

**Barriers and Facilitators of using Telehealth in Diabetic Foot Ulcer Management among  
Registered Nurses and Nurse Practitioners Working in Wound Care Across the Nation**

by  
Xiaodan Zhou

A DNP project submitted to the  
School of Nursing  
State University of New York  
In partial fulfillment of the requirements for the degree of Doctor of Nursing Practice

December 2020

## DNP Project Approval Form

This is to certify that Xiaodan Zhou  
(Name of Student)

successfully disseminated their project entitled:

Barriers and Facilitators of using Telehealth in Diabetic Foot Ulcer Management among Registered Nurses and Nurse Practitioners Working in Wound Care Across the Nation

on December 9, 20 20.  
(Date)

DNP Project Advisor  
(Required)

Pamela Paplham, DNP, AOCNP, FNP-BC, FAANP

(Typed Name)

Dr. Pamela Paplham

Digitally signed by Dr. Pamela Paplham  
Date: 2020.12.09 15:15:42 -05'00'

(Signature)

Committee Member 1\*

Loralee Sessanna, DNS, AHN-BC, Faith Community Nurse

(Typed Name)

Dr. Lorelee Sessanna

Digitally signed by Dr. Lorelee  
Sessanna  
Date: 2020.12.09 15:16:25 -05'00'

(Signature)

Committee Member 2\*

(Typed Name)

(Signature)

Committee Member 3\*

(Typed Name)

(Signature)

\*If applicable

**Table of Contents**

Acknowledgments.....	4
Abstract .....	5
Background and Significance .....	7
Project Purpose, Aim and Objectives .....	8
DNP Essentials Addressed.....	9
Advanced Practice Nursing Contribution to Scholarship and Practice .....	9
Theoretical Framework.....	10
Review of the Literature .....	12
Project Methods and Design .....	17
Human Protection and Ethical Considerations .....	19
Data Collection and Analysis.....	19
Findings.....	21
Discussion.....	29
Project Strengths and Limitations.....	30
Future Implications and Recommendations.....	31
Conclusions.....	31
References.....	33
Appendix A.....	38
Appendix B .....	40

Appendix C .....	42
Appendix D .....	43
Appendix E .....	45
Appendix F .....	51
Appendix G .....	53
Appendix H .....	54
Appendix I .....	55

### **Acknowledgments**

First, I would like to sincerely thank my project advisor, Dr. Pamela Paplham, and project committee member, Dr. Lorelee Sessanna, for their continued support and encouragement. I am so deeply grateful that I was able to go through this experience with your guidance. This work would not have been possible without your dedicated involvement in every step throughout the process.

I would also like to express my gratitude to my family who provided me with support during the process of completing my DNP project, as well as throughout my entire graduate education.

### Abstract

Diabetic foot ulceration has become a heavy burden on both the patient and the healthcare system. While telehealth has shown effectiveness in the management of chronic disorders, its adoption in diabetic foot care remains slow. The purpose of this Doctor of Nursing Practice project was to qualitatively explore through interviews the facilitators and barriers of using telehealth for the management of diabetic foot ulcers among registered nurses (RN) and nurse practitioners (NP) belonging to American Professional Wound Care Association. The project aim was to increase knowledge and understanding among RNs and NPs regarding utilization of telehealth in diabetic foot care to support improved patient outcomes. The Chronic Care Model and literature review findings guided development of the semi-structured interview questionnaire. Braun and Clarke's Reflexive Thematic Analysis method was utilized to analyze data. Data analysis generated one overarching theme, *There is an Opportunity for Telehealth to Continue to Gain Some Ground*, and three key themes, *I Do Think That There are Some Challenges*; *It's Improved Our Ability to Care for Our Patients*; and *It's Been Convenient for Me*. Findings revealed that telehealth use among the participants contributed to improved diabetic patient outcomes, that there has been a significant increase in the use of telehealth in diabetic foot care among the participants, and that telehealth is both convenient and easy to use. Future research is needed exploring telehealth educational needs and approaches among RNs and NPs to address telehealth utilization barriers and promote diabetic patient quality of life and care.

*Keywords:* telehealth, foot ulcer, diabetes, wound care

**Barriers and Facilitators of using Telehealth in Diabetic Foot Ulcer Management among Registered Nurses and Nurse Practitioners Working in Wound Care Across the Nation**

Diabetic foot ulceration has become a heavy burden on both the patient and the healthcare system. Data from the International Diabetes Federation estimated that annually, 9.1 million to 26.1 million people developed diabetic foot ulcers worldwide (Diabetes Atlas, 2015). The 5-year mortality of a patient with a diabetic foot ulcer is 2.5 times higher than that of diabetic patients without a foot ulcer (Armstrong et al., 2017). In addition, over 50% of diabetic ulcers become infected, and about 20% of moderate or severe diabetic foot infections lead to amputation, which significantly reduces the patient's quality of life (Armstrong et al., 2017). For each patient with lower limb amputation, the total economic burden is more than \$31,200 (Cychosz et al., 2016). Diabetic foot ulcer also has a high recurrence rate. Armstrong et al. (2017) estimated that about 40% of patients had a recurrence within one year after ulcer healing, and approximately 60% within three years. Because treatment for ulceration is very challenging and expensive, preventative care plays an essential role in diabetic foot management (Bus & van Netten, 2016).

Traditionally, the management of diabetic foot ulcers is conducted through in-person clinical visits, which could be burdensome for patients who live in rural areas or those who are immobile. Recent advances in digital technology have enabled diverse caring approaches. For instance, telehealth could be implemented through video calls, wearable devices, remote monitoring sensors, or emails and text messages. These approaches have enabled more frequent communications between the patient and healthcare providers to offer personalized intervention (Bohingamu Mudiyanse et al., 2019). Telehealth has been found to be effective in delivering education to improve the patient's self-efficacy, which plays a crucial role in reducing

complications of chronic disorders (Rush et al., 2018). However, despite these benefits, recent studies have shown that telehealth adoption in the field of diabetic foot care is still very slow (Hazenbergh et al., 2020).

