical and organizational practices in healthcare organizations, due to its broader implications for clinical care and patient outcomes. Conclusively, the framework creates a vision, assists in assembling a team of influential leaders, and attains quick victories to increase wound care knowledge.

Application to the Project

The success of the model has informed its choice since it has the potential for similar results in this QI project. First, the model served as a principle to guide the change process when it was applied in a QI project of head to neck surgery in the Canadian Surgical Department (Harrison et al., 2021). Second, the model was applied in another leadership-focused change program in the United Kingdom dubbed “Comprehensive Unit-Based Safety Program.” The program utilized the five principles of dual-operating systems to develop and implement surgical quality improvement initiatives. Kotter’s model guided a coalition of leaders, including staff, nurse leaders, and resident surgeons (Harrison et al., 2021). The model aimed to address two major quality issues, including surgical site infections and poor team communication. The

intervention helped identify and address quality issues, further supported by reporting improvement data and regular meetings that built a sustainable culture of quality improvement (Harrison et al., 2021). In essence, Kotter's 8-step principles helped to operationalize the intervention, ensuring that hospital readmissions were reduced within the first quarter of the intervention.

Evaluation of the Theory

Kotter's 8-step change model served as a critical framework for implementing and sustaining organizational change. As a result, the application of the theoretical framework to the computer-based educational intervention at Woundtech to improve APPs' knowledge on wound care protocol reveals intriguing perspectives across the eight stages of change. First, creating a sense of urgency entails highlighting the rising prevalence of chronic wounds, inconsistent APP protocol adherence at Woundtech, which contributes to poor patient outcomes like amputations and infections. Applying the model motivates stakeholders by linking knowledge gaps to serious risks, high mortality, and morbidity rates. Notably, success depends on clear communication of data to current leadership and APPs, while resistance may emanate if urgency is perceived as exaggerated. The second step is the formation of a powerful coalition, which involves assembling a team of Woundtech leaders, wound care experts, educators, and IT staff to champion the intervention. The coalition has the potential to drive commitment while leveraging the diverse expertise available for resource allocation and credibility (Kotter, 1996). The success of the intervention in the second stage depends on active and visible support from leadership, while challenges include coordinating varied schedules and priorities.

The third step features creating a vision for change. The approach entails defining a vision to achieve a 25% increase in APPs' knowledge of the company's wound care protocol

within 6 months, aiming to improve the consistency of care. The vision should be clear, measurable, and aligned with Woundtech's quality improvement goals. The step is practical if it is tied to patient outcomes, such as faster healing, but the challenge is ensuring the vision resonates with busy APPs. The fourth step concerns communicating the vision. The strategy is applicable by sharing the vision through meetings, emails, and training sessions. During the engagements, it is imperative to emphasize the benefits of the intervention to APPs and patients. Communicating the vision is vital for buy-in, as it has the potential to unify efforts through the use of Woundtech's communication channels. In essence, success needs consistent and clear messaging, while one notable challenge is overcoming information overload or skepticism about technology.

The fifth step in Kotter's framework involves features that empower broad-based action. The strategy is applied by removing barriers using a user-friendly and self-paced computer-based module. The strategy empowers APPs by offering flexibility, but key challenges include a lack of computer proficiency and system glitches. The sixth step involves generating short-term wins. For example, the short-term wins include highlighting early improvements, such as the increased mean scores from pre- to post-assessment after completion of the two-week module. The early improvements set the tone and build momentum to achieve set objectives. Although generating short-term wins is feasible and motivating because quick feedback from the assessment boosts morale, the strategy is only effective if the wins are visible, such as a 25% increase in knowledge. A significant part of the sixth stage concerns ensuring results are meaningful and communicated promptly.

The seventh step in Kotter's model is to consolidate gains and drive further change. Notably, the stage utilizes the initial success to refine the module, assess knowledge retention

within a 3- to 6-month timeline, and expand it to other staff or facilities. The strategy involves firmly aligning with QI goals and allowing for iterative improvements. Consolidating gains and driving further change supports scalability across Woundtech, but it will likely face challenges, such as resource constraints or the waning enthusiasm of APPs over time. The eighth step captures anchoring changes in the culture. This calls for integrating the module into Woundtech's onboarding, annual training, and, more importantly, quality framework. The approach reinforces standardized wound care practices. The evaluation is critical for sustainability by embedding learning into routine operations. Conclusively, embedding changes into organizational culture is effective if it is supported by leadership and policy implementations; however, challenges include resistance to cultural shifts or a lack of long-term funding sources.

Methodology

Project Design

Since it is a pre- and posttest assessment approach, measurements were taken both before and after an intervention (see Appendix D). Primarily, the intervention seeks to explore Woundtech's wound care protocol, including its assessment, treatment procedures, and documentation. The project runs for 10 weeks, followed by a 12-week follow-up (See Appendix G). While Woundtech has a solid base of tech use and a vast pool of healthcare workers acting as a disaster workforce, telehealth remains underutilized to improve patient outcomes. Therefore, applying a computer-based educational intervention is appropriate in optimizing the potential of telehealth to enhance safety, outcomes, and quality of care. Importantly, the pretest was sent to the study participants via email prior to the implementation of the educational intervention. The pretest was vital for gathering a baseline dataset. Furthermore, 80 clinicians were contacted via a

work email, constituting potential study participants. However, 20 responded to the email while 11 completed both pretest and posttest assessments. A pretest was administered via email to identify any changes in knowledge after the intervention. Using the study design, the educational intervention was measured for effectiveness. Although 45 study participants were targeted to assess a 25% knowledge increase, only 11 completed the study, thereby limiting statistical power but still allowing for exploratory analysis. Finally, the pretest/posttest and the educational presentation were created by the researcher using the information gleaned from the literature review.

Setting and Population

The project was conducted at Woundtech, a wound care organization that offers a diverse range of healthcare services. The facility has an electronic health record system that allows data collection and identification of outcomes during the critical stage of project implementation. The inclusion criteria include having served at Woundtech for at least 6 months, currently caring for wound patients, and frequently using the company's computers. All participants who do not meet the inclusion criteria will be excluded (see Appendix A). Woundtech specializes in managing a diverse range of chronic non-healing wounds. The wounds include pressure ulcers, venous leg ulcers, and diabetic foot ulcers, which require consistent application of outlined protocol to ensure patients receive quality patient care.

The setting is suitable due to its capacity to handle a large volume of wound cases and skilled personnel, providing a rich context for evaluating quality educational initiatives aimed at improving protocol adherence. The facility’s current quality improvement framework enables more effective monitoring and refinement of clinical practices. Additionally, the organization’s EHR system enables more accurate data collection, tracking of patient care outcomes, and

assessment of compliance during the study. Essentially, Woundtech's large pool of skilled, committed, and collaborative healthcare workers, particularly their specialized training in wound debridement, further enhances its capacity to adopt and test innovative training solutions, thereby aligning with the study's goal to enhance APPs' knowledge of wound care protocol.

Sampling and Recruitment

The study targeted Advanced Practice Providers (APPs), specifically, nurse practitioners employed by Woundtech at the time of data collection. However, the study targeted 80 participants since similar survey questionnaires were sent via work email. However, only 20 responded to the email, while 11 filled out both the pre-intervention and post-intervention questionnaires. First, two participants had worked at Woundtech for less than 1 year, while five had worked in the facility between 1 and 3 years, constituting 45% of the total sample size. One participant had worked at Woundtech for 4-6 years, while the rest of the participants had worked in the facility for more than 10 years. The oldest participant was 60 years old, while the youngest was 38 years old; however, the average age was 48 years. Finally, 81% of the study participants were female, while men constituted only 19% of the sample size.

