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Improving Wound Care using the TIME Framework

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Abstract

Background and purpose: Although wound care guidelines are available for primary care providers, barriers to assessment and treatment remain. This paper examines current evidence, guidelines, and discusses the need for improved training, education, and a simplified approach to wound management in primary care. The goal of the project was to increase the provider's comfort level in assessing and initiating wound care treatment in the clinical setting. ***Methods:*** An evidence-based wound treatment framework, identified as the TIME (tissue, infection, moisture, epithelial) framework, was selected for the project. The framework was tailored by subject matter experts to provide a distinctive approach to the non-wound care expert allowing more diverse utilizations across the primary care spectrum. The modified TIME framework was shared with 29 providers over three educational sessions. Participants included Nurse Practitioners and Physicians. The knowledge attained and the usability of the framework was evaluated using a case study approach and self-reported comfort level relating to the assessment and initiation of wound treatment. ***Conclusion:*** After the educational sessions, the comfort level of all providers increased dramatically from pre- to post-assessment. Comfort level was self-reported on a 5-point Likert scale (1 = *poor*, 3 = *average*, 5 = *excellent*). Responses indicated that 42% of participants reported below average or poor comfort at the pretest, while 96% of participants reported average or above average comfort at the posttest. Comfort level related to knowledge gained in developing a treatment plan also increased: At pretest, 77% of participants reported below average comfort, while 96% of participants reported average or above average comfort at the posttest. Results also indicated a significant increase in wound care knowledge and understanding of wound care concepts related to the modified TIME framework, including identifying specific wounds and initiating treatment.

Keywords: *Wound Care, primary care, wound resources, initial wound treatment, wound care tool kit*

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Introduction

Background and Significance

The geriatric population is expected to increase as the lifespan of baby boomers increases. The Centers for Disease Control and Prevention (CDC, 2013) identified that the American population aged 65 and older will double over the next 25 years to reach about 72 million. This number will account for almost 20% of the U.S. population by 2030. Primary care offices and clinics will remain the main access point for health care for these patients. As the population ages, the number of chronic diseases will also rise. Not only will the 65 and older population suffer from chronic illnesses, but according to the CDC (2016), about 14% of all adults aged 18 years to 64 will have at least two to three chronic health conditions. Chronic diseases are costly, are considered largely preventable, and are expected to increase in prevalence as the population ages and increases in number (CDC, 2013). The most common chronic conditions are heart disease, diabetes, obesity, stroke, and arthritis. In 2010, these five conditions cost the United States nearly $347 billion (CDC, 2013). As of 2014, the percentage of obese adults aged 20 and over surpassed 37% of the U.S. population (CDC, 2016). The prevalence of diabetes is almost 12% of the U.S. population (CDC, 2016). According to the American Diabetes Association (ADA), approximately 30 million Americans have diabetes while 7.2 million are undiagnosed. The prevalence of diabetes is greatest among individuals aged 65 and older, almost 25.2% (ADA, 2015).

As chronic diseases continue to affect the population, it is likely that many patients will present with comorbid complications. Of these complications, chronic wounds will affect at least 6.5 million patients who suffer from diabetes and obesity (Sen et al., 2009). The American College of Foot and Ankle Surgeons (ACFAS) projects that about 15% of patients with diabetes

will develop a serious foot ulcer during their lifetime (ACFAS, 2017). Diabetic ulcers develop not only from trauma to the foot, but also from pressure that goes unnoticed due to sensory neuropathy (ACFAS, 2017). Pressure sites can cause calluses and without attention, callouses can develop into an ulcer. Healing is often impeded due to poor vascular function in patients with diabetes, which means the chronic ulcer can become infected if left untreated or if interventions are delayed (ACFAS, 2017). Alavi et al. (2016) found that venous ulcers account for approximately 70% of all leg ulcers and affect 2.2 million Americans annually. Their recurrent nature has an impact on morbidity and reduces quality of life; following diagnosis, reoccurrence is as high as 50% over a 10-year period (O'Donnell et al., 2014).

Problem Description

Cost Burden of Chronic Wounds

Sen et al. (2009) discusses the burden of treating chronic wounds currently being around $25 billion annually and growing due to increased health care costs. The rise in cost has been attributed to the aging population and a sharp rise in diabetes and obesity worldwide (Sen et al., 2009). More than half of all foot ulcers will become infected, 25% of infected ulcers will require amputation, and 80% of documented non-traumatic amputations are a result of diabetes (ACFAS 2017). Furthermore, the cost for all medical services related to a lower extremity amputation is $52,000 per patient annually. This includes approximately 12 visits to an outpatient provider and two hospitalizations per year per patient (Margolis et al., 2011).

According to Yelland (2014), primary care providers have a critical role in both health outcomes and health expenditures related to wound management. However, one of the major barriers to improving wound care is the lack of education for general practitioners. Improvement

in wound care outcomes is dependent on the availability of evidence-based wound management resources (Yelland, 2014).

Primary care providers remain the main access point to the healthcare system and Yelland revealed concerns about primary care practitioners because they often express a lack of confidence in wound management (2014). The local bay area hospital selected for the DNP project requires a wound care consult prior to an intervention by the wound care specialist. Process time for the consult can be 24 to 72 hours depending on multiple factors, such as day and time of the consult submission. This lost time can be critical for appropriate wound management.

Setting

A local Bay Area hospital was selected for the DNP project. The healthcare system has a wound care program consisting of nurse practitioners and registered nurses who have completed additional course work and have national certification as wound care certified nurses. The wound care program receives referrals from both the inpatient and outpatient settings. However, the wound care program does not offer on call support or coverage after hours. Also, during the holiday and weekends, no wound care specialists are available. A stat wound care consult is usually seen within a 24-hour period. The exception to that time frame is if the wound care consult is placed on a Friday night at an emergency room visit, then the patient will not be seen until Monday or Tuesday. Also, if the consult is placed during a federal holiday weekend, it could be as much as three to four days before a wound care specialist is able to see the wound. Primary care providers also see patients during the weekdays in clinic. Some of the patients present with uncomplicated wounds. However, if the provider is unaware of the guidelines or is unable to select an appropriate treatment, the wound has the potential to deteriorate.

The health care system operates over 800 beds and includes three nursing homes and a 100-bed homeless domiciliary that serve over 67,000 current patients. The patient population that the healthcare system serves includes young adults ranging from 18 years of age to the geriatric population. The system has an affiliation with a local university and offers training to medical residents. The system provides inpatient, outpatient, and specialized care services. The health care system employs advance practice nurses, physician assistants, nurse practitioners, medical students, medical residents, and attending physicians. Approval for this project was gained from the education department associated with the health care system (Appendix B).

Available Knowledge

The PICOT question analyzed the state of wound care education (I) in primary care (P) as compared to wound specialist's knowledge (C) on management of wounds (O). The literature search included the following databases: CINAHL, PubMed, Joanna Briggs Institute EBP Database and the Cochrane Database of Systemic Reviews. Given minimal research availability on the state of wound care as it relates to non-wound care experts, inclusion criteria were made broad and focused on primary care providers, outpatient setting, inpatient settings, nurse practitioners and physicians. The inclusion timeline was also extended and included published articles over the last 15-year period. The project literature review progressed through three stages: Initial stage of the literature search reviewed how well-prepared primary care providers are to address wounds and used key words of *wound care, primary care, comfort level and education.* The search identified three articles meeting inclusion criteria. The next stage focused on current state of *guidelines* and *resources*. The search identified two articles meeting inclusion criteria. The final search included *treatment references, algorithms* and *framework*. The search identified four articles meeting inclusion criteria. Articles focusing on advanced interventions of

wound care were not included in the studies. The inquiry furnished a total of eight articles meeting inclusion criteria. The articles were evaluated using the Johns Hopkins Nursing Research Evidence Appraisal Tool. The articles reviewed included evidence strength and quality of Level 2A to Level 5B (Appendix C).

Several themes emerged during the literature review and three overall concerns became evident. First, the literature illustrated the existence of a wound care education gap among primary care providers. Secondly, varying guidelines and unreliable resources were found. Lastly, frameworks and electronic references are currently geared toward the wound care specialist and not the primary care provider who is a non-wound care expert.

Educational Gap for Wound Care

A knowledge deficit for wound care is a concern for physicians. Patel et al. (2008) studied retrospective data from medical school curriculums in the United States through the American Association of Medical Colleges (AAMC). They found that in the United States, medical schools averaged 9.2 hours of wound education during a 4-year curriculum (Patel et al., 2008). Further, the Accreditation Council for Graduate Medical Education (ACGME) does not require chronic wound care education or training and, not surprisingly, few family medical residency programs provide specific wound care teaching for their residents (Little, Menawat, Worzniak, & Fetters, 2013). Lemon, Munsif, & Sinha, (2013) recommended a concerted effort for more education in wound care in the undergraduate medical curriculum.

Appropriate wound care management can prevent complications associated with wounds. However, primary care practitioners are deemed underprepared, as they lack basic wound care knowledge. According to the American Association of Colleges of Nursing (AACN, 2018), nurse practitioner education should include “skin integrity” as a primary care core competency;

however, training programs often devote limited time to this critical area of education (AACN, 2018). Similarly, education on chronic and acute wounds is lacking in the core competencies for nurse practitioners, by the guiding curriculum organization, the National Organization of Nurse Practitioner Faculties (NONPF, 2018). The Accreditation Review Commission on Education for the Physician Assistant (ARCEPA, 2018) does not require chronic wound care education or training in their educational criteria. Moore and Clarke (2011) reviewed nursing school education at the undergraduate level, finding that Bachelor of Science in nursing programs, which produce registered nurses, devoted a maximum of one day to the topic of wound care.

Varying Practice Guidelines and Resources

The practice of wound care is complicated and access to guidelines, pathways, and educational resources is also limited (Yelland, 2014). Limited support is available to primary care practitioners, as there are very few publications for education on chronic wound care, and the ones that do exist primarily focus on prevention rather than treatment (Little et al., 2013). Other barriers include guidelines that are based on small studies, indirect evidence, or expert opinion (Little et al., 2013) Also, release of numerous new wound care products and research studies by the product manufacturers make it difficult for primary care physicians to discern the most effective products based on the available literature (Little et al., 2013). Building new wound care knowledge has not been a high priority for primary care practitioners (Yelland, 2014).