### **Background and Significance**

Based on a review of current literature, three major themes of nurse-led telehealth-based foot care exist: education, consultation, and monitoring (van Netten et al., 2016). Education can be implemented through various forms, such as a brief education, intensive education, or frequent educations (Adiewere et al., 2018). The overall goal of education is to improve the patient's knowledge of foot care and self-management skills. Conventional education often requires an office visit. Telehealth can simplify the process and facilitate the implementation of different educational approaches. Technology-assisted remote monitoring has also been reported in ulcer management (Abbott et al., 2019; Koziatsek et al., 2020; Skafjeld et al., 2015). They include temperature monitoring, pressure monitoring, and photo monitoring. While temperature monitoring and pressure monitoring require additional or custom-made devices, photo monitoring can be easily implemented in the patient's smartphone. Remote monitoring enables the identification of early signs of the disorder, so that intervention can be planned at the early stages. Telehealth also facilitates communication between patients and healthcare providers, so that timely consultation can be provided on foot care. Overall, telehealth has been found to be effective in the management of chronic disorders. While it might require an up-front cost to implement the technique, the reduction in hospitalization often offsets the increased cost of telehealth (Bohingamu Mudiyansele et al., 2019).

Despite these benefits, telehealth is not widely adopted in diabetic foot care. Findings from a recent systematic review conducted by Foong et al. (2020) indicated that there are various



barriers to the implementation of telehealth. The barriers could come from either the healthcare provider or the patient. For instance, older patients often prefer the traditional face-to-face consultation and feel this is an integral part of care (Foong et al., 2020). As diabetic foot ulcers mainly affect patients over 40 years old (Shahbazian et al., 2013), older adult patients consist of a major portion of the targeted population. As for providers, lack of clinical guidelines, lack of multidisciplinary approach, and licensure constraints are barriers in the telehealth implementation. While the systematic review was published in 2020, the majority of reviewed studies were conducted more than three years ago. The Covid-19 pandemic has abruptly changed healthcare delivery, and many clinics have seen a rapid expansion in the use of telehealth (Mann et al., 2020). Therefore, it is important to revisit the topic and offer updated information on the barriers and facilitators for utilizing telehealth for diabetic foot care.

### **Project Purpose, Aim and Objectives**

The purpose of this Doctor of Nursing Practice (DNP) project was to qualitatively explore the facilitators and barriers of using telehealth for the management of diabetic foot ulcers among registered nurses (RN) and nurse practitioners (NP) working in wound care. The targeted RNs and NPs were those either in the primary care field or in the wound/diabetes care specialty. The project aim was to increase the utilization of telehealth in diabetic foot care and improve the outcome of patients with diabetic foot ulcers. Project objectives were to 1) conduct an extensive review of the literature examining the implementation of telehealth in wound care practice; 2) create a semi-structured interview questionnaire based on findings resulting from the literature review; 3) conduct individual interviews with RNs and NPs working on diabetic wound care to understand the use of telehealth in practice; 4) qualitatively analyze and summarize the facilitators and barriers with recommendations on how to promote telehealth usage among RNs

and NPs; and 5) disseminate findings via an oral presentation.

### **DNP Essentials Addressed**

The American Association of Colleges of Nursing (AACN, 2006) outlines eight essentials for advanced nursing practice to ensure competencies for all nurses practicing at the DNP level. This project was well aligned with the eight Essentials. Essentials I and III were addressed through a comprehensive literature review of current scientific evidence in diabetic foot care and how telehealth can be integrated into practice. Essential II was addressed through summarizing and disseminating the research findings on the facilitators and barriers to inform future clinical practice. Essential IV was addressed through surveying the latest telehealth technologies on diabetic foot care, evaluating opinions from RNs and NPs, and offering suggestions for future technology development. Essential V was addressed by researching policy and licensure barriers and facilitators in telehealth-based foot care with the goal of advocating for nursing professions working in diabetic foot care. Essential VI was addressed by examining interprofessional facilitators and barriers in telehealth implementation with the goal of improving communication and collaboration in the care team. As for Essential VII, the focus of this DNP project was preventative care, which played an essential role in diabetic foot ulcer management. Telehealth-assisted preventative care improved both individual and community health. Essential VIII was addressed by offering evidence-based information to guide nursing practice on telehealth.

### **Advanced Practice Nursing Contribution to Scholarship and Practice**

This project aims to improve the utilization of telehealth among RNs and NPs working in diabetic foot care. The project will inform nursing science as it contained an extensive literature review to find the scientific evidences in diabetic foot care and telehealth implementation. The

analytical themes derived from the project will enhance clinical practice in telehealth and diabetic wound care. In addition, the finding from the project might also inform healthcare policies to increase the utilization of telehealth in wound care. Overall, this project would help to improve nursing practice, education, and policy.

### **Theoretical Framework**

The Chronic Care Model (CCM) served as the theoretical framework for this DNP project. The model was developed in the late 1990s by Wagner and colleagues after reviewing the literature on successful chronic disease management and prevention (Glasgow et al., 2001). The CCM contains six interrelated elements: organization of the health care, self-management support, decision support, delivery system design, clinical information systems, and community resources and policies (Glasgow et al., 2001). The organization of the health care element focuses on creating an environment in the organization to promote safe and high-quality care; the self-care support element suggests the creation of effective self-management support for the patients and families; the decision support element focuses on the utilization of evidence-based practice guidelines and collaboration with relevant specialties to support clinical decision making; the delivery system design element focuses on the implementation of effective and efficient health care delivery systems to offer proactive and continuous care to the patient; the clinical information systems element focuses on improving the efficiency and effectiveness of information systems to provide alerts, reminders and timely feedback to healthcare providers and patients; and the community resources and policies element focuses on the integration with community programs and partnerships to further help the patients on disease management (Baptista et al., 2016). Over the past twenty years, the CCM has been implemented in numerous investigations. Findings from a systematic review suggested that combining all six elements of

CCM would lead to more significant benefits for patients (Baptista et al., 2016).

To further promote population health, Barr et al. (2003) proposed an expanded chronic care model. In the expanded CCM, the organization of the health care element was removed, while the community resources and policies element was expanded into three elements: build healthy public policy, create supportive environments, and strengthen community action. The build healthy public policy element refers to the development and implementation of policies designed to improve population health; the create supportive environments element refers to the creation of safe, stimulating, satisfying, and enjoyable environments; while the strengthen community action element focuses on working with community groups to enhance the health of the community. It can be seen that major components of the expanded CCM and the original CCMs are very similar, and the original CCM still serves as a robust model to guide clinical care of chronic diseases.