Ethical Considerations and IRB Approval

The study sought approval from Florida International University's Institutional Review Board (IRB) to ensure compliance with federal regulations (see Appendix C). The review assessed risks, consent processes, and ethical alignment. The committee oversaw the project, guaranteeing ongoing protection during implementation, especially for the 11 APPs, who completed pre- and posttest assessments (see Appendix F). Protecting the 11 APPs was critical because it ensured ethical integrity. Having voluntary consent meant respecting participant autonomy while minimizing risks and ensuring secure data handling, thereby upholding

beneficence, justice, and fair recruitment practices. For example, ensuring that participants have a minimum of 6 years' experience in wound care and were computer proficient supports autonomy, justice, and beneficence. In essence, protecting participants fostered trust, encouraged participation, and directly aligned with Woundtech's goal of improving care through education without harm.

Intervention Description

The intervention in this quasi-experimental study was a computer-based educational module, primarily designed to improve advanced practice providers' knowledge of Woundtech's wound care protocol. Therefore, the intervention addressed knowledge gaps and inconsistent protocol adherence. Furthermore, the digital-based module was both an interactive and self-paced program that was tailored to a specific wound care protocol at the Woundtech facility. The key components of the intervention included text-based content that offers clear and concise explanations of protocol steps for laboratories and diagnostics studies, including wound assessment, classification, and documentation standards. The assessments included variables such as wound size, depth, and exudate, while classification categorizes wounds as either chronic or acute. The second component initially focused on laboratory and diagnostic studies that must be ordered in accordance with this specific section of the company's protocol to prevent wound care complications, which can lead to wound-related hospitalizations, ranging from wound infections to the need to rule out osteomyelitis and assess the risk of amputation. In essence, the pre- and posttest questions aim to demonstrate an enhanced understanding of the company's wound care protocol through real-world examples.

The third component of the intervention entails case studies. The cases include realistic scenarios of patients with diverse wound types that require clinicians to apply protocol steps;

hence, fostering clinical thinking and problem-solving is a critical aspect of APPs' knowledge of wound management protocol. The final component is the quizzes, which include multiple-choice and scenario-based questions. The quizzes test comprehension of key concepts, such as clinicians' ability to select appropriate dressings or identify signs and symptoms of infection. Conclusively, the quizzes, videos, case studies, and text-based content reinforce learning, ensuring clinicians are better prepared to follow wound care protocol and enhance patient care outcomes.

The plan was for the computer-based modules of the entire protocol to be hosted on Woundtech's digital platform, which was accessible via the organization's computers, thereby ensuring compatibility with the routine workflows of the APPs. Since the modules were designed to be self-paced and flexible for busy clinicians to complete training at their convenience. For this initial stage of the QI project, the intervention was delivered via a PowerPoint presentation. Returning to the ideal plan, the total duration of the project was estimated to take 4 hours, spread over 2 weeks, thereby balancing content depth with practicality. The system will allow APPs to log in, pause, and resume training when needed, accommodating clinicians' varied learning paces and schedules. The rationale for selecting computer-based educational training stems from its accessibility, consistency, and interactivity, thereby ensuring the relevance and standardization of care across diverse wound cases and optimizing APPs' experience levels.

Protection of Human Subjects

Protecting APPs as study participants is a critical aspect of the project. The protection encompassed recognizing APPs as autonomous individuals who require informed consent and voluntary participation (see Appendix D). Participants were also assured of the freedom to withdraw from the study at any time without penalty. The intervention equally focused on

maximizing benefits, such as improved knowledge and better patient care outcomes, while minimizing risks like data exposure and time burden. Justice was ensured by guaranteeing a fair selection of the 80 APPs contacted by work email while avoiding exploitation and ensuring equitable access to the training. Before participating in the study, all 80 APPs received a work email detailing the study's purpose, procedures, duration, risks, and benefits. Consent was obtained electronically, using clearly explained language that confirmed the voluntary participation of the clinicians.

The protection of human subjects in this study was also planned to minimize risk. Using a self-paced module was instrumental in accommodating the varying schedules of participants, thereby reducing the likelihood of fatigue or missing other personal duties and responsibilities. Furthermore, the initial stage of this study did not collect any sensitive health data, except for demographics, as well as pre- and post-knowledge assessment scores. Confidentiality and data protection were observed by ensuring anonymity, such as de-identifying pre- and posttest data with unique codes replacing names to prevent linkage to individual APPs. Furthermore, participant responses were stored in Woundtech’s encrypted electronic system, which was only accessible to the research team. Finally, the data were used solely for quality improvement, with aggregate results reported to prevent the possible identification of participants.

Data Collection Procedures

Multiple methods were employed to measure knowledge gains and protocol compliance. The methods ensured the collection of robust and reliable data to assess the impact of the intervention. Data were collected from both the pre-assessment and post-assessment, based on a previous consensus among stakeholders regarding protocol compliance observation. First, pre-assessment data measured the baseline knowledge of Woundtech’s staff regarding the wound

care protocol. A structured survey questionnaire was administered via email to 20 out of the 80 APPs, who responded to the email outlining the purpose of the study. The survey questionnaire included 11 questions addressing the use of X-ray for diagnosis, specific case studies of patients with wounds, locations of ulcers, and wound cultures, among other critical questions. The questionnaire was administered before the PowerPoint presentation intervention, allowing adequate time for completion and submission. The rationale for the pretest was to establish a benchmark for comparing post-intervention changes and identifying the initial knowledge gaps.

Post-assessment data were collected from the 11 participants, who had also answered the pretest. The questionnaire was structured to include multiple-choice and scenario-based questions, aligning with the protocol. The rationale for the post-intervention assessment was to enable comparison with pre-intervention assessment data and to use the scores to quantify the targeted 25% increase in knowledge. Finally, protocol compliance observations were conducted post-project completion to assess whether improved knowledge translates to better adherence to Woundtech's wound care protocol. Therefore, chart reviews were conducted using the electronic health records systems at Woundtech as part of the plan to ensure the QI project's sustainability. Conclusively, the initial study findings provided objective evidence of knowledge gains that can be linked to clinical behavior and the need to standardize training on the company's wound care protocol from onboarding to yearly evaluations.

Measures and Instruments

The pre- and post-assessment questionnaires were the primary measures and instruments employed to assess knowledge gains and protocol adherence. The adoption of the instrument was chosen to measure baseline and post-intervention knowledge of Woundtech's wound care protocol. The questionnaire consisted of 11 questions, administered via a work email, before and

after the intervention. The questions were multiple-choice and scenario-based, assessing applications that required critical thinking and knowledge of wound care. The content covered wound assessment, with a greater focus on laboratories and diagnostic studies. The measures and instruments were carefully selected to align with the study's objectives, leveraging the technological infrastructure available at Woundtech to ensure efficient data collection.

Data Analysis Plan

The data analysis for this quasi-experimental study included the use of descriptive statistics and a paired *t*-test. The mean scores gauged overall performance, the mode outlines possible skewness in the small sample, the standard deviation determines variability in scores, and the compliance assesses consistency. The range depicted how the scores were spread across the sample size. The data provided a clear snapshot of potential knowledge gains between pre-intervention and post-intervention periods. Furthermore, the paired *t*-test captured the significant differences between pre- and post-assessment scores to evaluate the impact of the intervention on clinicians' knowledge of wound care management, treatment, and the overall adherence to the company's protocol. Finally, the findings from the data analysis also established whether the intervention benefits certain groups more, such as experienced APP nurses.

Dissemination and Implementation

Invitations to participate in the study were sent to 82 clinicians at Woundtech. As a result, 21 potential participants responded to the request, expressing interest in the study. A technical challenge arose due to poor coordination with the IT department. Emails containing links to surveys and online consent forms were flagged as potentially containing spam or malware. Attempts to notify the department to allow the email were unsuccessful. The barrier was addressed by asking 21 clinicians to provide their email addresses. Eventually, 11 participants

responded with alternative contact information, completing the consent process and both pre- and post-intervention assessments.