Various organizations provide their recommendations for wound care (Table 1). This table is not all-inclusive. As an example, table 1 has at least six organizations that offer treatment guidelines for the “diabetic foot ulcer”. Multiple guidelines from different organization create a challenge of selecting the appropriate organization guidelines to follow. Which of those six

organizations has the most up to date guidelines or are the guidelines outdated? The process to access and navigate through the resources, then select the type of treatment creates additional confusion. Some organizations also require membership fees to access their guidelines. Apart from these referenced sources, primary care practitioners can also complete a national certification in wound care, which is available from three professional organizations (Table 2).

Variable Wound Care References

Managing wounds in primary care settings while utilizing technology must be considered and evaluated. Technology continues to evolve, and health care practitioners continue to incorporate it into their practice. The Health Information Technology for Economic and Clinical Health Act (CDC, 2016) aimed to modernize the nation's infrastructure. The act began the push for meaningful use, as more health care clinics and hospitals began to switch to electronic health care records and additional technology (CDC, 2016).

Beitz, Gerlach, and Schafer (2014) examined the use of a digital algorithm in ostomy care management by using a cross-sectional, mixed-methods web based survey. The sample included 297 registered nurses practicing in acute and post-acute settings. Participants were presented with seven ostomy-related digital scenarios consisting of real-life photos and pertinent clinical information. Respondents used the 11 assessment components of the digital algorithm to choose management options. Implementing the digital algorithm for use by non-expert providers improved the accuracy of wound treatment by 84%.

Divall, Camosso-Stefinovic and Baker (2013) completed a systemic review for randomized controlled trials and assessed the use of personal digital assist (PDAs) devices. Three studies were examined and found that the use of a personal digital assistant and technology in

clinics has been associated with an increase in data collection quality, more accurate diagnosis, and better treatment courses.

Practitioners are implementing more technology into their practice. *Precision medicine*, a relatively new term, refers to the use of information technology and electronic health records to create clinical care guidelines (Jameson & Longo, 2015). As the complexity of disease becomes more apparent, physicians—especially primary care providers—will need to utilize informatics with clinical guidelines in order to navigate these complex and specialized referral pathways (Jameson & Longo, 2015). Informatics and *precision medicine* could contribute significantly to wound care management.

Another example of health care technology is the implementation of a software application (app) on a smartphone. Several wound care software apps (Table 3) are available on different smartphone platforms and vary in cost and function. Out of the four apps listed in Table 3, three are intended for use by a wound specialist. These apps feature advanced options, such as tools that permit automatic measuring with a smartphone camera and the ability to upload the photo to the patient's electronic health record.

Inconsistent Frameworks for Wound Care

Schultz et al. (2003) completed an expert opinion and review of the wound bed preparation (WBP) technique used by the wound care specialist (Appendix D). The WBP technique is the management of a wound to accelerate endogenous healing or to facilitate the effectiveness of other therapeutic measures. The recommendations by Schultz et al. (2003) led to the development of the tissue, infection, moisture, epithelial (TIME) framework in 2003. The TIME framework is evidence based and functions as a systematic guide for wound care specialists in the treatment of chronic wounds (Appendix E).

Dowsett (2009) completed an experimental pre-test-post-test design study on the TIME framework. The study was completed in the community by 47 nurses. The framework was evaluated with questionnaires, non-participant observation and recording data from patients' clinical records. The study found that community nurses' wound care knowledge and practice improved significantly after training. Little et al., (2013), had positive outcomes from additional training which was provided to surgical residents during their rotation. The residents reported their level of comfort improved relating to wounds following their rotations.

Rationale

To consolidate the available referenced guidelines from the different types of organizations, an electronic algorithm was selected initially and piloted with a plan-do-study-act (PDSA) cycle (Appendix I). The PDSA cycle was completed by nurse practitioner students in their final semester at the University of San Francisco. The cycle examined the utility of a smartphone app for wound care (Appendix J). The educational material was presented utilizing a PowerPoint presentation, with a focus on the background and significance of wound care, as well as step-by-step instructions on how to download the Wound Central mobile app. The training also included a walkthrough of the Wound Central app (i.e., menus, location of resources).

Overall, the presentation lasted about 1 hour. The feedback collected was relevant to the Wound Central mobile app. The nurse practitioner students found the treatment selection process within Wound Central was also unclear. It was discovered that the app still needed updates by the developers to fine-tune the treatments options and to differentiate the basic from the advanced modalities and interventions. Students did, however, find the visual aids for the identification and description of wounds, guidelines for describing wounds, and discussion of the types of wound dressings to be positive aspects of the app.

The TIME Framework

Given the Wound Central mobile app's inability to provide clear assessment and treatment guidelines for the non-specialist practitioner in wound care, alternative resources were explored. The WBP technique and TIME framework are widely used by wound care specialists. Schults et al. (2003) completed an expert opinion on ways to accelerate healing using the WBP technique. The WBP has several key steps and includes debridement, bacterial balance, chronic inflammation and moisture balance. Dowsett (2009) was able to increase wound care knowledge and practice using the TIME framework.

In its current form, the TIME framework is only applicable to wound care specialists who have received additional training as the TIME framework guides the practitioners in selecting specialized assessments and interventions. These interventions include surgical and enzymatic debridement and advanced healing therapies such as Medihoney and calcium alginate. Although currently not available in a form for the non-specialist of wound care, these resources were selected to be modified for the primary care provider with limited knowledge and understanding of wound healing. A modified version of the TIME framework for the non-specialist of wound care can improve wound care assessment, diagnosis, and treatment, thereby reducing complications and increasing positive outcomes. Further, if successful in trial, the TIME framework could be converted into an electronic version and made available on the smartphone App.

Conceptual Framework for Project

Three change theories—Lewin's change theory, Lippitt's change theory, and the Carnegie School's theory of organizational change—were evaluated for the conceptual

framework of this study. Kurt Lewin's theory of change was selected, and it involves three steps: (a) unfreezing, (b) change, and (c) refreezing change. The first step of Lewin's framework of change is *unfreezing*. Unfreezing created awareness regarding the current process and what could be done better. A force field analysis was used to provide context for the gap analysis (see Table 4). The information presented focused on level of comfort, extent of education and training, variability in treatment, and difficulties accessing current guidelines for wound care.

The second step of Lewin's conceptual framework is *change*, which is described as the process of transition and implementation. During this step, the TIME framework is introduced and includes benefits of using the framework and developing a systematic approach to wound care. The education segment also included basic wound care principles and available dressings to treat the most common chronic wounds.

The last step is *refreezing*, which involves reinforcing, stabilizing, and solidifying the new state after the change has been made. Arguably, this is the most difficult step to achieve given the minimal interaction with providers (i.e., only a single face-to-face training session). A case study will be used to refreeze the TIME framework having participants work their way through the case study by assessing the type of wound and selecting initial treatment for the wound. Use of the case study will increase the confidence of providers in applicability and promoting greater use of the TIME framework. At the end of the training, the knowledge assessment is administered to participants to assess level of comfort and knowledge gained from the training.

Specific Aim

The overall goal for the DNP project is to increase the primary care provider's comfort level in accurately assessing a wound and initiating early treatment in the clinical setting by using a wound care treatment framework. By the end of the educational sessions and training, the objective is for at least 80% of participants to have increased comfort levels and improved knowledge regarding the use of the framework. This DNP project will also provide basic wound care principles as they relate to WBP and simplified treatment options. The desired end outcome is the ability for primary care providers in all settings to feel more comfortable initiating timely care using a standard EB algorithm to help ensure quality care across the health care system.

Methods

Context

The TIME framework (Appendix E) is designed to be used by the wound care specialist as a systematic tool to assess wounds and select an appropriate wound treatment (Dowsett, 2009). The interventions listed in the framework are considered advanced therapies requiring additional training. Three subject-matter experts, all three wound-care certified, assisted in revising the TIME framework and incorporating basic wound care interventions (Appendix F). The wound care subject matter experts also identified commonly prescribed inappropriate wound treatments at the healthcare system. These treatments were prescribed in both inpatient and outpatient settings. The inappropriate interventions included frequency of dressing changes, types of wound care dressings being ordered, non-selective wound debridement such as a wet-to-dry dressing changes, debridement of stable eschar and use of betadine on viable tissues. An emphasis was also placed on when to make a stat referral to wound care consult versus a recommendation for the emergency department. These concepts were added to the TIME framework.

The four steps of the TIME framework are an acronym for tissue, infection, moisture and edges. The modified TIME framework now has basic wound care principles embedded in the framework. The “T” for tissue now lists assessment of the wound bed beginning with cleansing the wound instead of debridement, which would have been a wound care specialist intervention. The “I” is a reference for infection or inflammation and includes use of antibiotics by the wound specialist. The infection section now stated to assess for signs and symptoms of infection being local or systemic and whether a referral to the emergency department was immediately necessary. The infection section also listed betadine use on nonviable tissue. The “M” for moisture no longer includes compression dressings and specialty absorbent dressing. The basic interventions for moisture now include assessing amount of drainage, use of heavy versus light gauze and not ordering wet-to-dry dressing changes. In its original description, step “E” for edges assessed for non-advancing edges requiring debridement or skin grafts. The moisture section now stated to use skin protectant to prevent wound deterioration, macerations and cover the entire wound with the dressing. Now the modified TIME framework was tailored to the primary care practitioner with minimum wound care knowledge.

A knowledge assessment and case study (Appendices L and M) were developed to assess the knowledge gained from the training. The knowledge assessment and case study were built to measure the baseline data on the current comfort and knowledge of wounds and compare it to the post presentation data. The questions in the knowledge assessment were multiple choice answers and focused on WBP techniques and commonly prescribed inappropriate wound treatments.

The case study used multiple choice answers and included three types of lower extremity ulcers for identification. Once the type of wound was identified, an appropriate treatment based on the TIME framework needed to be selected. The patient presented in the case study had a past

medical history (PMH) with comorbidities commonly seen in all three types of lower extremity ulcers including arterial, venous and diabetic. The case study and knowledge assessment were first used in the PDSA cycle at the University of San Francisco in January 2018.

After the PDSA cycle, revisions to both knowledge assessment and case study included simplifying the visual photographs to help better distinguish among arterial, venous, and diabetic wounds. An additional modification included the use of question-order randomization for the baseline and post-training knowledge assessment (Knowledge Assessment 2 in Appendix N and Case Study 2 in Appendix O). This change was made to ensure that participants would not answer questions solely based on priming or recall of the answer choice location.