This DNP project focused on the exploration of facilitators and barriers in the implementation of telehealth in diabetic wound care as perceived by RNs and NPs. As the diabetic wound is among the most challenging chronic conditions, the management of diabetic wounds fits the scope of the CCM. The telehealth component of the study was particularly related to the delivery system design element and the clinical information systems element. The telehealth approach enabled the transformation of reactive face-to-face patient care to proactive remote care, which is more effective and efficient for the management of chronic conditions. The clinical information system built around telehealth further facilitated patient data organization and communication among healthcare providers and patients. Other elements of the CCM were also relevant to the project: the implementation of telehealth in the organization was related to the health system organization element, research on evidence-based guideline for telehealth

practice served the decision support system, better self-management support was one of the main goals of telehealth, and community resources and policies further supported patients who receive telehealth care. Therefore, all six elements of the CCM coincided with the objectives of the project and would help the exploration of barriers and facilitators.

### **Review of the Literature**

An extensive literature review was conducted to explore current evidence on wound care and existing facilitators and barriers to telehealth nursing practice. Keywords utilized for the literature search included the following both singularly and in combination: facilitators, barriers, telehealth, telemedicine, telemedical, tele-homecare, remote care, nurse, nurse practitioner, nursing practice, diabetes, wound, ulcers, and foot care. The search was conducted in PubMed and Embase. The search results were limited to articles published over the past five years (2015 to 2020) to ensure that current evidence-based literature was reviewed and summarized. The search results were screened based on the article titles and abstracts to remove duplicates and irrelevant studies. The final review included ten articles classified into three major categories: diabetic foot ulcer care, telehealth applications, and barriers and facilitators of telehealth implementation. The findings of these articles were synthesized to provide support for this DNP project.

#### **Diabetic Foot Ulcer Care**

A comprehensive review of diabetic foot ulcer literature was conducted by Armstrong et al. (2017). The authors emphasized the importance of diabetic foot care and estimated that \$176 billion was spent annually on diabetes care and that nearly one-third of this expenditure was related to lower extremity care. The authors also reviewed five intervention categories of ulcer care and found that self-management and patient education have the highest effect size (higher

percentage reduction in ulcer recurrence). The authors concluded that use of innovative technologies to improve patients' self-management skills and adherence to treatment plans is needed. The authors also suggested new studies to develop additional effective strategies for preventing ulcer recurrence.

The effect of different patient education approaches on diabetic ulcer prevention and reduction was studied by Adiewere et al. (2018). This systematic review summarized results from six randomized clinical trials (RCTs). The authors found that there was no advantage of combining different educational approaches, that the effect of education alone still required further investigation to offer robust evidence, and that intensive education offered a positive result in ulcer reduction. Findings resulting from this review suggested that education needed to be combined with other interventions to show effective improvement in ulcer healing or recurrence reduction.

The effect of nursing interventions in the prevention and healing of leg ulcers was studied by Fonseca et al. (2016) in a systematic review. The authors reviewed findings from 11 articles, including systematic reviews, RCTs, retrospective studies, prospective studies, and case studies. While different types of ulcers might require different intervention approaches, overall, the authors found that the following factors promote ulcer healing: individualization of care, patient-provider relationship, pain control, control of the exudate, education for health self-management, self-care, therapeutic adherence, and implementation of guidelines of good practice.

### **Telehealth Applications for Diabetic Foot Care**

The applications of telehealth in diabetic foot care were summarized in a recent systematic review conducted by Hazenberg et al. (2020). After reviewing results from 61 studies, the authors classified telehealth applications into four areas: dermal thermography, hyperspectral

imaging, digital photographic imaging, and audio/video/online communication (traditional approach). Research findings suggested that infrared dermal thermography as a home monitoring tool was effective in reducing ulcer recurrence, hyperspectral imaging was still in the experimental stage, digital photography was reliable in monitoring pre-ulcerative lesions, and audio/video/online communication was as effective as regular outpatient clinic visits. In conclusion, the authors recommended the combination of traditional telehealth with new monitoring approaches to improve patient outcomes.

Another telehealth application was introduced by Abbott et al. (2019). In the study, the authors developed an intelligent insole system, which could monitor plantar pressure continuously and send alerts when aberrant pressures were detected. The application was tested in a prospective, randomized study. The authors recruited 90 patients, and among them, 58 completed the study. The authors found that the intervention group had 71% reduction in ulcer incidence compared to the control group. Among good compliers, the ulcer incidence was reduced by 86% in the intervention group compared to the control group. This study supported that remote continuous pressure monitoring was effective in reducing ulcer incidence.

### **Barriers to Telehealth Practice**

The barriers and facilitators for the sustainability of tele-homecare were discussed in a systematic review published by Radhakrishnan et al. (2016). The authors found that patients' level of satisfaction was higher than those of nurses, as patients tended to have sustained adoption of telehealth. The technical problems and preference for in-person care were the barriers to patients' use of telehealth. As for nurses, the barriers included lack of training and orientation, perceptions on the effectiveness of tele-homecare, and lack of interprofessional collaboration.

The licensure barriers to telehealth nursing practice were discussed in a technical note published by Mataxen (2019). Historically, nurses received licensure in a single state and practice in a single state. As telehealth enabled remote care, nurses can potentially practice in multiple states. This issue is particularly relevant to nurses and patients living across state lines. While this issue has been partially addressed by the Nurse Licensure Compact (NLC), which included 31 states as of August 2019, there were still over a dozen states that have not enacted NLC legislation. This may create issues if a patient in the compact state was traveling in a non-compact state while receiving telecare. Other licensure barriers included specialty practice requirements (The American Academy of Ambulatory Care Nursing encourages telehealth nurses to seek certification in ambulatory care) and education-related issues (preceptors and educators might be licensed in a different state as nursing students).

The barriers to telehealth as perceived by NPs were discussed by nursing scholars from Indiana University-Purdue University Fort Wayne (IPFW) (Shelton & Reimer, 2018). The authors mentioned that IPFW has developed a wound care software, named WoundView, to be used by NPs. As the software was still in the early stage, the authors did not survey the NPs' opinions regarding this particular software. Instead, they conducted a literature review on the barriers to the general implementation of telehealth. The barriers and facilitators identified in the article include clinician education and training, technical support, level of involvement of a local champion, and cost-benefit analyses.