Results

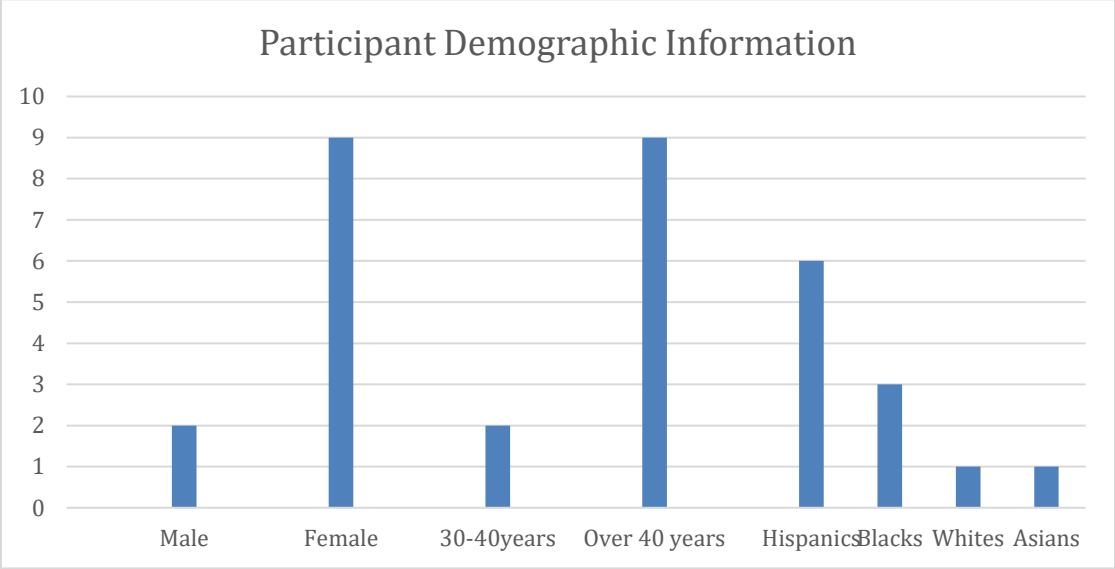
This section highlights the study findings regarding whether the computer-based educational intervention will significantly enhance APPs' knowledge of Woundtech's wound care protocol. Therefore, the study aimed to achieve its target of increasing APPs' knowledge and protocol for wound care management by 25%. Additionally, a paired *t*-test was predicted to yield a statistically significant improvement of $p < 0.05$, underscoring the module's effectiveness in addressing current knowledge gaps. Descriptive statistics demonstrated moderate baseline variability, with post-intervention scores reflecting a consistent upward shift.

Participant Demographic Information

Eleven participants consented to complete the survey questionnaire for this QI project. All 11 participants voluntarily completed the questionnaire for both pre- and post-assessments. Some of the demographic information collected from the study participants included gender, age, work experience, occupation, and race. First, all study participants were nurse practitioners, emphasizing the QI's focus on advanced practice providers. Second, the youngest participant was 38 years old, while the oldest was 60 years old. The average age of the respondents was 48.8 years; nine of the 11 participants were aged over 45 years (see Figure 1). Since all 11 participants completed both pretest and posttest assessments, the study did not have missing data.

Figure 1

Participant Demographic Information



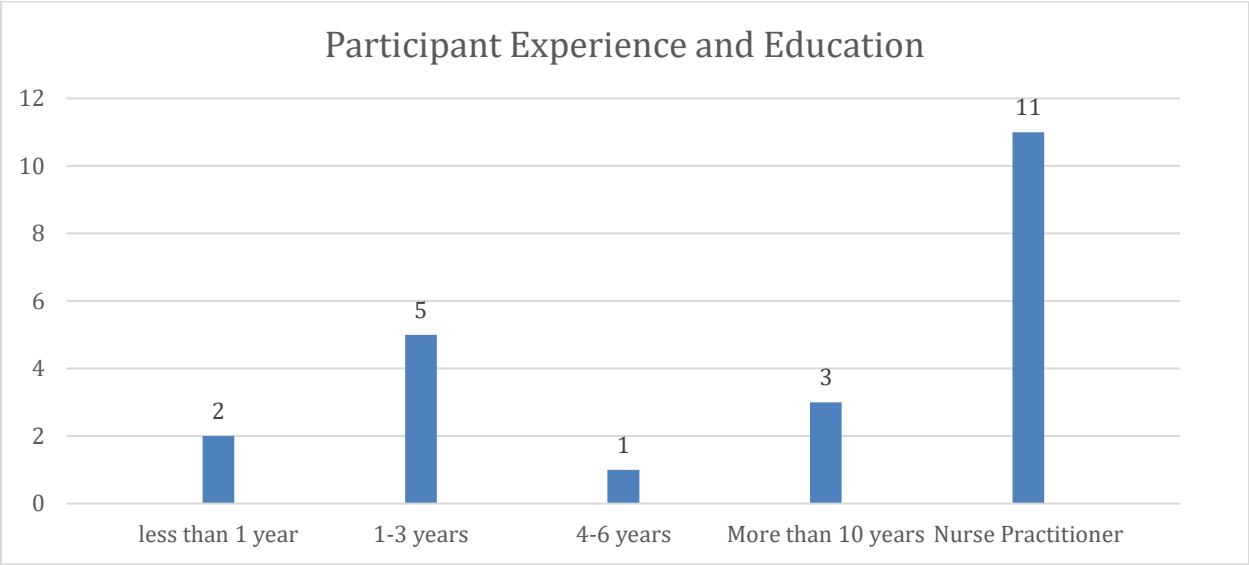
Note: Summary of the demographic information of all 11 study participants

The sample population was predominantly female, with nine of the 11 participants, or 82%, being female, while only two participants, or 18%, were male (see Figure 1). Race demographics of the sample participants include Whites, African Americans or Blacks, Hispanics, and Asians. Racially, the study participants were predominantly Hispanic, at 55%, followed by African Americans at 27%, Asians at 9%, and Whites at 9%. Notably, most of the study participants had work experience in wound care ranging from 1 to 3 years, with five of the 11 participants, approximately 45%. Only two participants had a work experience of more than 10 years, constituting 18%. However, one participant had 4 to 6 years of work experience, while two respondents had less than one year of experience (see Figure 2). Essentially, all study

participants met the study —they must have worked in a wound care facility for at least 6 months.

Figure 2

Study Participants' Level of Experience and Education



Note: The figure displays the experience levels of all 11 study participants, ranging from less than one year to over 10 years, as well as their educational levels.

Participant Knowledge of the Company's Wound Care Protocol

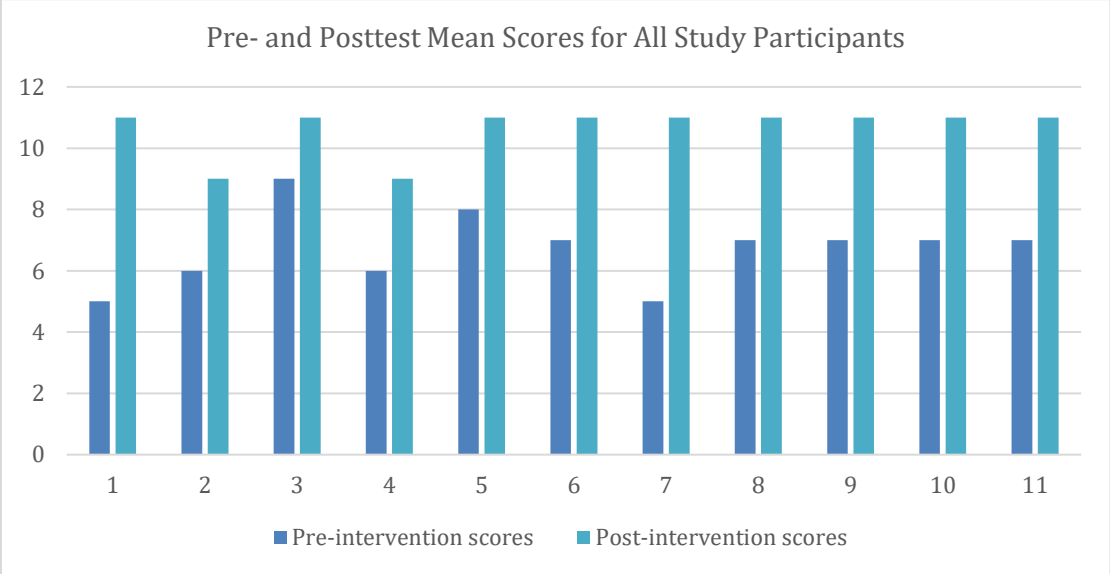
Research participants' answers to survey questionnaire questions helped to clarify their knowledge of wound care protocol. First, 45% of the participants felt that X-rays help diagnose bone infection or osteomyelitis, while 55% viewed them as helpful in diagnosing arterial calcification or vascular disease. This indicates that 45% of the participants are not familiar with the role of X-rays in diagnosing arterial calcification or vascular disease. These findings were equally consistent in establishing whether X-rays are effective in diagnosing foreign bodies and osteomyelitis during wound assessment. Second, all participants demonstrated critical thinking

by discerning a specific case patient in a case study. All participants correctly answered a case study involving a 65-year-old male patient with a history of diabetes presenting with a chronic ulcer by identifying the most appropriate step as ordering vascular studies and obtaining wound culture.