This project includes several stakeholders including the patients, healthcare system's education department, nurse practitioners, medical residents and attending physicians. Responsible parties of the DNP project include the student, faculty, and the facility education department. Project controls include using the TIME framework to assess its specific applicability to primary care practice. The changes to practice, as with most change, were anticipated to be met with resistance. Primary care practitioners may be resistant to adding wound care interventions to their typical encounters, as they are already extremely busy and have limited time with patients.

Interventions

Educating the primary care practitioner on wound care assessment and management remains a priority. The primary care provider will also be more equipped to assess and initiate accurate treatment of wounds through use of resources in real time. Part of the presentation will focus on the modified wound care TIME framework. The modified TIME framework will be assessed with a knowledge assessment and a case study.

The education presentation on wounds will have three specific learner objectives: (a) wound bed preparation (WBP), (b) modified TIME framework, and (c) recognizing three common types of lower extremity ulcers to initiate wound treatment using the modified TIME framework. The material was presented with a power point presentation, hard copy of the modified TIME framework, baseline knowledge assessment, case study, lower extremity ulcers (see Appendix O) and a toolkit handout that listed most common supplies needed for most dressing changes (see Appendix H).

The first objective focused on concepts of WBP. The approach of WBP requires the provider to assess the wound bed and have the wound bed tell the provider the type of treatment it needs. Factors to consider when selecting a treatment include amount of drainage, type of drainage and size of the wound. If the wound appears wet with moderate to heavy drainage, then according to the WBP, apply something that will absorb the drainage and avoid maceration of the wound. If the wound appears dried out, cover it with a dry or moist dressing. These concepts were initially discussed and added to modified TIME framework.

The second objective focused on the modified TIME framework: a systematic approach to assessing and initiating the initial treatment with the acronym TIME. The presentation included T for tissue, I for infection, M for moisture and E for edges. The framework guides the provider thought process and prioritization when deciding the characteristics of the wound and anticipating the next steps of the wound treatment.

The last objective focused on differentiating arterial, venous and diabetic lower extremity ulcers, which are commonly confused with one another in the clinical setting. The presentation focused on understanding the pathophysiology as it relates to the location, shape, presentation and drainage of the ulcer.

To assess the knowledge gained from the presentation and training, a knowledge assessment and case study will be administered prior to the start of the presentation and at the completion of the training.

The GAP analysis highlights several issues that need to be resolved. The analysis underlines the lack of comfort of primary care providers with wound knowledge. The knowledge deficit originates form initial education. Providers are not provided sufficient studies to become comfortable with wound care nor are there wound care residency programs designed to immerse a primary care provider into the world of wound care. This barrier of knowledge affects assessment and initiation of wound treatment. Further, the risk for inappropriate assessment and inaccurate treatment selection increases.

The future state would focus on accurate assessment and selection of the initial treatment. The accuracy of assessment and treatment of wounds will increase with readily available resources, such as the modified TIME framework, and additional education for the primary care provider.

The strength, weaknesses, opportunity and threats (SWOT) of this project have been evaluated (Appendix J). The strengths of this project include providers openness to change, increase in efficiency secondary to an easy to follow framework, providing timely care to patients, decreasing complications specifically infections and amputations, decreasing healing time, improving health outcomes, decreasing inappropriate referrals to wound care specialists thereby increasing access for the community to the healthcare system.

Weaknesses include large organizations uninterested in providing wound care knowledge to their providers, limited time that the provider is spending with the patient, and limited wound care resources. Opportunities include providers gain confidence in their ability to

initiate wound care treatment focusing on evidence-based practice, developing a framework to standardize initial assessment and treatment initiation would decrease variability and poor prognosis from improper wound care treatments. Threats include time of the provider and availability out of clinic to participate in the training, resistance to change and taking additional duties by completing wound care as the primary care provider.

The budget for the project included time volunteered by the author. The cost is approximated at $100 per hour for a total cost of $300 for the 3 training sessions. Additional costs include costs for handouts. The total cost of the project was minimal at $400 (Appendix P). There was no incentive offered for participation in the project.

Alavi et al. (2016) found that venous ulcers account for approximately 70% of all leg ulcers and affect 2.2 million Americans annually. More than half of all foot ulcers will become infected, 25% of infected ulcers will require amputation, and 80% of documented non-traumatic amputations are a result of diabetes (ACFAS 2017). Furthermore, the cost for all medical services related to a lower extremity amputation is $52,000 per patient annually (Margolis et al., 2011). If the proposed modified TIME framework could reduce 5% of venous ulcer wounds from progressing and deteriorating to the point requiring amputation, that would prevent 13,750 patients from receiving an amputation and would save $715 million dollars annually in the United States (Appendix S).

Timeline of the DNP presentation began in January of 2018. The PDSA cycle was completed in February at a Bay Area University for nurse practitioner students. The PDSA cycle was unsuccessful in implementing the use of a smartphone application for wound care. However, the presentation was successful in testing the first version of the knowledge assessment and case study along with gathering feedbacks for revisions.

The TIME presentation was delivered at a Bay Area hospital in the months of June and July. The presentations lasted one hour and were presented on three separate training sessions over three different dates. August and September were used to analyze the data. Gantt and milestone charts are attached in Appendices R and S. Communication took place on two different occasions with the facility providers: at the time of the implementation of the intervention (i.e., commencing with framework) and with the DNP chair every 2 weeks to check on the progress of the project (Appendix R).

Study of the intervention

The project aimed to measure the modified TIME framework's effectiveness in the clinical setting. The evaluation included comfort level, accuracy in assessing a wound, ease of selecting appropriate treatment, and identification of the type of lower extremity ulcer while applying the modified TIME framework to select the appropriate treatment.

Several types of evaluations (Appendix L & N) were used to compare pre-and-post training knowledge. The first section of the baseline knowledge assessment consisted of a self-reported comfort level of the providers using a Likert scale to capture baseline comfort level in assessing and developing initial wound care treatment plan. The second part of the knowledge assessment used multiple-choice answers to capture types of treatments that the provider would order. This format of questions attempted to verify if in fact the inappropriate interventions mentioned earlier were commonly ordered by the providers.

The case study (Appendix M & O) included visual photographs of lower extremity ulcer and was used to simulate a patient that would be seen by the primary provider in a clinical setting. Innes-Walker, K., & Edwards, H. (2013) found that providers were least confident in managing the mixed venous/arterial leg ulcers. Therefore, the case study focused on lower

extremity ulcers. The patient could present with any of three types of wounds—arterial, venous, or diabetic—based on past medical history. Three types of ulcers of the lower extremity were pictured in three different questions. The providers are asked to assess and identify the type of wound based on the presenting characteristic using multiple choice questions.

The same knowledge assessment and case study were again completed following the training session. The providers would now be familiar with WBP concepts, the modified TIME framework in hand and tools to differentiate the types of lower extremity ulcers. The post-training knowledge assessment and case study questions were altered in their sequence and the locations of the answers were also shuffled. The step to alter the sequence of questions and answers required the provider to work through the questions instead of relying solely on memory recall to select the same potential answer.

Measures

Three outcomes were used to evaluate the DNP project's effectiveness.

1) To increase in the primary care provider's comfort level by 25%.
2) To increase primary care provider's wound care knowledge by 25%.
3) To increase primary care provider's accuracy of identifying the type of lower extremity ulcers by 80%.

To be eligible to participate, providers had to have completed the pre-assessment; providers who arrived late to the presentation were not eligible to participate. They were, however, welcomed to remain for the training.

Analysis

The primary method of analysis for this project was comparing pre-and post-intervention data. To capture and match the providers results from the pre-and post-intervention, the handouts

were labeled with a number in the upper right-hand corner to associate with the post-intervention handouts. As an example, if the participant received a handout with the number two in the upper right-hand corner, then the post-intervention data sheets also had the number two in the upper right-hand corner.

Data collected was both qualitative and quantitative data. The qualitative component consisted of participants' subjective responses regarding their level of comfort. The comfort level was measured with two questions. The first question measured the comfort level in assessing a wound. The second question measured the comfort level in initiating wound care treatment. The number of responses in each section of the Likert scale were counted and provided a sum for each section. The data was then converted to percentages of each section. Lastly, the percentages were compared to the pre-intervention results.

The quantitative data focused on knowledge assessment, lower extremity ulcer identification and selection of treatment. The number of correct questions for each section was counted and provided a sum for each question. The data was then converted to percentages of questions answered correctly. Finally, the percentages were compared to the pre-intervention results for each question in all three sections.

The knowledge assessment and case study were transcribed into Microsoft excel program. The data was sorted by the number designated on the handout. The questions from the knowledge assessment and case study were further examined individually. Once analysis of the data was complete and percentages for each section were obtained, graphs were created to make the data more visible.

Ethical Considerations

This project promotes knowledge and empowers primary care providers to function with a high degree of confidence in assessing and initiating evidence-based treatment of wounds. Further, ethical barriers in delays of treatments are addressed by providing resources to be used in real-time.

Ethical considerations for appropriate wound management include nonmaleficence, negligence, and autonomy. *Nonmaleficence* is defined as providers' commitment to cause no harm in treating patients. As primary care practitioners, inability to initiate treatment for wounds—and limited confidence in initiating treatment—due to lack of adequate education could ultimately cause patients harm. Lack of treatment or delayed treatment can cause a wound to deteriorate, possibly constituting neglect by the provider. Understanding wound care and making resources more readily available will allow for greater autonomy among primary care practitioners to assess and make appropriate recommendations for wound care (Appendix A for research determination form).

Results

Three training sessions were held and a total of 29 providers participated in the project. Participants included nurse practitioners and medical doctors. Out of the 29 providers, four submissions were deemed ineligible due to incomplete answers on the case studies (i.e., blank documents). Overall, the results demonstrated increases in all outcomes when compared to the pre-intervention results. An increase in comfort level in both assessing and developing a treatment plan for a wound, an increase in knowledge of WBP technique and an increase in identification of the type of lower extremity ulcer presented in the case study were evident. During the case study, it was found that accurate initial treatment selection was also increased. The knowledge assessment and case study confirmed the findings of the literature review and

used the modified TIME framework in delivering a systemic approach to assessing and selecting an appropriate wound treatment.