The nursing professionals' experiences of facilitators and barriers to the use of telehealth were discussed in a systematic review of qualitative studies conducted by Koivunen and Saranto (2018). The authors searched literature published from 1998 to Fall 2015 and included 25 studies in the review. The facilitators and barriers were grouped into five main categories, which were



nurses' skills and attitudes, nurses' work and operations, organizational factors, patients, and technology. The authors found that the nurses' work and operation category had the highest number of facilitators and barriers. The facilitators included communication, patient-nurse relation, job satisfaction, while the barriers included insufficient experience to use telehealth, lack of control of their own work, and changes in the patient-nurse relationship. The authors also found that nurses' skill and attitudes were preventing factors of telehealth, while patients generally support the adoption of telehealth. Facilitators related to technology included ease of use and functional solutions, while barriers related to technology included usability problems and data security problems.

A more generalized qualitative systematic review on facilitators and barriers of using digital technology for ulcer care among patients and healthcare practitioners was conducted by Foong et al. (2020). The authors searched literature published from 2000 to 2019 and identified three studies on patients and five studies on healthcare practitioners. In the review, healthcare practitioners included nurses, physicians, podiatrists, and nurse assistants. The authors identified three analytical themes from studies on healthcare practitioners. They were the impact of digital technology, the role of digital technology in ulcer care, and the organization of ulcer care delivery. Among these themes, the authors identified 17 facilitators and 16 barriers, such as adequate wound care training, lack of multidisciplinary approach, and lack of direct contact in care provision.

### **Conclusion of the Literature Review**

Based on existing literature, it is evident that diabetic foot ulcers have been a major burden to diabetic patients. As a chronic disease, caring for foot ulcers is also associated with high medical costs (Armstrong et al., 2017). The management of foot ulcers requires frequent

communication between patients and healthcare providers to identify pre-ulcer lesions and to offer guidance and education on foot care and ulcer management. The telehealth approach could transform traditional practice to enable more accessible ulcer care (Hazenberget al., 2020). Developments in telehealth have allowed new applications, such as foot temperature monitoring, photo monitoring, and pressure monitoring (Abbott et al., 2019; Hazenberget al., 2020). These approaches can effectively reduce ulcer incidence and recurrence. The facilitators and barriers on the implementation of telehealth was addressed in several articles (Foong et al., 2020; Koivunen & Saranto, 2018). However, they were either too early (included research conducted over five years ago) or too generic (surveyed all health care professionals and patients). This project aimed to fill the gap in previous studies by conducting a qualitative interview among nurses and NPs to explore the facilitators and barriers of implementing telehealth in diabetic foot ulcer management and care.

### **Project Methods and Design**

#### **Project Design**

A qualitative descriptive design with use of individual semi-structured interviewing was utilized for this DNP Project to qualitatively explore the facilitators and barriers of implementing telehealth in diabetic foot ulcer management and care among RNs and NPs. A qualitative descriptive approach allows participant voices to be heard in a particular context and themes to be constructed from the data (Braun et al., 2019). Semi-structured interviewing is the most common type of interview used in qualitative research (Doody & Noonan, 2013). In a semi-structured interview, the interviewer uses predetermined questions but also seeks clarification when needed. A semi-structured interview questionnaire was developed by the DNP project student based on findings resulting from the literature review, input from the DNP Project

Advisor who is an expert in telehealth, and guided by the Chronic Care Model (Glasgow et al., 2001). The project, including the interview questions, was reviewed and approved by UB IRB (Appendix A). The interview questions are shown in Appendix B.

### **Project Setting**

This project was conducted among RNs and NPs who were members of the American Professional Wound Care Association (APWCA), a professional organization for wound care nurses, NPs, podiatrists, vascular surgeons, and all specialists involved in the management of wounds and related complications (APWCA, 2020).

### **Participants**

The choice of sampling technique is essential for the success of the research. For qualitative descriptive research, the best sampling process is nonprobability convenience or purposive sampling (Bradshaw et al., 2017). Purposive sampling selects participants with required experiences for the study. This study utilized purposive sampling. Recruitment efforts began with permission from the APWCA, whose committee was supportive of the research (Appendix C). A recruitment email was sent by the contact person at the APWCA to RN's and NP's who are members of the association (Appendix D). Additional recruitment was performed through the DNP student's local network. Responses from the initial recruitment email were obtained within one week. Those interested in voluntary study participation were followed up with a second email containing detailed information about the project objectives, timeline, available time slots for the interview, and a verbal consent form to read prior to participating in the interview (Appendix E). Regardless of whether the participants were recruited locally or within APWCA, their personal information was kept confidential to the DNP project student only.

### **Human Protection and Ethical Considerations**

Approval from the University at Buffalo's Institutional Review Board (IRB) was granted before project implementation. The project imposed minimal risk to the participants. Prior to the implementation of each interview session, participants were informed of their right to refuse to answer any question, the right to withdrawal from participation at any time, and all questions were answered. Verbal consent was then obtained from each participant (scripts shown in Appendix F).

Potential risks included data breach and loss of confidentiality. To prevent data breach, all interview audio files were saved on a password-protected laptop computer that only the DNP project student had access to and then were destroyed following interview transcription. All de-identified transcripts and any documents resulting from data analysis work will be stored in the DNP Projector Advisor's office in Wende Hall on the South Campus in a locked file cabinet drawer for a period of three years and then destroyed as per the UB IRB approved protocol.

### **Data Collection and Analysis**

#### **Data Collection**

All interviews were conducted via password protected Zoom video-conferencing using the semi-structured interview questionnaire developed by the DNP project student. A demographic questionnaire was utilized to obtain participant demographic information (Appendix G). Depending on participant responses, the interviewer sought clarification as needed. All interviews were audio-recorded, transcribed verbatim as de-identified, and assigned a unique numeric code to eliminate identifiable information. The DNP project student verified transcription accuracy by reading and re-reading the transcripts while listening to the audio-

recordings. After confirming transcription accuracy, the audio files were permanently deleted from the DNP project student's computer. The de-identified transcripts were used for data analysis by the DNP project student, the DNP Project Advisor, and the project qualitative methods expert (the DNP project team). Findings were disseminated as de-identified.

Due to the Covid-19 pandemic, there was a low response rate, despite sending recruitment emails twice. Three participants, all members of the APWCA, were recruited. Among them, two were NPs and one was an RN. Two participants were female and one was male. All participants had over 10 years of experience in wound care. Participant demographic information is shown in Appendix H.