Third, when asked about the common location of venous ulcers, participants were divided between the area above the lateral malleolus (18%), the area above the medial malleolus (45%), the lower anterior shin (18%), and the calf (18%). Fourth, clinicians' knowledge of nutrition's role in wound care was impressive. For example, all APPs recognized the need for a dietitian consultation when treating wounds. Similarly, if a patient has dysphagia, APPs acknowledge consulting a dietitian, underscoring their knowledge on the role of nutrition in promoting wound healing and overall care management. All participants demonstrated an improvement in their knowledge of wound care protocol during the intervention's implementation (see Figure 3). Conclusively, prior to implementing the intervention, advanced practice providers demonstrated average knowledge of wound care protocol, particularly regarding the role of X-ray in diagnosis; however, they showed a better understanding of the contribution of nutrition to the treatment and management of wounds.

Figure 3

All Study Participants' Knowledge Improvement from Pre- and Posttest Mean Scores



Note: The figure shows how each study participant's mean scores changed from pre- and posttest assessments, indicating that the intervention is effective in addressing the research question

Pre-and Posttest Assessment

The analysis of pre- and posttest outcomes included the data for 11 APPs. First, the knowledge scores of all 11 participants were collected before and after a computer-based educational intervention to assess whether the targeted 25% increase in knowledge was achieved. The pretest scores were calculated as a mean of 6.27, a median of 7.00, a mode of 7, a standard deviation of 1.27, and a range of 4. Notably, the mean and median suggest moderate baseline knowledge, while the mode of 7 indicates a standard performance level before the intervention. Furthermore, since the maximum score for all questions is 11, the pretest average of 6.27 indicates a slightly above-average knowledge of wound care management and treatment protocol. The slight difference between mean and median suggests a mild left skew—lower

scores are pulling down the mean. Conclusively, the pretest scores indicate moderate baseline knowledge of wound care management and treatment protocol, with some variability, as evidenced by the standard deviation of 1.27.

Posttest scores indicate significant changes. The mean was 10.64, the median was 11.0, and the mode was 11—it appears that 9 out of 11 scores were. The standard deviation of the posttest scores was 0.67, while the range is 2 (See Table 1). The posttest scores show a substantial increase, with a mean score of 10.64. Most advanced practice providers scored near or at the maximum score, with the mode and median being 11. Furthermore, the standard deviation of 0.67 suggests consistent and high-performance post-intervention (see Table 1). The mean score rose from 6.27 during the pretest to 10.64 in the posttest, reflecting a 69.7% improvement in APP knowledge relative to the baseline, further surpassing the targeted 25% increase (see Table 3).

Table 1

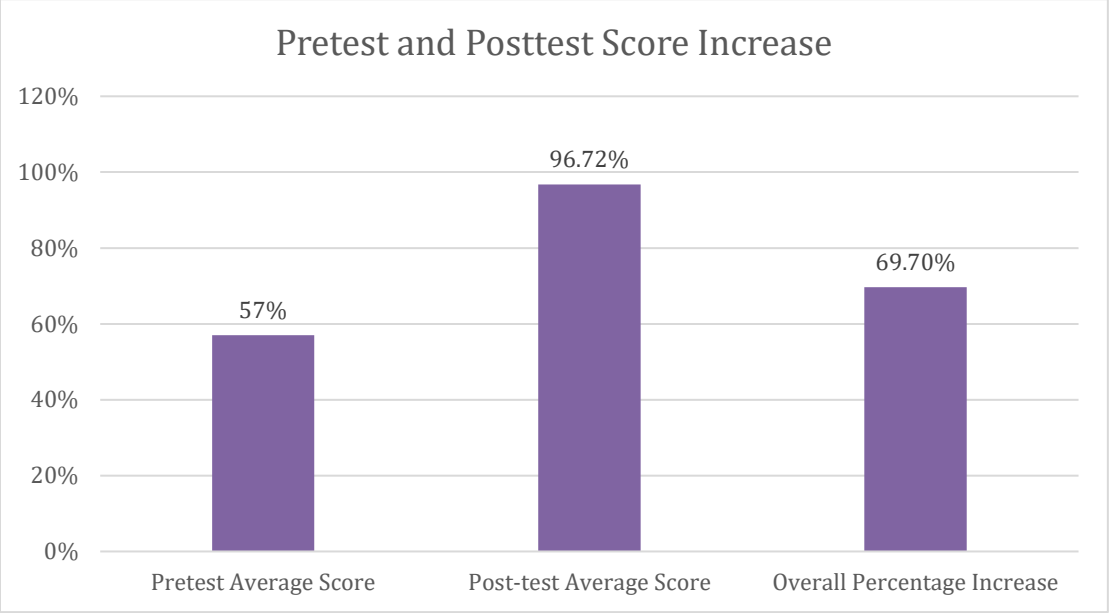
Summary of Descriptive Statistics for Pre- and Posttest Scores

	Participants (*N*)	Mean	Median	Mode	Range	Standard Deviation	Standard Error
Pretest Scores	11	6.27	7.00	7	4	1.27	0.38
Posttest Scores	11	10.64	11.00	11	2	0.67	0.20

Note: Computed measures of central tendency for pre- and posttest scores reflecting baseline knowledge variability and standardized knowledge at a high level

Figure 4

Aggregate Increase in Pre- and Posttest Scores



Note: Figure 4 illustrates that the aggregate knowledge increases from the pretest to the posttest mean score values. Pretest average scores stood at 57% but rose in the posttest to 96.72%,

A Paired *t*-Test

A paired *t*-test was performed using Microsoft Excel. The test aimed to determine whether the intervention resulted in a statistically significant increase in knowledge scores by comparing the pre- and posttest means for the 11 participants ($p < 0.05$). The paired data included scores from the same APPs at both pre- and post-intervention times. Scores are treated as continuous, with the data normally distributed, and no extreme values were detected, as the difference ranges from 2 to 6. The mean difference (d) for pre- and posttest was 3.91, the standard deviation of difference (SDd) was 1.22, the *t*-statistic was 10.63, and the degree of freedom computed as $df = 10$ (See Table 2). The *p*-value for $t = 10.63$ and $df = 10$ is 0.001 ($p < 0.001$), suggesting that it is highly significant, per the *t*-distribution (See Table 2). The *t*-test

indicated a statistically significant increase in knowledge scores post-intervention (t (10) = 10.63, $p < 0.001$). The increase in the posttest confirms the effectiveness of the intervention.

Table 2

Summary of the Paired T-Test Results

	Statistic	Value
1	Sample size (*N*)	11
2	Mean difference	3.91
3	Standard deviation of differences	1.22
4	Standard Error of Difference	0.37
5	*t*-statistic	10.63
6	Degrees of Freedom (df)	10
7	*p*-value	0.001
8	Percentage Increase	69.7%

Note: The table shows the summary of paired *t*-test outcomes, where 11 participants successfully recorded pre- and posttest assessments.