Providers' comfort level increased dramatically from pre- to post-assessment. Comfort level was self-reported on a 5-point Likert scale (1 = *poor*, 3 = *average*, 5 = *excellent*). Responses indicated that 42% of participants reported below average or poor comfort at the pretest, while 96% of participants reported average or above average comfort at the posttest. Comfort level in developing a treatment plan also increased. At the pretest, 77% of participants reported below average comfort, while 96% of participants reported average or above average comfort at the posttest (Figure 1).

Wound care knowledge, as measured by the knowledge assessment, also increased significantly (Figure 2). Questions 1 and 2 concentrated on WBP technique. Question 3 through 5 concentrated on commonly prescribed inappropriate wound treatments as identified by the wound care subject matter experts. Question 1 focused on the first step of wound management and highlighted cleansing of the wound. The pre-intervention was 48% accurate and increased to 96% post-intervention. Question 2 focused on exudate and moisture of the wound. The pre-intervention was 68% accurate and increased to 84% post-intervention. Question 3 focused on wet-to-dry dressings. The pre-intervention was 48% accurate and increased to 96% post-intervention. Question 4 focused on use of non-selective wound debridement. The pre-intervention was 24% accurate and increased to 100% post-intervention. Question 5 focused on stable eschar and use of betadine. The pre-intervention was 32% accurate and increased to 92% post-intervention.

The case study included a visual identification exercise for three different types of wounds (Questions 6, 8, & 10). Response accuracy was 88% at the pretest, increasing to 100%

at the posttest. Response accuracy for the selection of an initial treatment (Questions 9 & 11) also increased from pre- to posttest: For Question 9, accuracy increased from 28 to 88%; for Question 11, accuracy increased from 40 to 88%. Both questions focused on the initial treatment of a diabetic wound and stable eschar. Most of the participants selected "begin debridement" as the initial treatment in the pre-test, which was the incorrect response.

Discussion

Summary

The project aim was achieved as the provider's comfort level in assessing wounds and developing a treatment plan for wounds increased following the training. The providers were also able to apply WBP concepts and the modified TIME framework in a simulated clinical setting with the knowledge assessment and case study. The concerns on use of inappropriate interventions, such as wet-to-dry dressing changes, more frequent dressing changes, use of betadine on viable tissue and selection of stable eschar debridement were also addressed. The inappropriate interventions were discussed during the presentation as part of the WBP section and built into the modified TIME framework.

New possibilities emerged regarding the modified TIME framework as an effective tool that can be taught throughout nursing and medical schools. Dissemination plans include submitting these results relating to the modified TIME framework to a journal and attempting to publish. Further, these results will be submitted to the Wound Central App developer for evaluation to be added into the App. The implications for Advance Nursing Practice include more accurate assessment of wounds, increase confidence in selection of initial wound care treatment and decreasing the incidents of wounds deteriorating from inappropriate wound treatment.

Interpretation

The increase in comfort level with wound assessment and wound care knowledge are a direct result of training and education regarding the TIME framework. Also, presenting and discussing concepts of the WBP technique allow for the participants to understand the rationale of their selected wound treatment. Using a readily available systematic wound framework will continue to build confidence for the primary care provider. In comparison, this DNP project resulted in similar findings with other publications such as Little et al., (2013), in that similarities exist regarding positive outcomes from additional training provided to surgical residents during their rotation. The residents reported their level of comfort improved relating to wounds.

The impact of this DNP project and specifically implementation of the modified TIME framework could be tremendous to the healthcare system and could potentially increase access by initiating treatment for chronic wounds in the outpatient setting. It seems appropriate to further suggest that the number of inappropriate referrals to wound care service would decrease and allow more prompt response to consults deemed more appropriately requiring immediate wound care specialist intervention. Also, the number of patients with inappropriate referrals to the emergency department would decrease as well. Another benefit is a potential decrease in infections related to chronic wounds such as osteomyelitis and sepsis. A training of this kind offered in primary care programs and for practicing NPs, PAs, and physicians would also provide a stronger foundation for wound care management.

Limitations

Most of the participants were medical residents and a total of six Nurse Practitioners out of the 25 that were included in the final count. Efforts to minimize and adjust for limitations were made for the project. However, no Physician Assistants were able to partake in the training

sessions. Time constraint and the availability of the provider for only a one-hour block was also challenging and limited in-depth discussion throughout the presentation. This challenge limited the ability to fully interact with the audience throughout the presentation. Approximately 10 to 15 minutes was allotted for questions post presentation as additional speakers were schedule the following hour to present their topic. No alterations to the presentation slides or case study was made after the start of the first presentation to limit variability of the collected data.

Future presentations would include time allotted for questions to promote interaction with the participants. Education time could be extended to a two-hour block. The case study could also be used with wound models to present the types of wounds and allow for participants to actually select and apply the type of treatment. Live demonstration of the assessment and initiating treatment is another form of assessing the providers' confidence level. Also, an electronic case study could be used to assess knowledge retained at the three and six-month marks following the training.

Conclusion

Primary care providers are ill-prepared to provide optimal wound care to the aging population. Guidelines vary across professional organizations and are not readily available. Use of the modified TIME framework in primary care could potentially have numerous positive outcomes. It could help to increase the accuracy of diagnosis and facilitate early interventions for wound care while also preventing wound deterioration or delayed treatment. The modified TIME framework could also help increase provider confidence in initiating wound care.

The use of technology will continue to be more common in health care, and primary care providers need to take advantage of the benefits of such technology. Next steps for this modified TIME framework are to test this in an electronic format, preferably a smartphone App. Findings

from the study will be submitted to the Wound Central App for further evaluation and potential inclusion in the App. An electronic version of the modified TIME framework will have short-term implications of allowing primary care providers access to resources needed in assessing, identifying, and treating wounds in primary care settings. The long-term implications include potentially decrease in wound healing times, patient discomfort, and health care costs.

Funding

The project was fully funded by the student and no additional funds were received. Time spent on the development was volunteered by the author, wound subject matter experts and an informatics nurse.

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Table 1: *Wound Organizations*

Wound Organizations		
Agency (Site)	Information Available	Cost
Advance Tissue https://www.advancedtissue.com/chronic-wounds-dominate-protocol/	Chronic wound treatment	Free
Agency for Healthcare Research and Quality (AHRQ) https://www.ahrq.gov	Arterial and venous wound management guidelines. Wound care algorithm, pressure ulcer prevention, and management guidelines.	Free
American Academy of Dermatologists (AAD) https://www.aad.org/practicecenter/quality/clinical-guideliness	Clinical-based guidelines for leg ulcer status and dermatitis.	Free
American College of Foot and Ankle Surgeons (ACFAS) https://www.acfas.org	Diabetic foot care guidelines.	Free
American Diabetes Association (ADA) https://professional.diabetes.org/content/clinical-practice-recommendations	Practice guidelines for diabetic ulcer management.	Free
American Society of Plastic Surgeons (ASPS) https://www.plasticsurgery.org/for-medical-professionals/quality-and-registries/evidence-based-clinical-practice-guidelines	Evidence-based guidelines for management of chronic wounds of lower extremities.	Membership required
Association of the Advancement of Wound Care https://aawconline.memberclicks.net/resources	Treatment guidelines for wound infection, venous ulcers, and pressure ulcers.	Free
Center for Disease Control Guideline (CDC) https://www.cdc.gov	Emergency wound management, surgical wound prevention, and surgical site prevention guidelines.	Free

Infectious Diseases Society of America (IDSA): Clinical Practice guidelines for Diagnosis and Treatment of Diabetic Foot Infections (2012) http://www.idsociety.org/PracticeGuidelines/	Practice guidelines for diabetic ulcer management	Free
National Guideline Clearinghouse https://guideline.gov	Wound care algorithm, pressure ulcer prevention and management, arterial and venous wound management.	Free
Society for Vascular Surgery https://vascular.org	Wound care guidelines for diabetic foot ulcers and arterial ulcers venous ulcers.	Free
The Wound Healing Society (WHS) http://woundheal.org/Publications/WHS-Wound-Care-Guidelines.cgi	Wound care guidelines for diabetic foot ulcers, arterial ulcers venous ulcers, and pressure ulcers.	Free
Wound, Ostomy, and Continence Nurses Society (WOCN) https://www.wocn.orgg	Wound care guidelines for diabetic foot ulcers and arterial ulcers venous ulcers.	Purchase of guidelines

Note. This table lists commonly located resources and some organizations may not be listed.

Table 2: *Wound Care Certifying Bodies*

Wound Care Certifying Bodies		
Name of organization	Name of Certification	Cost
National Alliance of Wound Care and Ostomy (NAWCO) https://www.nawccb.org	Wound Care Certified (WCC)	$300
Wound Ostomy Continence Nursing Certification Board (WOCNCB) https://www.wocncb.org	Certified Wound Care Nurse (CWCN)	$375
American Association of Wound Management (AAWM) http://www.abwmcertified.org	Certified Wound Specialist (CWS)	$575

Table 3: *Mobile Software Applications(Apps) Addressing Wound Care*

Mobile Software Applications (Apps) Addressing Wound Care					
Name (Last updated date)	Available Platforms	Benefit of Features	Disadvantage of Features	User Ratings	Developed by
Wound Central (5/2017)	Android and iOS	• Made for practitioner, nurse, physical therapist • Free App • No need to create account • Wound descriptions • Wound photos • Wound care videos • Documentation guidelines • Wound care guidelines	• Treatment guideline confusing and not step by step • Needs more information for description of wounds	4.3 out of 5 stars (64 reviews)*	Wound Central (Private company specializing in wound care)
+Wound Desk (11/2017)	Android, coming iOS soon.	• Made for practitioner • Free App • Wound care analysis evolution • Wound photo • Wound measures encryption • Documents wound progression	• Must create an account • Only available on the android • Designed for wound care specialist	4 out of 5 stars (13 reviews)*	Digital Med Lab (International)
Wound Smart (6/2015)	Android and iOS	• Made for practitioner • Documentation of wound description used • Wound care providers	• Purchase required at $5.99	4.6 out of 5 stars (12 reviews)*	Pocket Professions, Inc.

Mobile Wound Care 2.0 (12/2016)	Android	• Made for practitioner • Free App • Automated wound measurements • Tracking of wound • Photo capture and documentation • Availability of graphs for analysis	• Not available on iOS • Need to create an account	4.6 out of 5 stars (10 reviews) *	Tissue Analytics, Inc. (Baltimore)

Note. The table lists several available apps and some apps may not be listed. User ratings were obtained from the Apple store (https://www.apple.com/itunes/) and Google Play store (https://play.google.com/store).