### **Data Analysis**

Braun and Clarke's (2006; Braun et al., 2019) six-phased reflexive thematic analysis method was utilized for data analysis guided by an essentialist/realist framework. An inductive approach with use of direct participant quotes (semantic coding) was utilized. During all six phases, the DNP project team held regular meetings until the final report was written. Reflexivity was practiced during data collection by the DNP project student and throughout the data analysis process by the DNP project team. Reflexivity entails critical reflection on the research progress and process by the research team with each researcher having awareness of how their personal and professional experiences may influence data collection and analysis. The researcher asks reflexive questions to themselves and has open dialogue with their colleagues. Practicing reflexivity improves the credibility of results and reduces bias (Braun et al., 2019).

The six phases of Braun and Clarke's reflexive thematic analysis method include the following. The familiarization phase, phase one, started during data collection and transcription with the DNP project student. A copy of the de-identified transcripts were provided to the DNP

project team by the DNP project student for data analysis purposes. The DNP project team then read and re-read each transcript, making casual notes or initial data connections and impressions. In phase two, initial codes were generated first independently by the DNP project team and then discussed together in a team meeting while practicing reflexivity. In the constructing themes phase, phase three, the DNP project team generated candidate themes and subthemes from codes developed in the previous phase. During the revising, defining, and naming themes phases, phases four and five, candidate themes were reviewed, refined, and finalized by the DNP project team to ensure that they told the participant's story and addressed the research question and study purpose. The connection among themes were presented in a thematic map to illustrate how the themes fit together and to ensure that the themes did not overlap (Appendix I). Finally, in the producing the report phase, phase six, the final report was written with connections made to existing literature on the topic of interest (Braun et al., 2019).

### **Findings**

One overarching theme, *There is an Opportunity for Telehealth to Continue to Gain Some Ground*, and three key themes, *I Do Think That There are Some Challenges; It's [Telehealth]Improved our Ability to Care for Our Patients;* and *It's Been Convenient for Me*, were generated as a result of the analysis of data. The following presents the overarching theme and three key themes in detail.

**Overarching Theme:** *There is an Opportunity for Telehealth to Continue to Gain Some Ground.*

The overarching theme captured the main idea encapsulated within all three key themes (Braun et al., 2019). The overarching theme was succinctly summarized by one participant who, when asked about the organization's support for the use of telehealth and training regarding

caring for patients with diabetic foot ulcers, commented “We feel like there’s an opportunity for telehealth to continue to gain some ground” (P1). Another participant additionally commented on how telehealth can improve care among patients with diabetic foot ulcers and how telehealth can continue to evolve in the future. Participant 3 commented,

All of both myself and my other fellow nurse practitioner providers in our group practice thoroughly enjoy the use of Telehealth because we can see our patients more often if they have a problem or a complication. The patients feel comfortable and reaching out to us if there's a problem on their end. And this is something that needs to be funded by all the insurance payers, as well as the government, to ensure telehealth does not go away for any patients, especially those who have chronic wounds, such as diabetic foot ulcerations. Because we can improve their care that is more cost effective for the patient for the health care system, as well as for the provider. And it is a what we like to call a win-win-win scenario, for all that are invested in this.

### **Key Theme 1: *I Do Think That There are Some Challenges***

Theme 1 supported the participant’s perception that there are still some challenges regarding telehealth-based wound care. Participants discussed how challenges could come from the provider, patient, and/or technology. This key theme was summarized by Participant 1, who stated, “I do think that there are some challenges if we are only utilizing telehealth.” Participants further described challenges to telehealth as including the need to still see patients in the office, that many podiatrists aren’t on the technological bandwagon, that telehealth care for patients with the diabetic foot ulcers is only as good as the assessment and information you get, that barriers to patient ability to collaborate with technology exist, and that there are concerns with having a secure internet or phone connection.

With regard to the participant's view that patients still need to be seen in the office, the participants strongly felt that telehealth cannot replace in-person care and that certain assessment and/or treatment procedures can only be performed in person. Participant 1 stated,

I feel the patient still needs to be seen in the office of a podiatrist or qualified clinician, and in order to complete, you know, testing and debridement if necessary. And so, there's always be a necessary brick and mortar consultant for these patients...

You know, there's all kinds of tests that need to be done on a patient prior to certain modalities being initiated. And a lot of times we can't do those in the home health setting. Like TBIs and ABIs, and you know vascular studies, all of those things have to be done in the clinical setting.

Participant 2 commented,

...so that you know, the downfall of telehealth is that physical care and skilled clinical care that the patients need can't be provided that way...I can't look in the patient's shoes...when I first started...I worked in a wound care clinic and I found like popcorn kernels in a diabetic foot, in a shoe. And that's what was causing their diabetic foot ulcers and that's not something you're not going to capture when you're not physically in the room with a patient...And I think that's part of the problem of not having your actual hands on the patient at times is that things can get out of hand.

Regarding the participant's perception that many podiatrists aren't on the technological bandwagon, participants described challenges associated with interdisciplinary collaboration.

Participant 1 mentioned,

There's certainly a number of podiatrists that aren't on the technological bandwagon very well. And some of those, you know, situations, make it difficult to navigate and because



they're not willing to come on board with telehealth...I feel they need to be more open to technology in their practice.

Participant 2 made a similar comment, voicing, "...the collaborating piece. I think, for one, I don't think people are used to requesting any type of tele help."

Concerning the participant's view that telehealth care for patients with the diabetic foot ulcers is only as good as the assessment and information you get, Participant 2 reflected,

"Yeah, so telehealth with the diabetic foot ulcer is basically only as good as the assessment that you are getting. And so part of that issue is that the home health patient, you need the home health nurse to be able to send you the appropriate information. So it's almost as if the home health nurse is your wound care triage person...they need to like describe things in their assessment like erythema, what the drainage is, there's any tunneling or undermining. So, if you have a clinician that isn't comfortable with like the full scope of a wound assessment, like a wound care specialist, maybe, then you're not really getting all the information you need...that's one of the big limitations for me...my consultation or my visit is only as good as the information that I'm getting.

Participant 2 also discussed how issues impeding quality assessment and information included poor photo quality, untrained clinicians, and patients' conditions, stating,

...Part of, I would say, the biggest problem that we've encountered as a health care system has been poor photo quality or the inability to truly assess the wound over telehealth...I think just the quality of the photograph is one of the biggest [challenge] ...if we have an untrained clinician in wound photography, then there's challenges in getting an accurate photograph or wound assessment of a diabetic foot ulcer...

Especially in the home health setting, where these patients are often sitting in a chair and

you're trying to get a photograph of a wound that's on the bottom of their foot. And often, the patient is unable to hold their leg up, for instance, has some essential tremors when trying to keep a leg elevated...