Discussion

Limitations

Despite the project's positive outcomes, the QI is fraught with several limitations. First, technological difficulties primarily affect practicing professionals, necessitating occasional updates for educators on the latest practices (Bambi et al., 2022; Finlayson et al., 2024; Lee et al., 2021; Ma et al., 2023). Second, the possibility of selective reporting bias arises from the selection of studies that align with the current study's expected findings, thereby indicating a

potential for selective bias (Lee et al., 2021; Ma et al., 2023). The biases imply the possibility of overestimating the effectiveness of computer-based interventions. The study targeted a sample size of 45 patients, which is insufficient to generalize findings in other contexts.

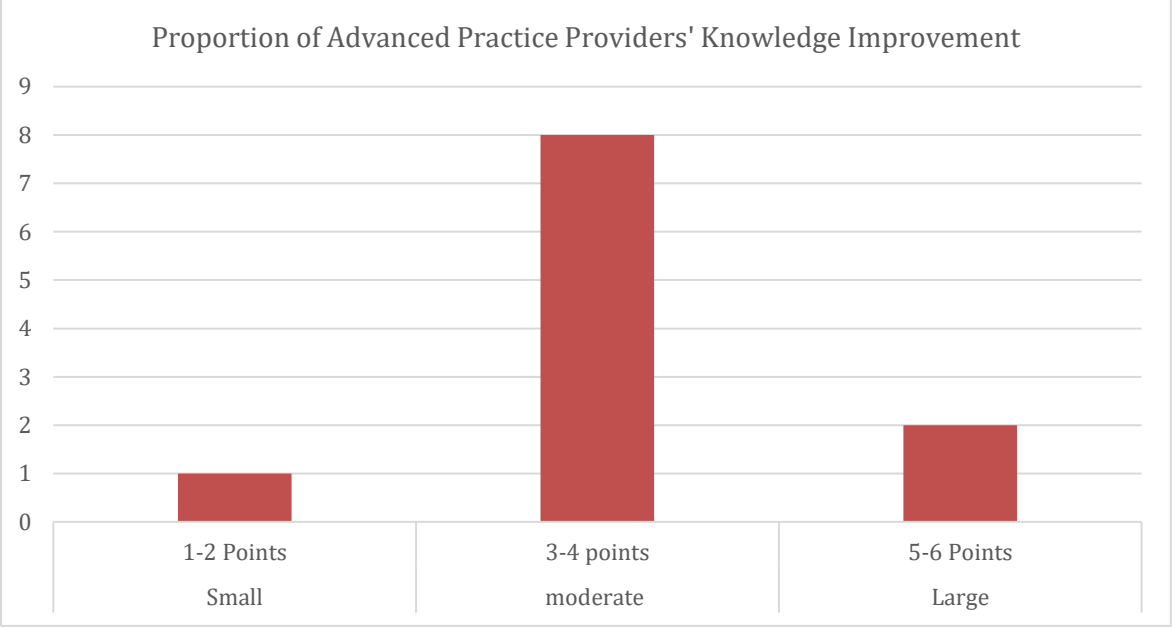
Interestingly, only 11 of the 82 contacted APPs completed both the pre- and posttest assessments, although 21 were notified. The small sample reduces statistical power, limits the ability to establish differences from the data, and therefore increases the risk of Type II errors. Consequently, the results are explanatory rather than conclusive. The non-response bias is a possible concern. The low response rate of 21 out of 82 suggests potential non-response bias. Therefore, it is likely that non-participants differ in motivation, workload, or baseline knowledge. Non-response bias skews results toward more knowledgeable or engaged advanced practitioners, which may not reflect the broader workforce at Woundtech. The lack of a control group in this quasi-experimental design, which receives either traditional training or no intervention, limits the study's causal inferences. For example, the 69.7% knowledge gain could signify the influence of external factors, such as test familiarity or workplace learning, rather than the computer-based module alone. The limitations underscored the importance of studying computer-based education with more rigorous dependent variables and conducting longer follow-ups.

The study presents a ceiling effect in assessment, where the independent variable no longer has an impact on the dependent variable. For instance, the 11-point assessment scale resulted in a ceiling effect, with nine of the 11 APPs scoring 11 points during the post-intervention period. The high median of 11 and mean of 10.64 restrict sensitivity to further knowledge gains, therefore, underestimating the full impact of the intervention. For example, during the posttest assessment, significant knowledge improvement was observed in the

moderate section— most participants gained 3 to 4 points between the pre- and posttests (see Figure 5). Although protocol compliance was planned to use EHR chart reviews, data was not provided. This limits insights into whether knowledge gains translate to practice or the perception of the advanced providers on the usability of the module and its relevance. The study lacks robust psychometric validation. Although the pretest and posttest analyses were pilot tested for clarity, they lacked psychometric properties, such as validity metrics and Cronbach's alpha. As a result, the study raises concerns about the reliability and accuracy of the instruments used to measure knowledge.

Figure 5

Proportion of APPs' Knowledge Improvement



Note: The proportion of knowledge improvement among 11 APPs' following posttest assessment was aggregated as slight, moderate, and significant increases.

Implications for Practice

The quasi-experimental study, which surpassed the targeted 25% increase in advanced practice providers' knowledge of wound care protocol, has significant implications for clinical practice. Woundtech's APPs recorded a 69.7% increase in knowledge of wound management and treatment. Therefore, this section discusses the next steps of this QI project, the plan to sustain practice change, and the overall implications for advanced practice nursing.

Next Steps for This Quality Improvement Project

Primarily, the success of this computer-based educational intervention warrants further development, despite its small sample size. Furthermore, evaluation is needed to maximize the impact of this QI project. The following steps for the computer-based educational intervention QI at Woundtech include validating, refining, and expanding the initiative to enhance APPs' knowledge of the wound care protocol and improve care outcomes. Therefore, the first step is to validate and expand the data. The strategy demands conducting an in-depth analysis of additional data, such as protocol compliance from the EHR chart reviews. Validating entails data analysis and evaluation, focusing on analyzing pre- and post-assessment scores from the 80 APPs to confirm the targeted 25% increase in knowledge of wound care protocol at Woundtech. A paired *t*-test will assess statistical significance, while descriptive statistics will highlight trends in the scores. This approach will confirm the practical impact of the intervention. Validating data will pave the way to expand the study to include more APPs, targeting the original goal of 80 participants to enhance generalizability and statistical power.

The second step is to refine the module. The phase dwells on refining the intervention using assessment results. For example, additional content will be developed if protocol areas show persistent knowledge gaps. Refining the module may include incorporating participant

feedback to improve the content. For instance, case studies can be added for complex wounds. Another consideration is addressing potential technical issues that may arise from Woundtech's technical infrastructure. Notable emerging technical issues include access barriers to enhance the user experience. More importantly, it is recommended to adjust the current 11-point assessment scale to a 100-point scale to improve sensitivity. The refining stage equally entails assessing knowledge retention. A post-intervention will evaluate knowledge retention among APPs to determine whether the targeted 25% knowledge increase is sustainable, with a focus on long-term adherence to the company's wound care protocol.

The expansion of the broader staff will closely follow the knowledge retention assessment exercise. Therefore, the third step will be to conduct a follow-up assessment. The evaluation can be performed at 3 and 6 months to establish knowledge retention. The assessment ensures sustained protocol adherence. A decline in retention will warrant introducing booster sessions or micro-learning modules. The fourth plan involves broader implementation of the QI project by piloting the module in additional Woundtech facilities to test scalability across multiple settings. Expanding the QI equally involves standardizing knowledge across roles, tailoring content to address role-specific needs, and aligning all team members with protocol standards to achieve care consistency. Following staff expansion, the next step is to pilot-test for scalability in additional Woundtech facilities to assess its effectiveness across diverse settings. The pilot will account for variations in patient populations, facility resources, and wound types and identify necessary adjustments. The implementation can include extending training to other staff members, such as registered nurses and wound care aides, to standardize care throughout the entire organization. Finally, tracking outcomes is recommended. It revolves around utilizing Woundtech's EHRs to monitor patient outcomes, including healing and infection rates. Tracking

focuses on post-intervention by linking knowledge gains to clinical improvements. Additionally, the strategy entails monitoring long-term consequences, such as lower healthcare costs, and possibly faster wound healing, and lower complication rates. Tracked data will guide iterative quality improvement cycles. Conclusively, the assessed metrics will quantify the impact of the intervention, support the value to stakeholders, and form future QI initiatives.