Figure 1: *Reported level of comfort pre- and post-test*

How would you rate your comfort level in the Assessment wounds (Arterial, Diabetic and Venous)?	Excellent	Above Average	Average	Below Average	Poor
	0% 7%	0% 48%	56% 40%	37% 4%	7% 0%
How would you rate your comfort level developing a treatment plan for wounds (Arterial, Diabetic and Venous)?	Excellent	Above Average	Average	Below Average	Poor
	0% 4%	0% 40%	22% 52%	44% 0%	33% 4%

Pre (Red) and Post (Blue)

N=25

Figure 1. Reported level of comfort pre- and post-test. Comfort level in assessing wound increased by 55%. Comfort level in development a treatment plan for the wound increased by 44%.

Figure 2. Case Study Results by Question.

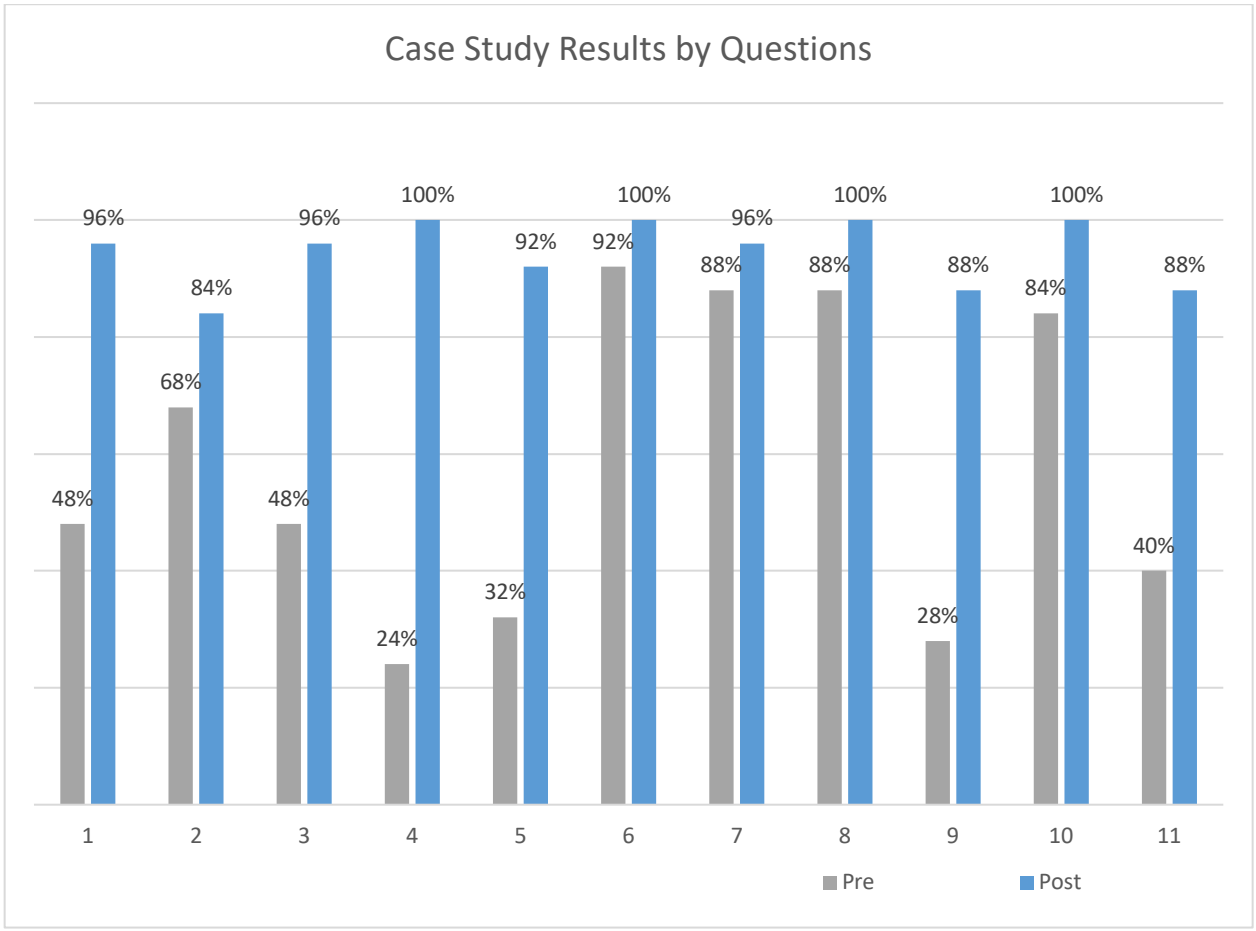


Figure 2. Case study results by question.

Appendix A: DNP Statement of Non-Research Determination Form

Student Name: Pavel (Pasha) Kulikov

Title of Project:

"Improving Wound Care Using The TIME Framework"

Brief Description of Project:

According to Patel & et al dated 2008, primary care providers receive less than 10 years dedicated to various wounds and their treatment in medical schools. Nursing schools devote 2-8 hours of wound care education (Moore & Clarke, 2011). Hesitancy and uncertainty of recommended treatment creates delays and barriers to providing wound care. Delayed wound care and mismanagement of wounds is associated with longer healing times, infections, osteomyelitis, amputations and increase cost to the health care system. Death from MRSA sepsis affects 19,000 patients annually (Koi, 2012). Resources are also limited in "low resource" settings.

A) Aim Statement:

The primary care provider will initiate wound care treatment using an algorithm with comfort and confidence. A toolkit including cheap first aid wound care products will also recommended to maintain in the office.

B) Description of Intervention:

Primary care provider will have access to a portable and easy to use reference that can be stored on person or in the office. The card will allow any primary care provider to identify the type of a wound and potential complications which a patient presents with. The reference card will also include an algorithm to identify the type of treatment the wound can requires and at what point to make a referral for wound care specialist.

C) How will this intervention change practice?

The reference card and toolkit will give the practitioner a level of comfort and confidence relating to initiating initial wound care at the initial clinic visit. Early and appropriate treatment of wounds will decrease complications and unnecessary cost to our already strained health care system.

D) Outcome measurements: Three outcomes were used to evaluate the DNP project's effectiveness.

1. To increase in the primary care provider's comfort level by 25%. 2. To increase primary care provider's wound care knowledge by 25%. 3. To increase primary care provider's accuracy of identifying the type of lower extremity ulcers by 80%.

To qualify as an Evidence-based Change in Practice Project, rather than a Research Project, the criteria outlined in federal guidelines will be used:
(http://answers.hhs.gov/ohrp/categories/1569)

☐ This project meets the guidelines for an Evidence-based Change in Practice Project as outlined in the Project Checklist (attached). Student may proceed with implementation.

☐ This project involves research with human subjects and must be submitted for IRB approval before project activity can commence.

Comments:

EVIDENCE-BASED CHANGE OF PRACTICE PROJECT CHECKLIST *

Instructions: Answer YES or NO to each of the following statements:

Project Title:	**YES**	**NO**
The aim of the project is to improve the process or delivery of care with established/ accepted standards, or to implement evidence-based change. There is no intention of using the data for research purposes.	**X**	
The specific aim is to improve performance on a specific service or program and **is a part of usual care**. ALL participants will receive standard of care.	**X**	
The project is **NOT** designed to follow a research design, e.g., hypothesis testing or group comparison, randomization, control groups, prospective comparison groups, cross-sectional, case control). The project does **NOT** follow a protocol that overrides clinical decision-making.	**X**	
The project involves implementation of established and tested quality standards and/or systematic monitoring, assessment or evaluation of the organization to ensure that existing quality standards are being met. The project does **NOT** develop paradigms or untested methods or new untested standards.	**X**	
The project involves implementation of care practices and interventions that are consensus-based or evidence-based. The project does **NOT** seek to test an intervention that is beyond current science and experience.	**X**	

The project is conducted by staff where the project will take place and involves staff who are working at an agency that has an agreement with USF SONHP.	**X**	
The project has **NO** funding from federal agencies or research-focused organizations and is not receiving funding for implementation research.	**X**	
The agency or clinical practice unit agrees that this is a project that will be implemented to improve the process or delivery of care, i.e., **not** a personal research project that is dependent upon the voluntary participation of colleagues, students and/ or patients.	**X**	
If there is an intent to, or possibility of publishing your work, you and supervising faculty and the agency oversight committee are comfortable with the following statement in your methods section: *"This project was undertaken as an Evidence-based change of practice project at X hospital or agency and as such was not formally supervised by the Institutional Review Board."*	**X**	

ANSWER KEY: If the answer to **ALL** of these items is yes, the project can be considered an Evidence-based activity that does NOT meet the definition of research. **IRB review is not required. Keep a copy of this checklist in your files.** If the answer to ANY of these questions is **NO**, you must submit for IRB approval.

*Adapted with permission of Elizabeth L. Hohmann, MD, Director and Chair, Partners Human Research Committee, Partners Health System, Boston, MA.