The challenge of patients having the ability to collaborate with technology was described by participants as patient inability to adopt telehealth into their care. Contributing factors voiced by participants were that patients did not have a smartphone/tablet and internet connection at home, that the patient's health/physical status prevented the use of digital communication, and that living in rural areas was a barrier. Participant 3 commented,

Now, limitations have been if the patient does not have a smartphone, or an iPad, or internet capability, or unable to communicate because of their overall health status...If we strictly relied upon the internet connection with laptop or desktop computers and cameras, that drastically limits the patients that we could see...the majority of our patients that we deal with that have diabetic foot ulcerations are elderly...so they may have some physical handicaps, some limitations in that regard.

Participant 2 responded, "...and then we also have very rural patients. Whether or not there is technology within their home, to provide any type of synchronous visit with the use of telehealth has also been a barrier."

Finally, having a secure internet or phone connection was described as a telehealth challenge by participant 3, who simply noted, "The biggest technical difficulty is a, just a secure, either internet connection or our phone connection."

### **Key Theme 2: *It's [Telehealth] Improved our Ability to Care for Our Patients***

Theme 2 captured the participant's perception that telehealth has improved RN and NP ability to care for patients with diabetic foot ulcers. Participant 1 commented,

...our use of telehealth is allowing more patients. It's allowing patients to be seen and not more frequently by us but by the physicians...I feel like it's improved our ability as a home care agency to care for our patients because we have more accessibility to the specialist, such as podiatrist, then we did before. And the patients actually like it better too.

Participants described how the use of telehealth improved their ability to better care for patients because patients were thankful that telehealth was available to them, that they were able to see the patient in their own environment, that telehealth streamlined communication, and that telehealth improved communication between patients and providers. With regard to patients being thankful for telehealth, Participants noted, "Yes, we have had a multitude of patients verbally express gratitude to us as well as send us written letters thanking us for making telehealth available to them" (Participant 3); "...they [Patients] are actually more open to it, simply because they're not having to travel and wait to see that physician. They're not having to sit in a waiting room and have that travel time involved..." (Participant 1); "...and they actually had a better connection with their, you know, provider versus just going in sitting for two hours, seeing the doctor for seven minutes, and then driving home for two hours" (Participant 1); and

So we have seen an increased, um, rate in healing in our patients because of telehealth and our patients realize that as well...We have some patients that are not able to get to our clinic. They can't get to us because of their bed bound status and we are able to coordinate and utilize telehealth in that regard to continue care for these patients, including those with diabetic foot ulcerations. (Participant 3)

The ability to see the patient in their own environment was described by the participants as helping providers to see the patient's home environment, which helped the providers to make

care plans that were tailored to the patient. Participant 3 noted,

Another advantage has been we could see the patient in their own environment, whether or not they have steps that they're having to walk up or down, if they have poor lighting in their house or their home setting. Those little things become very beneficial to myself and my colleagues and how do we care for the patient. Now that we know the environment that they're living in...Every diabetic foot ulceration looks the same, but telehealth allows you the ability...to see inside that patient's home to have a more intimate relationship with the patient in their own environment. And it allows you to offer the best treatment options for that patient that you would not necessarily know otherwise without telehealth.

Finally, with regard to telehealth's ability to streamline communication, participants felt that telehealth expanded dialogue among clinicians, providers, and the patient, improved patient response time, and allowed for patient test and lab results to be visible in system. Concerning telehealth's ability to expanded dialogue among clinicians, providers, and the patient, Participant 1 noted,

I have found that it actually has expanded the dialogue between myself, my clinicians and the provider. And we're also able to include the patient in on that decision making process because we're all there together and then we don't have the, he said, she said, or the patient or caregiver not understanding what the doctor said, we can always make sure that you know, there's clarification....Streamlined communication!

Regarding improved response time to patients, Participant 2 remarked,

...it's actually improved my response time to patients. I'm able to have more information in front of me...on admission, I could order... all the diagnostic screening things that I

would need to complete a full evaluation on the patients..., so when I physically examine the patient...that information is already there.

Participant 3 made a similar comment, stating, “So I am able to reach more patients in a timely fashion with the use of telehealth than I could otherwise without it.” In addition, participants felt the patient family members and/or caregivers were more involved in wound care because of telehealth. Participant 3 stated,

Now, one of the ways we’ve been able to overcome that [patient inability to utilize telehealth technology] is having the patient’s family or caregiver involved, or we have the home health nurse that may be attending to that patient involved. And they’re able to communicate with us in real time. We’re able to take wound photographs in real time. And that has been a definite advantage and we have seen just numerous patients continuously improve, and the patients are appreciative because it limits their exposure to leaving their household.

Finally, participants described how telehealth allowed test and lab results to be visible in one system, which was viewed by participants as very important for providers to get the whole patient picture. Participant 3 voiced, “I can see like all their lab values in front of me. And I think that’s the important piece...I think that’s super important, it’s kind of getting the whole picture...having everything visible in one system is really important.”

### **Key Theme 3: *It’s [Telehealth] Been Convenient for Me***

The third and final key theme, *It’s [Telehealth] has Been Convenient for Me*, captured the participant’s perception that telehealth is convenient to use for themselves, staff, and their colleagues and that it is easy to navigate and incorporate into the Electronic Health Record (EHR). Participant 1 noted, “...I haven’t had any problems with it [telehealth]. It’s been

convenient for me. And or staff seems to be pretty agreeable with it too...so far I like it.”

Participant 2, stated,

...I’m very comfortable with the EHR. It’s been easy for me to navigate...the telehealth is separate from my EHR, but I’m able to document at the same time I am conducting that telehealth visit and it becomes more effective from a time management perspective on my end than it would otherwise.

### **Discussion**

This study explored the facilitators and barriers of telehealth as perceived by RNs and NPs working in diabetic wound care. The Chronic Care Model was a good fit to guide this study as the six elements were closely related to the delivery of telehealth-based wound care (Glasgow et al., 2001). In particular, the delivery system design element emphasizes the importance of an effective and efficient health care delivery system to offer proactive and continuous care to the patient. Telehealth facilitates communication between patients and healthcare providers in a very time-efficient manner.