Plan for Sustaining Practice Change

Health Policy

Sustaining the impact of practice change is the hallmark of this QI project. Therefore, maintaining the change demands integrating the QI into Woundtech's framework. Consequently, the approach calls for a strategic plan that addresses health policy, fiscal factors, organizational change, and support. First, the health policy calls for advocating for Woundtech to incorporate internal policies that mandate regular computer-based training for Wound care. The strategy aligns with national standards and guidelines. The Wound Healing Society (2018) identified several wound care standards, including thoroughly examining the patient to assess and correct causes of tissue damage, performing initial debridement and maintaining it, and selecting an appropriate method based on the wound's status. Additionally, wound cleansing is required at each dressing change using a non-irritating and non-toxic solution. Health policy calls for collaborating with regulatory bodies to promote policies that recognize tech-driven education as a quality improvement tool, thereby enhancing reimbursement for telehealth-based wound care.

Fiscal Factors

Fiscal factors equally play a critical role in sustaining practice change. Notable avenues of maintaining this practice change from a financial standpoint include securing funding for ongoing module maintenance, upgrades, and staff training. Notable fiscal factors include

ensuring a budget for ongoing module maintenance, licensing, and updates, as well as justifying QI costs through improved outcomes. With wound care costs ranging from $28 billion to $96 billion and projected to continue rising, this project can demonstrate ways to tackle healthcare costs and enhance affordability for millions of people. Besides improved outcomes, it is also appropriate to justify costs by demonstrating benefits of the intervention, such as reduced complications, adherence to treatment protocols, lower readmissions, and shorter patient healing times. Justifying costs promotes stakeholder buy-in for the project, avails requisite resources, and accelerates the pace of progress. Highlighting the benefits will demonstrate how they are offsetting initial investments. Finally, fiscal factors also extend to exploring grants from wound care associations and partnering with medical device companies.

Organizational Change

Sustaining practice change from an organizational standpoint involves integrating the module into Woundtech’s onboarding process for new APPs and annual competency training for existing staff. For example, this may include regularly updating staff on wound care protocol. The updates will reflect evidence-based practices and sync the module content accordingly. It is imperative to advocate for policies that mandate regular computer-based training for wound care, aligning with quality standards. Organizational change features embedding the module in Woundtech's onboarding and annual training are backed by leadership commitment. Change is sustained by establishing a QI team to monitor compliance and offer technical support. Finally, organizational change may also involve fostering a culture of continuous learning, specifically by acknowledging and recognizing advanced practice nurses who excel in training and certification.

Support

Support is crucial in sustaining practice change and maintaining an increased understanding of the company's wound care protocol to enhance care outcomes. One primary consideration involves establishing a quality improvement team. The team should include educators, wound care experts, and IT specialists. The IT specialists will be responsible for overseeing module updates, monitoring compliance through EHRs, and providing technical support. Wound care experts will be training healthcare staff on EBP wound care practices, raising awareness about wound prevention and self-care, especially on non-healing wounds like diabetic ulcers. Educators will also develop educational materials and protocols necessary to standardize care procedures and ensure compliance with national guidelines for wound care. However, wound care experts, such as surgeons and nurses, assess and diagnose wounds, including staging and etiology, and formulate treatment plans that include dressing selection, infection control, and debridement. Wound care experts will monitor wound healing and adjust treatment accordingly, while also collaborating with multidisciplinary teams, such as nutritionists and endocrinologists. Finally, offering ongoing training for APPs on wound care advancements will enhance accessibility and engagement, ensuring the practice change is sustainable.

Implications for Advanced Practice Nursing

The expected outcomes of this project offer a massive opportunity for advanced nursing practice across practice, education, organization, and policy. Therefore, this section explores the implications of the study's findings for advanced practice nursing. Santos et al. (2022) recommended that enhancing healthcare providers' knowledge of wound care management will help eliminate current disparities in practice and the gap between published guidelines and actual practice. An enhanced understanding of wound care protocols improves the consistency of APPs

in wound assessment, treatment, and documentation, thereby elevating patient care quality. The findings from this study have broad implications for advanced practice nursing across core areas of practice, education, organizations, and policy.

Practice

The QI highlights the value of computer-based learning, promoting scalable, interactive training for APPs in wound care. First, enhanced knowledge, specifically a 69.7% increase, enables advanced practice nurses to deliver evidence-based wound care, hence reducing practice variability. This implies that APPs will be better equipped with current EBP practices in wound care, ensuring that they provide consistent and standardized care across diverse patient populations, apply best practices confidently, leading to improved infection control and prevention of complications. Second, findings will also improve outcomes, such as faster healing and fewer amputations. Woundtech (n.d.) noted that 30% of untreated wounds lead to amputations. Conclusively, the findings from this study will strengthen the role of APPs in in-person settings and their potential to optimize the company's telehealth prospects in the future.

Education

The success of this QI intervention demonstrates the effectiveness of digital learning tools for teaching wound care. The findings will encourage nursing programs to adopt similar platforms for wound care education. Conventional nursing education often lacks in-depth training on wound care, particularly for complex cases. Digital-based learning platforms, particularly those with interactive and tailored modules, can effectively simulate real-world clinical scenarios. Such an approach will help APPs develop critical thinking and decision-making skills in a safer and more flexible learning environment. Finally, digital platforms can be

self-paced, more accessible, and adapted to different learning styles—hence, making them ideal for busy professionals.

Organizations

Woundtech can inspire other organizations to adopt tech-based training to address wound care and related healthcare challenges. Specifically, Woundtech can adopt the current model to improve APPs' knowledge in wound care for other protocol, fostering a culture of continuous learning and quality improvement. Taidouch et al. (2021) view APPs' knowledge of wound care as instrumental in facilitating better assessment, treatment recommendations, and adherence to protocol. Implementing a similar training model fosters a culture of quality improvement. More importantly, standardized education enhances both organizational efficiency and care outcomes. Emphasizing continuous learning through modern technology, healthcare teams will become more focused on improving across the core areas of safety, efficiency, and better care outcomes. Consequently, technology-oriented training will reduce costs due to fewer complications, positioning an organization as a leader in wound care. Essentially, organizations can invest more in innovative and evidence-based practices, gaining a reputation for excellence, attracting top talent, and raising patient trust.

Policy

Policy is a fundamental component of successful quality improvement. The study demonstrates that tech-based training has a significant impact on the skills and knowledge of advanced nurses in wound care. These findings support the need to push for healthcare policies that mandate continuous digital education for APPs. Advocating for policies is important because healthcare is increasingly moving toward digitalized solutions as observed in EHRs, telemedicine, and artificial intelligence (AI)-assisted diagnostics. As a result, training programs

should keep pace by using technology-enhanced learning to prepare providers for modern care environments. Furthermore, the current training is one-time learning, which helps APPs stay updated with best practices and new evidence, pivotal for managing non-healing wounds—a condition that affects millions of Americans each year. Formulating and implementing policies that require technology-based learning means governments can motivate healthcare organizations to invest in these programs (Boersema et al., 2021). Ultimately, the success of this QI project may lead to policies that mandate technology-based education for APPs, thereby influencing standards across healthcare to prioritize evidence-based and accessible training.