STUDENT NAME (Please print):
Pavel (Pasha) Kulikov

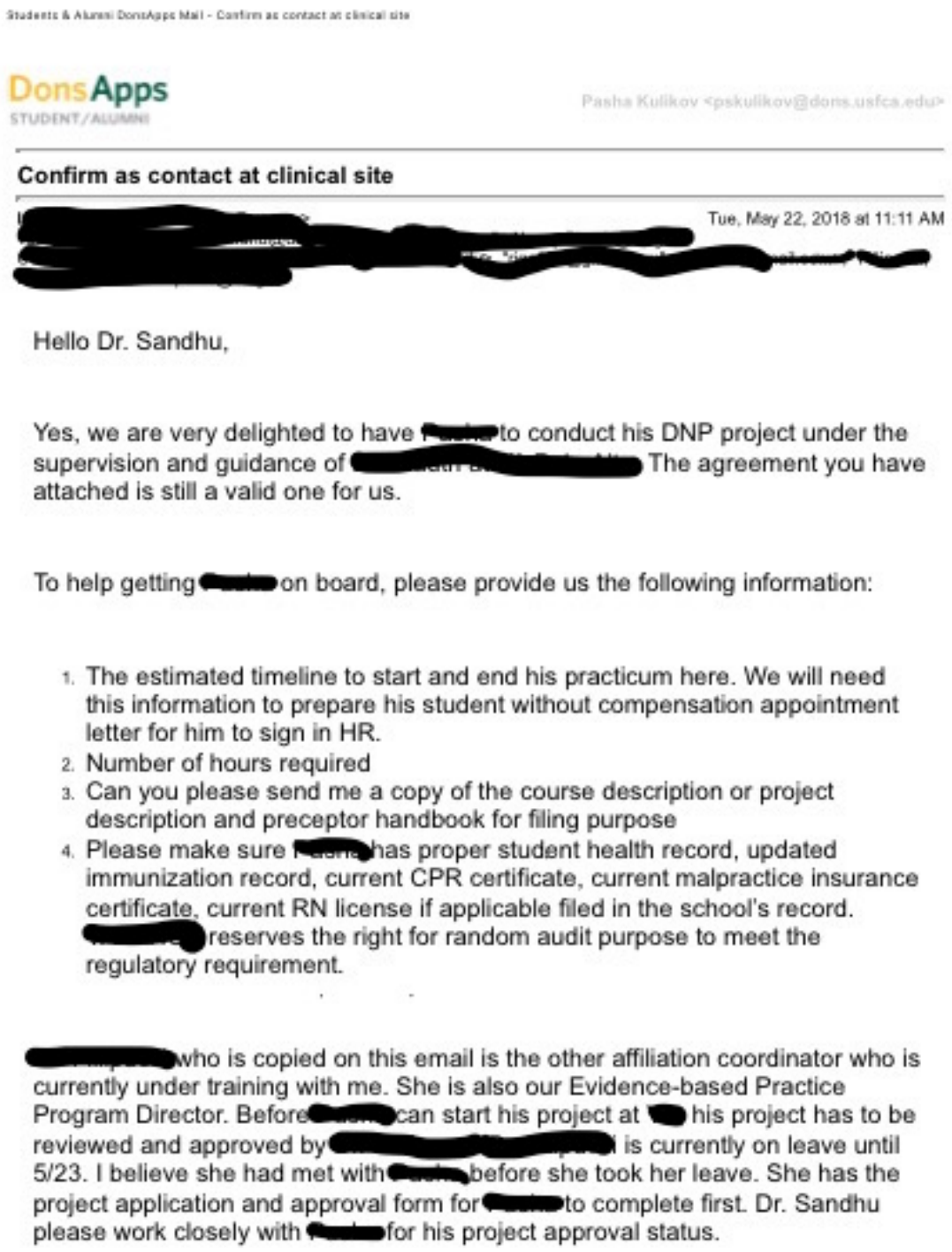
Signature of Student:
_____DATE_____

SUPERVISING FACULTY MEMBER (CHAIR) NAME (Please print):
Prabjot (Jodie) Sandhu

Signature of Supervising Faculty Member (Chair):

_____DATE_____ Appendi

Appendix B: Clinical Site Permission



Students & Alumni DonsApps Mail - Confirm as contact at clinical site

DonsApps
STUDENT/ALUMNI

Pasha Kulikov <pskulikov@dons.usfca.edu>

Confirm as contact at clinical site

[redacted] Tue, May 22, 2018 at 11:11 AM

Hello Dr. Sandhu,

Yes, we are very delighted to have [redacted] to conduct his DNP project under the supervision and guidance of [redacted] The agreement you have attached is still a valid one for us.

To help getting [redacted] on board, please provide us the following information:

1. The estimated timeline to start and end his practicum here. We will need this information to prepare his student without compensation appointment letter for him to sign in HR.
2. Number of hours required
3. Can you please send me a copy of the course description or project description and preceptor handbook for filing purpose
4. Please make sure [redacted] has proper student health record, updated immunization record, current CPR certificate, current malpractice insurance certificate, current RN license if applicable filed in the school's record. [redacted] reserves the right for random audit purpose to meet the regulatory requirement.

[redacted] who is copied on this email is the other affiliation coordinator who is currently under training with me. She is also our Evidence-based Practice Program Director. Before [redacted] can start his project at [redacted] his project has to be reviewed and approved by [redacted] is currently on leave until 5/23. I believe she had met with [redacted] before she took her leave. She has the project application and approval form for [redacted] to complete first. Dr. Sandhu please work closely with [redacted] for his project approval status.

Appendix C: Literature Review

Author/Year	Study Design	Sample Size/Setting	Intervention	Findings	Evidence Strength: Level; Quality
Beitz, Gerlach, & Schafer, 2014	A cross-sectional, mixed-methods Web-based survey design	297 Registered Nurses in both acute care and postacute setting	Participants were presented with 7 ostomy-related digital scenarios consisting of real-life photos and pertinent clinical information. Respondents used the 11 assessment components of the digital algorithm to choose management options.	The mean overall percentage of correct responses was 84.23%.	Level III; Quality B
Divall, Camosso-Stefinovic, & Baker, 2013	A systemic review	Three randomized controlled trials	Investigating usefulness of personal digital assistants (PDAs) in clinical setting. PDAs use in either recording patient information or in decision support of diagnoses or treatment.	An increase in data collection quality was reported and the appropriateness of diagnosis and treatment decision was improved	Level IV; Quality B

Dowsett, 2009	An experimental pre-test-post-test design	A sample of 47 community nurses	Data was collected using questionnaires, non-participant and observation and recording data from patients' clinical records.	Community nurses' wound care knowledge and practice improved significantly after training	Level II; Quality B
Innes-Walker & Edwards, 2013	Online surveys	500 respondents	Need analysis component to determine the priorities for future wound management education and training planning. Identify and map the current wound management education and training activities and resources.	Overall, the wound type least confident managing is mixed venous/arterial leg ulcers, followed by arterial leg ulcers.	Level IV; Quality B
Lemon, Munsif, & Sinha, 2013	Used a survey tool for medical students	60 students in each clinical school	Asses pre- and post-attendance confidence in managing chronic wounds	64% indicated they did not have adequate knowledge of chronic wounds. Over 1/3 of the participants still had difficulty in choosing appropriate wound dressing.	Level IV; Quality B
Little, Menawat, Worzniak & Fetters, 2013	Pre and post intervention designed survey	A sample of 14 residents	Surveyed residents on their knowledge about treating chronic	Residents' (n = 8) scores on the knowledge test improved from a mean of 42.5% to 62.4%	Level IV; Quality B

			wounds (25 multiple-choice questions) and level of comfort (14 questions) before and after their rotation on the service.	from before to after the rotation. Moreover, residents' (n = 5) reported level of comfort improved from 3.2 to 1.9 on a scale of 1−5 (where 1 represented most confident and 5 represented least confident).	
Moore & Clarke, 2011	Cross section descriptive survey	68 persons in 35 countries representing the Cooperating Organization of European Wound Management Association (EWMA)	Invitation to participate in a predesignated questionnaire using survey monkey	80% response rete with participants representing 28 of the 35 countries surveyed. 85% of participants were not satisfied with time allocated to wound education and 60% of cases between two hours and one day in the total undergraduate program wound management	Level IV; Quality B
Patel, Granick, Kanakaris, Giannoudis, Werdin & Rennekampff, 2008	Retrospective study	Reviewed medical school curriculum data from United States (50 schools), United Kingdom (30	Total hours of required wound education received during medical school	United States a total of 9.2 hours in the four years. United Kingdom a total of 4.9 hours over five years. Germany a total	Level II; Quality A

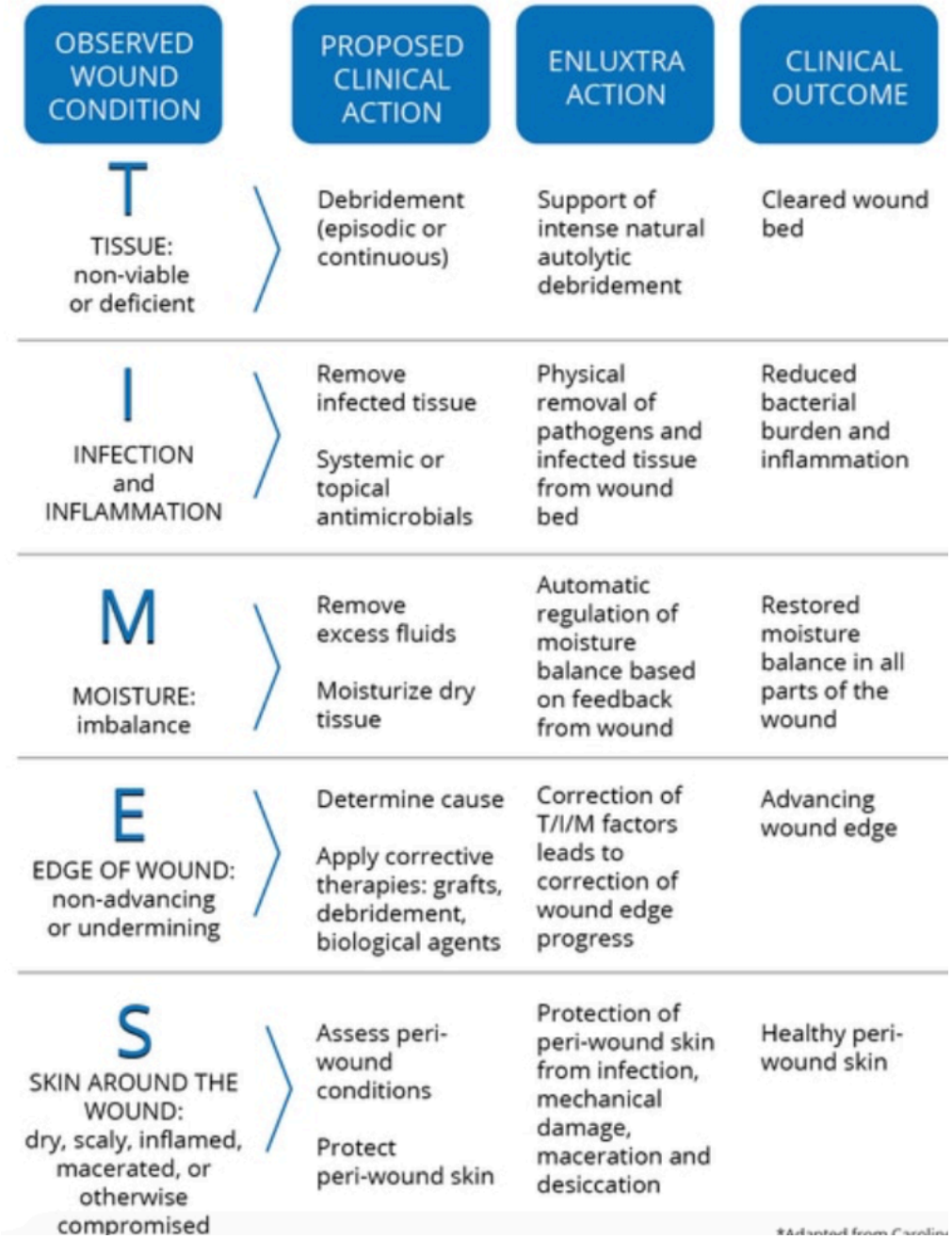
		schools) and Germany (36 schools)		of 9 hours over six years.	
Schultz, Sibbald, Falanga, Ayello, Dowsett, Harding, Romanelli, Stacey, Teot, & Vanscheidt, 2003	Expert opinion	Review of wound bed preparation technique	Wound bed preparation is the management of a wound in order to accelerate endogenous healing or to facilitate the effectiveness of other therapeutic measures.	Chronic wounds differ in healing from acute wounds	Level V; Quality B
Yelland, 2014	Expert opinion	Review of comfort level of general practitioner for wound care management	Management Venous Leg Ulcers in the primary care setting	General practitioner lack confidence managing wounds. Guidelines, pathways and education resources is limited and fragmented.	Level V; Quality B