The overarching theme and the key themes are also in good agreement with existing literature. As mentioned in the literature review section, Foong et al. (2020) conducted a systematic review on the facilitators and barriers of using digital technology for the management of diabetic foot ulcers. The authors summarized three analytical themes based on the views from health care providers (HCP). Analytical theme 1 *The impact of digital technology on HCPs* described HCPs competency in telehealth and empowerment resulted from the use of telehealth. It is closely related to the key themes 1 and 3 of the project. Analytical theme 2 *The role of digital technology in diabetic foot care* mentioned the impact of telehealth on patient care and electronic documentation system. These discoveries agree well with the key themes 2 and 3

derived from this project. Finally, the analytical theme 3 *Organization of diabetic foot care delivery* talked about the organization of care and delivery of care in terms of clinical guidance and physical limitations. These findings align well with key themes 1 and 2 of the project.

Based on the overarching theme and the key themes, the facilitators of telehealth included the reduced burden to both providers and patients, better patient and provider connection, increase healing rate, the ability to see patient in their own environment, streamlined communication, and increased convenience. Barriers included the lack of physical access to the patient, inability to perform clinical tests in the home health setting, untrained clinician, poor photo quality, lack of internet or phone connection, and rural patient's adoption to telehealth.

One thing not covered by previous studies was the impact of Covid-19 pandemic on telehealth. All three participants agreed that the pandemic had increased the use of telehealth. Participant 1 mentioned that the increase was about 700% due to lockdown or quarantine requirements. In addition, the pandemic has changed the regulatory requirements for telehealth, as many temporary policies were introduced to encourage the use of telehealth. Participant 1 noted that "Covid, it is what kicked off the ability for us to be able to bypass some of the strangest requirements by CMS, Medicare for qualifying our patients." On the other side, the Covid pandemic has also affected the financial situation of the healthcare system. Due to the increase in personal protective equipment expenses and the decrease in patient volume, the healthcare system was very financially frugal and did not have funding to improve the telehealth system. Participant 2 noted that "So we've just had real financial struggle and we're trying to rebound from that. So, investing in a third-party resource that could improve our telehealth isn't a priority for the system at this juncture."

### **Project Strengths and Limitations**

A strength of this study was the inclusion of both RNs and NPs across the nation, allowing the DNP project student to explore and gain insight into the use of telehealth-based wound care in different regions and by different healthcare providers. Also, all three participants had over ten years of experience in wound care and their responses allowed the project student to be aware of recent advances in telehealth-based wound care. The participant population also had a good balance in gender, as there were two female participants and one male participant. In addition, the qualitative approach was appropriate for the project as responses from the semi-structured questions provided a good amount of information for thematic analysis. Limitations of the study included the limited sample size, sampling from a single wound care association, and that the findings were not generalizable.

### **Future Implications and Recommendations**

This project helped to identify future areas of research regarding telehealth-related wound care. One area warranting further research is whether RNs and NPs have different perspectives regarding the use of telehealth, because RNs and NPs are involved in different aspects of wound care. Therefore, a follow-up study focusing on only RNs or NPs would be very helpful. A second area of needed research is the comparison of telehealth among providers in the U.S. and other countries, who might have different healthcare reimbursement schemes. That research might provide insight regarding the policy aspects of telehealth. Finally, data from the interview indicated that different telehealth platforms were available. Future studies could be implemented to investigate the pros and cons of different telehealth wound care platforms. This type of study will provide important information to guide the development of telehealth technologies.

### **Conclusions**

This project revealed one overarching theme *There is an opportunity for telehealth to*



*continue to gain some ground*, which represented a coherent and meaningful pattern found across the dataset. Telehealth is increasingly been used in the management and care of diabetic foot ulcers. Since the start of the Covid-19 pandemic, the utilization of telehealth has significantly increased. Telehealth has increased the convenience for both providers and patients and it will definitely continue to gain some ground.

The three identified key themes resulting from this study included *I do not think that there are some challenges*; *It's improved our ability to care for our patients*; and *It's been convenient for me*. These key themes indicate that while there are still some technical and physical limitations, telehealth has improved the RN/NP's abilities to care for patients. RNs and NPs can now see more patients in a given time and telehealth has allowed the providers to see the patient's environment. In addition, telehealth has been convenient for both the provider and the patient. The overarching theme played a foundational and essential role in each of these three key themes.

Digital technology is increasingly been used in the healthcare system. This DNP project will help to improve the utilization of telehealth in the care of diabetic foot ulcers. The overarching and key themes summarized in the project provide helpful information to guide organization support for telehealth and the development of telehealth technologies. As the themes were captured from the perspective of RNs and NPs, this project will also help in advancing nursing practice and clinical scholarship, and eventually improving patient care.

### References

- Abbott, C. A., Chatwin, K. E., Foden, P., Hasan, A. N., Sange, C., Rajbhandari, S. M., Reddy, P. N., Vileikyte, L., Bowling, F. L., & Boulton, A. J. (2019). Innovative intelligent insole system reduces diabetic foot ulcer recurrence at plantar sites: A prospective, randomised, proof-of-concept study. *The Lancet Digital Health*, 1(6), e308-e318.
- Adiewere, P., Gillis, R. B., Jiwani, S. I., Meal, A., Shaw, I., & Adams, G. G. (2018). A systematic review and meta-analysis of patient education in preventing and reducing the incidence or recurrence of adult diabetes foot ulcers (DFU). *Heliyon*, 4(5), e00614.
- American Association of Colleges of Nursing. (2006). *The essentials of doctoral education for advanced nursing practice*.  
<https://www.aacnnursing.org/Portals/42/Publications/DNPEssentials.pdf>
- American Professional Wound Care Association. (2020). *Overview of APWCA MEMBERSHIP*.  
<https://www.apwca.org/>
- Armstrong, D. G., Boulton, A. J., & Bus, S. A. (2017). Diabetic foot ulcers and their recurrence. *New England Journal of Medicine*, 376(24), 2367-2375.  
[https://www.nejm.org/doi/full/10.1056/NEJMra1615439?url\\_ver=Z39.88-2003&rfr\\_id=ori%3Arid%3Acrossref.org&rfr\\_dat=cr\\_pub%3Dpubmed](https://www.nejm.org/doi/full/10.1056/NEJMra1615439?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub%3Dpubmed)
- Baptista, D. R., Wiens, A., Pontarolo, R., Regis, L., Reis, W. C. T., & Correr, C. J. (2016). The chronic care model for type 2 diabetes: A systematic review. *Diabetology & Metabolic Syndrome*, 8(1), 7.
- Barr, V., Robinson, S., Marin-Link, B., Underhill, L., Dotts, A., Ravensdale, D., & Salivaras, S. (2003). The expanded chronic care model. *Hosp Q*, 7(1), 73-82.