Conclusions

This quality improvement intervention at Woundtech demonstrated the efficacy of a computer-based educational module in enhancing the knowledge of advanced practice providers (APPs) regarding the wound care protocol. The intervention resulted in a 69.7% increase in score ($p < 0.001$), surpassing the goal of 25%. The mean scores rose from 6.27 in pretest assessments to 10.64 in posttest assessments. The change demonstrates the potential of the intervention to address critical knowledge gaps and reduce current practice variability, which remain significant challenges facing the United States healthcare system, particularly in the quest to manage highly prevalent cases of chronic wounds. Although the study relied on a small sample size of 11 nurse practitioners completing pre- and posttest questionnaires, the intervention successfully achieved its target. Kotter's 8-step change model guided the study, highlighting the importance of behavioral changes and their impact on healthcare initiatives. The intervention reduced existing knowledge gaps, thus holding promise for standardizing practice. Knowledge gains demonstrate the power of technology-driven education to standardize care where consistent adherence to protocol is critical. Conclusively, improving the ability of advanced practice providers to

accurately assess wounds, select requisite treatments, and document them correctly means the intervention is foundational for enhancing clinical competency and patient safety.

The study sought to closely align with the article from Kotter (1996), which inspired this research. Despite considerable efforts, two of the most critical components of successful change implementation efforts, as described by Kotter, were lacking: a sense of urgency about the problem and a guiding coalition. First, a sense of urgency did not develop among the stakeholders. Second, a guiding coalition did not create and sustain the change effort. For instance, the surveys revealed competing organizational initiatives and individual priorities diverted provider attention, hence lowering screening as a priority. Ead (2015) noted that continuous organizational change initiatives not only add to the workload but also compromise recall, consume time, and saturate resources, leading to a phenomenon known as change fatigue. Consequently, Kotter (1996) recommended forming a guiding coalition of strong leaders to prioritize change measures and identify barriers, such as support for knowledge exchange and change fatigue, thereby creating realistic approaches to implementing change initiatives. Furthermore, strategies to ensure the intervention's sustainability include integrating training into onboarding, securing additional funding, and aligning the QI with relevant health policies. Conclusively, the initiative demonstrates that computer-based interventions can effectively bridge knowledge deficits, providing a model for organizations to enhance wound care quality and patient safety.

Future Research

Although the findings from this study are promising in addressing knowledge gaps in wound care, several areas require further investigation to address limitations and expand the knowledge base. First, future studies should replicate this study with a larger and more diverse

sample across multiple Woundtech facilities to enhance generalizability and explore variations by experience and practice type. Second, future research should also consider conducting longitudinal studies with follow-up assessments at 9-12 months to evaluate knowledge retention and establish the need for booster training sessions. Third, studies should also implement a randomized controlled trial with a control group receiving traditional training. The intervention will strengthen causal inferences about the effectiveness of digital learning. Fourth, future research should also investigate the relationship between knowledge gains and patient outcomes, such as a decrease in amputations and healthcare costs. The study will rely on robust analysis of EHR data. Finally, future studies should also assess the cost-effectiveness of the intervention by comparing training costs to the savings from improved outcomes, thereby informing policy advocacy and scalability.

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Appendices

Appendix A: Support Letter from the Facility

Woundtech

April 15, 2025

To Whom It May Concern:

As the Vice President of Human Resources, I am writing to confirm our organization's full support for Alexandre Mendes's Doctor of Nursing Practice(DNP) quality improvement project. Our organization is committed to advancing evidence-based wound care practices, and we believe this educational initiative aligns perfectly with our mission to enhance patient care through provider excellence.

The proposed project, "Implementing a Computer-Based Educational Module to Optimize Utilization of a Wound Care Order Set for APPs, Based on Company Protocol: A Quality Improvement Project" addresses a crucial need in our organization. We will provide Mr. Mendes with access to our learning management system and facilitate the recruitment of Advanced Practice Providers through our internal communication channels. Our organization commits to:

- Supporting implementation through our established technological Infrastructure
- Facilitating APP participation while maintaining normal operations
- Providing secure data storage compliant with our privacy standards
- Assisting with coordination between departments as needed

Dr. Leah Ford, DPM, our National Director of Clinical Excellence, will serve as the site organizational sponsor and preceptor. Her extensive experience in protocol development and provider education makes her uniquely qualified to guide this initiative's successful implementation. She will ensure all necessary organizational approvals are obtained and that date collection processes align with our institutional policies.
We look forward to collaborating on this important quality improvement initiative, which we believe will significantly contribute to our ongoing efforts to standardize and enhance wound care delivery.

Sincerely,

Mark S. Floyd, Esq

CC: Carol Anderson, Vice President of Clinical Operations, Eastern Division

866.986.2263 • woundtech.net • 200 South Park Road Suite 200, Hollywood, FL 33021

Appendix B: Recruitment Email Letter to Potential Study Participants

Online Informed Consent

https://fiu.yul1.qualtrics.com/jfe/preview/previewId/fdb3cc6e-4abd-4547-9f24-8ed5715fea39/SV_3WZCDM06Ga51Zci?Q_CHL=preview&Q_SurveyVersionID=

Dear Woundtech Advanced Practice Provider (APP), my name is Alexandre Mendes, and I am a Doctor of Nursing Practice student from the Graduate Nursing Department at Florida International University. I am writing to invite you to participate in a quality improvement project focused on enhancing wound care protocol knowledge and implementation at Woundtech (WTN). The goal of this project is to improve APP's knowledge and application of WTN wound care protocol, through a standardized computer-based educational module. You are eligible to participate because you are currently practicing as an APP at WTN and provide direct wound care services.

I am contacting you with the permission of Dr. Carol Anderson, vice President of clinical operations of the East region, and the clinical leadership team at WTN. If you decide to participate, you will be asked to:

- Click and select "I consent" to complete the form
- Take a pre-test assessment (approximately 15 minutes)
- Complete an interactive computer-based educational module on wound care protocols (approximately 25 minutes)
- Complete a post-test assessment (approximately 15 minutes)

All activities can be completed at your convenience through our secure learning management system during the implementation period. Your responses will remain completely anonymous, and participation will not affect your employment status. This is completely voluntary, and you can choose to participate or not. If you'd like to participate, please select: "I consent"

If you have any questions about the study, please contact me at amendes@woundtech.net or 786.441.6650.
Thank you for considering participation in this important initiative to enhance our wound care services.
Sincerely,
Alexandre Mendes
DNP Student Florida International University

( ) I consent
( ) I do not consent

Appendix C: IRB Waiver Document

Woundtech™
Wound Technology Network Inc.

April 3rd, 2025

RE: IRB Waiver

Dear Dr. Victor Delgado,

After reviewing the project "Implementing a Computer-Based Educational Module to Optimize Utilization of a Wound Care Order Set for Advanced Practice Providers (APPs), Based on Company Protocol: A Quality Improvement Project," we have determined that IRB approval is not required by Woundtech. The project complies with all ethical guidelines and poses no risk to participants or the public.

This letter serves as a waiver for IRB approval for this project. Please let us know if you need any additional information.

Sincerely,

Minghsun Liu, MD PhD
Medical Director and NVP for Clinical Operations
Woundtech of Nevada
C: 310-570-2198
HQ: 866-986-6223
F: 310-697-1999
mliu@woundtech.net

Appendix D: Researcher-Developed Pretest & Posttest Instrument

1. What does an X-ray help to diagnose in the case of a suspected arterial wound?
a) Arterial calcification or vascular disease
b) Bone infection or osteomyelitis
c) Presence of edema
d) Soft tissue involvement
e) a) Arterial calcification and osteomyelitis

2. A 65-year-old male with a history of diabetes mellitus presents with a chronic ulcer on his right foot that has not healed for 6 months. The ulcer is on the plantar surface of the foot, with moderate exudate, and the surrounding tissue is erythematous and swollen. His ABI is 0.7, HbA1c is 8.5%, albumin is 2.9 g/dL, and ESR is 50 mm/hr. What is the most appropriate next step in his management?
a) Initiate systemic antibiotic therapy
b) Obtain wound culture
c) Order vascular studies and obtain wound culture
c) Order bilateral vascular studies (duplex ultrasound)
d) Start nutritional supplementation