Appendix D: Wound Bed Preparation (WBP) technique used by wound specialists

TIME – Principles of wound bed preparation

Clinical observations	Proposed pathophysiology	WBP clinical actions	Effect of WBP actions	Clinical outcome
Tissue non-viable or deficient	Defective matrix and cell debris impair healing	Debridement (episodic or continuous): »Autolytic, sharp surgical, enzymatic, mechanical or biological »Biological agents	Restoration of wound base and functional extracellular matrix proteins	Viable wound base
Infection or Inflammation	*High bacterial counts or prolonged inflammation* ↑Inflammatory cytokines ↑Protease activity ↓Growth factor activity	Remove infected foci *Topical/systemic:* »Antimicrobials »Anti-inflammatories »Protease inhibition	*Low bacterial counts or controlled inflammation:* ↓Inflammatory cytokines ↓Protease activity ↑Growth factor activity	Bacterial balance and reduced inflammation
Moisture imbalance	Desiccation slows epithelial cell migration	Apply moisture-balancing dressings	Restored epithelial cell migration, desiccation avoided	Moisture balance
	Excessive fluid causes maceration of wound margin	Compression, negative pressure or other methods of removing fluid	Oedema, excessive fluid controlled, maceration avoided	
Edge of wound — non-advancing or undermining	Non-migrating keratinocytes Non-responsive wound cells and abnormalities in extra-cellular matrix or abnormal protease activity	Re-assess cause or consider corrective therapies: »Debridement »Skin grafts »Biological agents »Adjunctive therapies	Migrating keratinocytes and responsive wound cells. Restoration of appropriate protease profile	Advancing edge of wound

Appendix E: TIME Framework for wound specialists



Appendix F: Modified TIME Framework

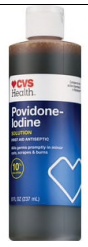
	Clinical Need	Clinical Action
T	Tissue Management	•Cleanse the wound to visualize wound bed •Assess the wound bed
I	Control of infection	•Assess for signs of infection local and systemic •Paint with betadine nonviable tissue (Stable Eschar)
M	Moisture Balance	•Assess amount of drainage •Non-adherent/non-stick versus absorbent dressing •Do not order wet-to-dry (Nonselective mechanical debridement)
E	Advancement of the epithelial edge of the wound	•Asses for risk of maceration and deteriorate of wound •Apply skin protectant (Cavilon) to peri-wound area •Assure wound is appropriately covered

Appendix G: Lower Extremity Wounds Reference

Info	Venous	Arterial	Diabetic
Location	• On medial lower leg and ankle • Superior to medial malleolus • Seldom if ever noted on the foot or above the knee	• Between toes, tip of toes, around lateral malleolus	• Plantar aspect of foot • Over metatarsal heads • Under heal • Toes
Clinical Presentation	• Irregular wound margins • Moderate to large amounts of drainage • Yellow slough common • Dilated superficial veins	• Even wound edges, oval or round • Minimal drainage • Severe pain, pain at rest, diminished pulses or no pulse • Necrotic or gangrene	• Even wound margins • Low to moderate drainage • Usually painless
Surrounding tissue	• Firm edema • Dermatitis • Brown staining • Weepy	• Hairless, shiny, dry • Cyanosis • Decreased temperature	• Callus • Diminished or absent sensation

(Spentzouris & Labropoulos, 2009)

Appendix H: Tool kit for basic wound care

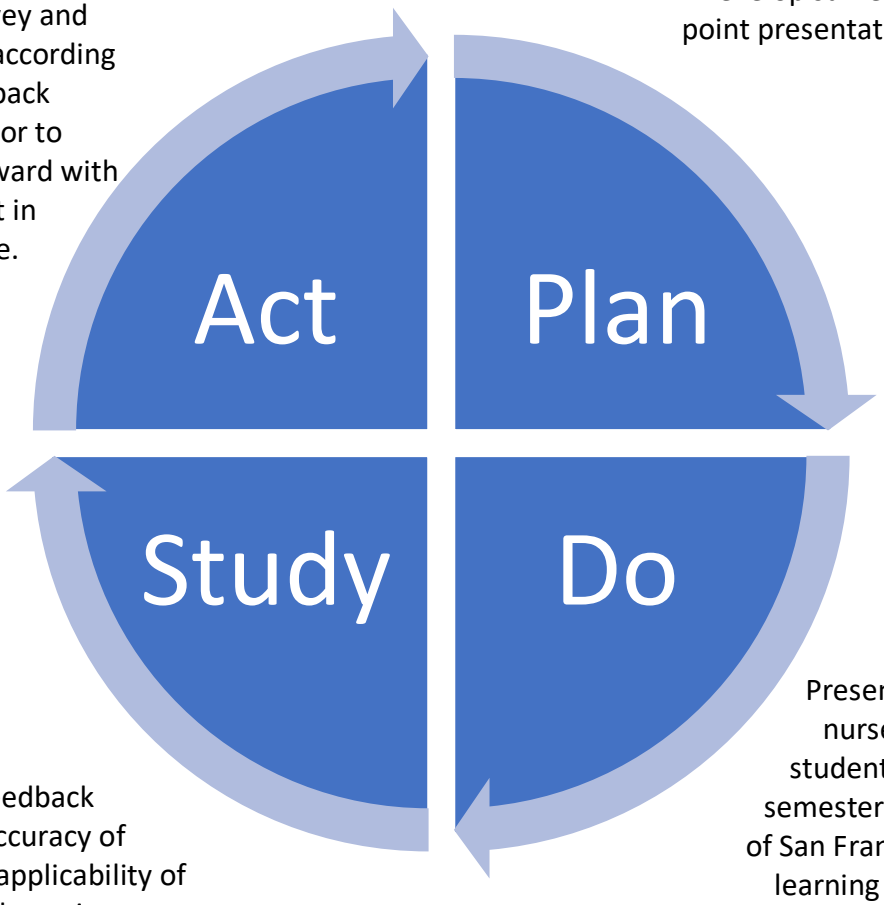
Name	Product	Cost	Image
Wound Cleanser	Hollister Restore Wound Cleanser, 12 OZ Appropriate PSI	$13.29	
Dry Gauze	CVS Health Sterile Latex-Free Non-Stick Pads	$4.49	
Mepilex/Absorbent	CVS Health Mepilex Border Foam Adhesive Sterile 4”x4” 2 dressings	$14.79	
Betadine/Povidone	CVS Povidone Iodine 10%, 8 OZ	$15.79	
Kirlex	CVS Health Rolled Cotton	$4.69	
Skin protectant	3M Cavilon No Sting Skin Protectant	$1.49	

Products obtain from CVS pharmacy at https://www.cvs.com

Appendix I: PDSA Cycle

Develop surveys and power point presentation regarding wound care.

Modify survey and case study according to the feedback received prior to moving forward with pilot project in primary care.



Present material to nurse practitioner students in their last semester at University of San Francisco. Assess learning with comfort survey and case study.

Collected feedback regarding accuracy of survey and applicability of the material to primary care providers.

Appendix J: Permission to Use Wound Central App

Robert Lange
To: Pasha Kulikov
WCEI Wound Central Mobile App

December 1, 2017 at 12:40 PM

RL

Hello Pasha,

Thank you for your note on the WCEI Website Request.

Yes, you and your colleagues my utilize the Wound Central Mobile App as much as you would like. Let us know if you have something you would like added.

Would your facility be interested in Hosting a Skin and Wound Care Management course for WCC Board Certification in the future? As you know, we teach the current standards of care backed by evidence based information that will help keep you legally defensible at bedside with positive outcomes.

Let me know if we can be of any further assistance.

Keep healing,

Robert Lange, CWCMS
Corporate Accounts Director
WOUND CARE EDUCATION INSTITUTE
M:913.485.4885 • F:877.649.6021 • www.wcei.net

Appendix K. SWOT analysis

Strengths	Weaknesses
• Concerned for patient outcomes • Open to change • Increase efficiency • Decreasing complications specifically (infections and amputations) • Decreasing healing time Improving health outcomes Decreasing inappropriate referrals to wound care specialists thereby increasing access for the community to the healthcare system	• Providers are busy • Learning new concepts is not considered deemed important • Already little time spend with the patient already • Resources are limited
Opportunities	**Threats**
• Increase confidence level of provider • Evidence Based Practice • Standardize and decrease variability • Decrease improper wound care treatments	• Attendance and training of staff • Resistance to change current practice • Additional step that would be required to take with patient

Appendix L: Baseline Knowledge - Assessment 1

Baseline Knowledge - Assessment 1					
How much wound care education have you received?	None	2–4 hours	One full day	Multiple days	Nationally certified in wound care
What type of licensure do you hold?	Nurse practitioner	Medical doctor	Physician assistant	Wound care-certified nurse	Nurse
How often do you encounter wounds in your practice?	Never	Once a year	Once a month	Once a week	Daily
Describe your access to wound care resources and algorithms?	Very Reliable	Slightly reliable	Neither	Slightly unreliable	Very unreliable
How would you rate your comfort level in the Assessment wounds (arterial, diabetic, and venous)?	Excellent	Above average	Average	Below average	Poor
How would you rate your comfort level developing a Treatment plan for wounds (arterial, diabetic, and venous)?	Excellent	Above average	Average	Below average	Poor
1) What is the first step in wound management?	Cover the wound and refer to specialist	Debridement	Cleanse the wound		
2) A moist wound with large amount of exudate has the potential to…	Stabilize the wound	Increase in size due to the maceration	Decrease healing time		
3) What is *not* an appropriate dressing in outpatient setting	Wet to dry	Dry dressing	Betadine on stable eschar		
4) Which statement is true?	Frequent dressing changes allows appropriate healing conditions	Wet to dry dressings cause unselective mechanical debridement	Is the first step in wound management		
5) What would you want to do with stable eschar?	Debridement to visualize wound bed	Order wet to dry dressing changes	Paint with betadine		

Appendix M: Case Study 1

Case Study

CC: New appointment for 64 y/o with a new wound.
PMH: includes CAD, HTN, and DM diagnosed about 10 years ago, poor follow up, not taking medication and sedentary lifestyle.