3. Where are venous ulcers most commonly located?
a) Lower anterior shin
b) Above the medial malleolus
b) Above the lateral malleolus
c) Calf
d) Heel

4. When performing a venous duplex ultrasound, which of the following findings would suggest that a venous ulcer is related to venous insufficiency?
a) Significant arterial narrowing
b) Venous reflux
c) Venous reflux or incompetent valves
d) Poor blood flow in the capillaries
e) Complete venous obstruction

5. Under what circumstances should a wound culture be obtained?
a) For every chronic wound, regardless of clinical presentation
b) Only if the patient has a systemic infection
c) With clinical signs of infection (e.g., redness, warmth, purulent drainage)
d) Wound with erythema, edema, and stagnated wounds
e) For stagnated diabetic foot ulcers
6. If a patient with a wound is suspected of having osteomyelitis, what lab should be ordered to assess for infection?

a) HgA1c and albumin
b) ESR and CRP
c) CBC and CMP
d) CBC, CMP, ESR, CRP, pre-Albumin, albumin, HbA1c, and wound culture
e) Wound culture

7. True or False: X-rays can effectively diagnose both foreign bodies and osteomyelitis in wound assessment.
a) True
b) Neither true nor false
c) False

8. In a patient with suspected osteomyelitis, when is an X-ray indicated?
a) Only if the wound is on the foot
b) As a first-line assessment
c) Only if ESR and CRP values are elevated
d) After 3 months of non-healing
e) Stage 3 pressure ulcer

9. Under which circumstances should a Dietitian consultation be ordered?
a) For patients with a BMI of more than 25 or less than 18.5
b) If there are nutritional concerns and/or heavy exudate
c) When the patient has a diagnosis of diabetes
d) Bedridden patients with signs of malnourishment and anemia
e) All of the above

10. A patient is having trouble chewing and swallowing (dysphagia). What is the appropriate next step?
a) Perform a water swallow test
a) Provide softer foods
b) Consider a dietitian consultation to evaluate nutritional needs
c) Encourage increased fluid intake
d) Monitor without intervention

11. True or False: A Comprehensive Metabolic Panel (CMP) provides information about Electrolyte imbalances, organ function, and blood glucose levels.
a) True
b) Neither true nor false
c) False

Appendix E: Participant Informed Consent Document

FIU | FLORIDA INTERNATIONAL UNIVERSITY

Office of Research Integrity
Research Compliance, MARC 414

MEMORANDUM

To: Dr. Victor Delgado
CC: Alexandre Mendes

From: Maria Melendez-Vargas, MIBA, IRB Coordinator

Date: March 20, 2025

Protocol Title: "Implementing a Computer-Based Educational Module to Optimize Utilization of a Wound Care Order Set for Advanced Practice Providers (APPs), Based on Company Protocol: A Quality Improvement Project"

The Florida International University Office of Research Integrity has reviewed your research study for the use of human subjects and deemed it Exempt via the **Exempt Review** process.

IRB Protocol Exemption #: IRB-25-0126 **IRB Exemption Date:** 03/20/25
TOPAZ Reference #: 115398

As a requirement of IRB Exemption you are required to:

1) Submit an IRB Exempt Amendment Form for all proposed additions or changes in the procedures involving human subjects. All additions and changes must be reviewed and approved prior to implementation.
2) Promptly submit an IRB Exempt Event Report Form for every serious or unusual or unanticipated adverse event, problems with the rights or welfare of the human subjects, and/or deviations from the approved protocol.

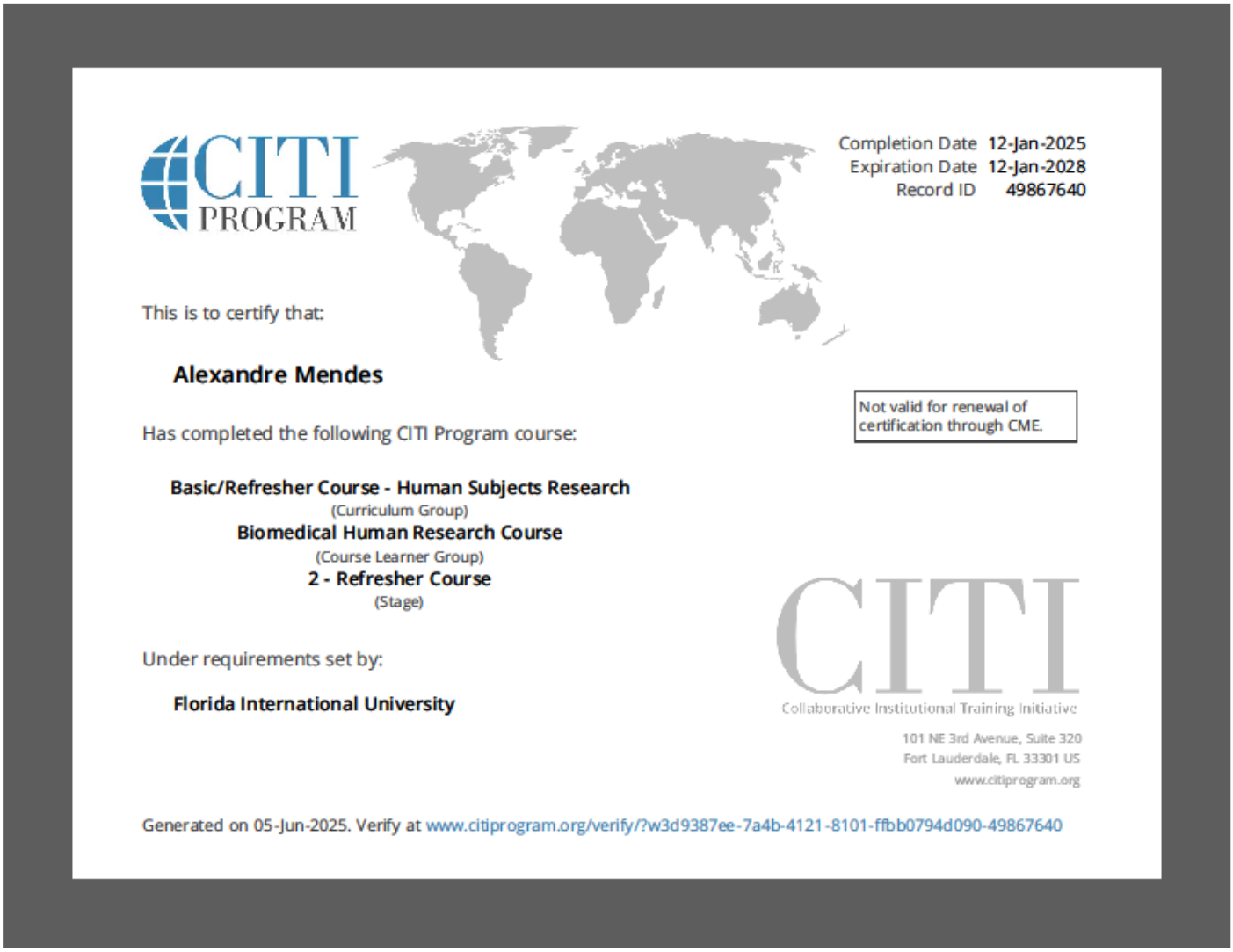
Special Conditions: N/A

3) Submit an IRB Exempt Project Completion Report Form when the study is finished or discontinued.

For further information, you may visit the IRB website at http://research.fiu.edu/irb.

MMV/em

Appendix F: CITI Ethics Certification



CITI PROGRAM

Completion Date 12-Jan-2025
Expiration Date 12-Jan-2028
Record ID 49867640

This is to certify that:

Alexandre Mendes

Not valid for renewal of certification through CME.

Has completed the following CITI Program course:

Basic/Refresher Course - Human Subjects Research
(Curriculum Group)
Biomedical Human Research Course
(Course Learner Group)
2 - Refresher Course
(Stage)

Under requirements set by:

Florida International University

CITI
Collaborative Institutional Training Initiative
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Fort Lauderdale, FL 33301 US
www.citiprogram.org

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