Please identify the type of wound pictured and appropriate treatment using the Wound Central mobile app:

The patient can present with either of the following wounds given his PMH and CC.

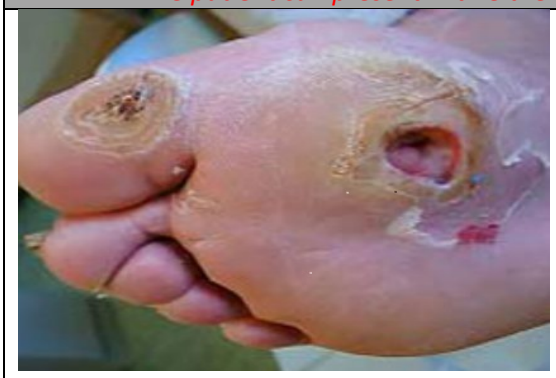
6) Type of wound (Circle your answer)

Arterial *Diabetic* *Venous*

7) B: What would you do as your treatment?

Clean wound bed and cover with dressing *Paint with betadine* *Begin debridement*

The patient can present with either of the following wounds given his PMH and CC



8) Type of wound (Circle your answer)

Arterial *Diabetic* *Venous*

9) What would you do as your treatment?

Clean wound bed and cover with dressing *Paint with betadine* *Begin debridement*

The patient can present with either of the following wounds given his PMH and CC

10) Type of wound (Circle your answer)

Arterial *Diabetic* *Venous*

11) What would you do as your treatment?

Clean wound bed and cover with dressing *Paint with betadine* *Begin debridement*

Appendix N: Post Test Knowledge Assessment 2

Knowledge Assessment 2					
What type of licensure do you hold?	Nurse practitioner	Medical doctor	Physician assistant	Wound care-certified nurse	Nurse
How would you rate your comfort level in the Assessment wounds after completing this training (arterial, diabetic and venous)?	Excellent	Above average	Average	Below average	Poor
How would you rate your comfort level developing a Treatment plan for wounds after completing this training (arterial, diabetic and venous)?	Excellent	Above average	Average	Below average	Poor
What type of wounds can betadine be used on?	Stable eschar	Open and weeping wounds	Unstable eschar		
What would you want to do with stable eschar?	Debridement to visualize wound bed	Paint with betadine			
What is the problem with wet to dry dressing changes?	Frequent dressing changes allows appropriate healing conditions	Is the first step in wound management	Wet to dry dressings cause unselective mechanical debridement		
What is *not* an appropriate dressing in outpatient setting	Betadine on stable eschar	Dry dressing	Wet to dry		
A moist wound with large amount of exudate has the potential to…	Stabilize the wound	Decrease healing time	Increase in size due to the maceration		
What is the first step in wound management?	Cover the wound and refer to specialist	Cleanse the wound	Debridement		

Appendix O: Case Study 2

Case Study

CC: New appointment for 64 y/o with a new wound.
PMH: includes CAD, HTN, and DM diagnosed about 10 years ago, poor follow up, not taking medication and sedentary lifestyle.

Please identify the type of wound pictured and appropriate treatment using the Wound Central mobile app:

The patient can present with either of the following wounds given his PMH and CC.

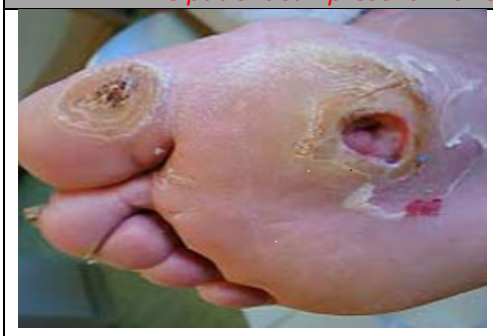
A: Type of wound (Circle your answer)

Venous *Diabetic* *Arterial*

B: What would you do as your treatment?

Clean wound bed and cover with dressing *Begin debridement* *Paint with betadine*

The patient can present with either of the following wounds given his PMH and CC



A: Type of wound (Circle your answer)

Arterial *Venous* *Diabetic*

B: What would you do as your treatment?

Paint with betadine *Clean wound bed and cover with dressing* *Begin debridement*

The patient can present with either of the following wounds given his PMH and CC

A: Type of wound (Circle your answer)

Arterial *Venous* *Diabetic*

B: What would you do as your treatment?

Begin debridement *Paint with betadine* *Clean wound bed and cover with dressing*

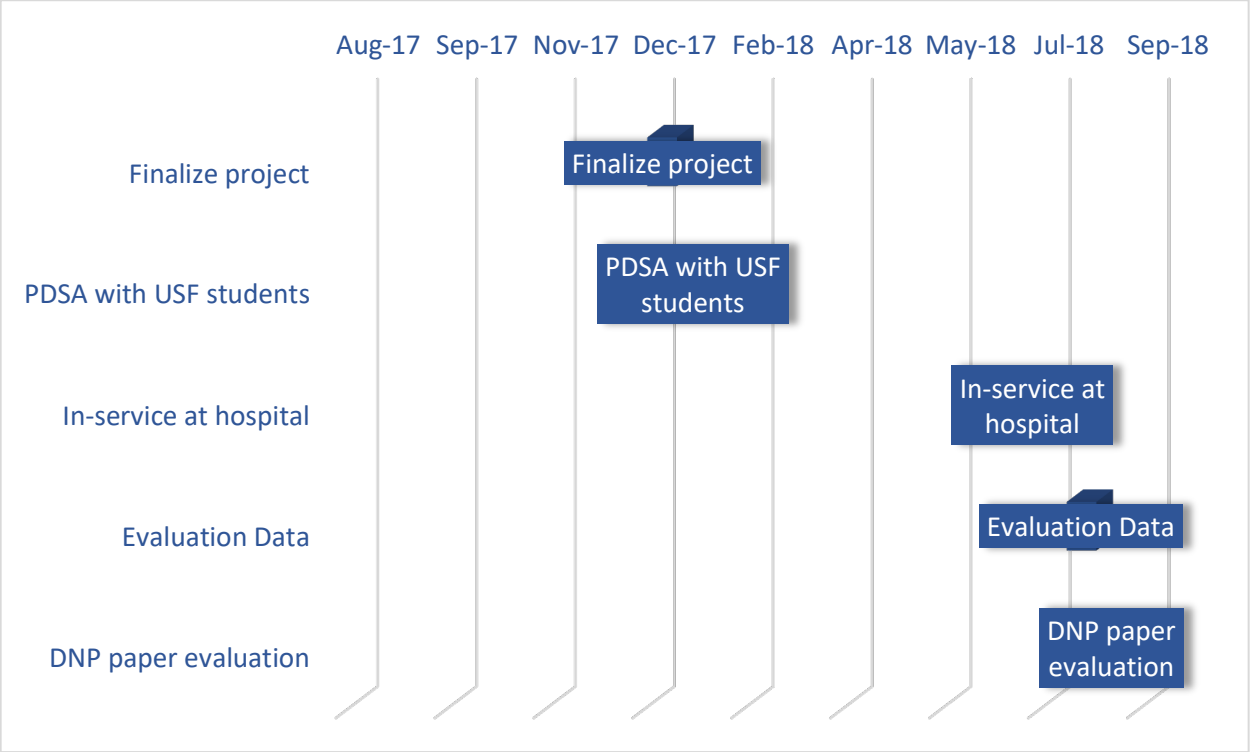
Appendix P: Budget for Training

Cost of Project	
Supplies/material	$100
Presenter's time ($100/1 hour)	$100
Participating provider's time ($100/ 1 hour)	$1,000 (10 providers)
Space	$200
Total Cost	$1,400

Appendix Q: Cost Benefit Analysis Table

2,200,000	1) Americans affected by venous ulcers annually
1,100,000	2) Of those ulcers 50% will become infected
275,000	3) 5% of those ulcers will require amputation
$52,000	4) Cost per amputation
$14,300,000,000	Total cost for 275,000 Americans to receive amputation annually, over 14 billion dollars
$715,000,000	Potential Cost Savings A 5% reduction in amputations related to venous ulcers would prevent 13,750 patients from receiving an amputation and would save $715 million dollars

Appendix R: Gantt Chart



T.I.M.E. Framework			DURATION (days)
START DATE	END DATE	DESCRIPTION	
1/1/18	1/15/18	Finalize project	14
1/15/18	2/1/18	PDSA with USF students	16
7/1/18	7/28/18	In-service at hospital	27
8/1/18	8/15/18	Evaluation Data	14
8/15/18	9/1/18	DNP paper evaluation	16

Appendix S: Communication Matrix

ID	Communication Vehicle	Target Audience	Description/Purpose	Frequency	Owner	Distribution Vehicle
1	Weekly status report	Faculty at USF	Communicate updated project status	Weekly	Pavel Kulikov	Email
3	Once during the presentation	NP Students	PDSA cycle assessment	Once	Pavel Kulikov	In person
4	Biweekly status report	Medical Director	Proposal of project and approval	Twice	Pavel Kulikov	In person
5	Initial training and follow up survey	Primary Care Providers	Assess pilot project effectiveness and applicability	Twice, initially and one month after the training	Pavel Kulikov	Email and in person