Bohingamu Mudiyansele, S., Stevens, J., Watts, J. J., Toscano, J., Kotowicz, M. A., Steinfert,

C. L., Bell, J., Byrnes, J., Bruce, S., & Carter, S. (2019). Personalised telehealth intervention for chronic disease management: A pilot randomised controlled trial.

*Journal of Telemedicine and Telecare*, 25(6), 343-352.

[https://journals.sagepub.com/doi/full/10.1177/1357633X18775850?url\\_ver=Z39.88-2003&rfr\\_id=ori%3Arid%3Acrossref.org&rfr\\_dat=cr\\_pub%3Dpubmed](https://journals.sagepub.com/doi/full/10.1177/1357633X18775850?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub%3Dpubmed)

Bradshaw, C., Atkinson, S., & Doody, O. (2017). Employing a qualitative description approach in health care research. *Global Qualitative Nursing Research*, 4, 2333393617742282.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.

Braun, V., Clarke, V., Hayfield, N., & Terry, G. (2019). Thematic Analysis. In P. Liamputtong (Ed.), *Handbook of Research Methods in Health Social Sciences* (pp. 843-860). Springer Singapore. [https://doi.org/10.1007/978-981-10-5251-4\\_103](https://doi.org/10.1007/978-981-10-5251-4_103)

Bus, S. A., & van Netten, J. J. (2016). A shift in priority in diabetic foot care and research: 75% of foot ulcers are preventable. *Diabetes/Metabolism Research and Reviews*, 32, 195-200.

Cychosz, C. C., Phisitkul, P., Belatti, D. A., & Wukich, D. K. (2016). Preventive and therapeutic strategies for diabetic foot ulcers. *Foot & Ankle International*, 37(3), 334-343.

Diabetes Atlas. (2015). International diabetes federation. *IDF Diabetes Atlas, 7th edn. Brussels, Belgium: International Diabetes Federation*. <https://www.idf.org/e-library/epidemiology-research/diabetes-atlas/13-diabetes-atlas-seventh-edition.html>

- Doody, O., & Noonan, M. (2013). Preparing and conducting interviews to collect data. *Nurse Researcher*, 20(5), 1-10.
- Fonseca, C., Lopes, M., Ramos, A., Santos, V., Esquinas, A., & Parreira, P. (2016). Nursing interventions in prevention and healing of leg ulcers: Systematic review of the literature. *Journal of Palliative Care & Medicine*, 5(6), 1000238.
- Foong, H. F., Kyaw, B. M., Upton, Z., & Tudor Car, L. (2020). Facilitators and barriers of using digital technology for the management of diabetic foot ulcers: A qualitative systematic review. *International Wound Journal*, Advance online publication.  
<https://doi.org/10.1111/iwj.13396>
- Glasgow, R. E., Tracy Orleans, C., Wagner, E. H., Curry, S. J., & Solberg, L. I. (2001). Does the chronic care model serve also as a template for improving prevention? *The Milbank Quarterly*, 79(4), 579-612.
- Hazenbergh, C., Aan de Stegge, W., Van Baal, S., Moll, F., & Bus, S. (2020). Telehealth and telemedicine applications for the diabetic foot: A systematic review. *Diabetes/Metabolism Research and Reviews*, 36(3), e3247.
- Koivunen, M., & Saranto, K. (2018). Nursing professionals' experiences of the facilitators and barriers to the use of telehealth applications: A systematic review of qualitative studies. *Scandinavian Journal of Caring Sciences*, 32(1), 24-44.
- Koziatek, C., Klein, N., Mohan, S., Lakdawala, V., Swartz, J., Femia, R., Press, R., & Caspers, C. (2020). Use of a telehealth follow-up system to facilitate treatment and discharge of emergency department patients with severe cellulitis. *The American Journal of*

*Emergency Medicine*, Advance online publication.

<https://doi.org/https://doi.org/10.1016/j.ajem.2020.01.061>

Mann, D. M., Chen, J., Chunara, R., Testa, P. A., & Nov, O. (2020). COVID-19 transforms health care through telemedicine: Evidence from the field. *Journal of the American Medical Informatics Association*, Advance online publication.

<https://doi.org/10.1093/jamia/ocaa072>

Mataxen, P. A. (2019). Licensure barriers to telehealth nursing practice. *Nursing2020*, 49(11), 67-68.

Radhakrishnan, K., Xie, B., Berkley, A., & Kim, M. (2016). Barriers and facilitators for sustainability of tele-homecare programs: a systematic review. *Health Services Research*, 51(1), 48-75.

Rush, K. L., Hatt, L., Janke, R., Burton, L., Ferrier, M., & Tetrault, M. (2018). The efficacy of telehealth delivered educational approaches for patients with chronic diseases: A systematic review. *Patient Education and Counseling*, 101(8), 1310-1321.

Shahbazian, H., Yazdanpanah, L., & Latifi, S. M. (2013). Risk assessment of patients with diabetes for foot ulcers according to risk classification consensus of International Working Group on Diabetic Foot (IWGDF). *Pakistan Journal of Medical Sciences*, 29(3), 730.

Shelton, A., & Reimer, N. (2018). Telehealth wound applications: Barriers, solutions, and future use by nurse practitioners. *Online Journal of Nursing Informatics*, 22(2).

<https://www.himss.org/resources/telehealth-wound-applications-barriers-solutions-and-future-use-nurse-practitioners>

- Skafjeld, A., Iversen, M. M., Holme, I., Ribu, L., Hvaal, K., & Kilhovd, B. K. (2015). A pilot study testing the feasibility of skin temperature monitoring to reduce recurrent foot ulcers in patients with diabetes - a randomized controlled trial [Article]. *BMC Endocrine Disorders*, 15(1). <https://doi.org/10.1186/s12902-015-0054-x>
- van Netten, J. J., Price, P. E., Lavery, L. A., Monteiro-Soares, M., Rasmussen, A., Jubiz, Y., Bus, S. A., & International Working Group on the Diabetic Foot. (2016). Prevention of foot ulcers in the at-risk patient with diabetes: A systematic review. *Diabetes/Metabolism Research and Reviews*, 32, 84-98. <https://onlinelibrary.wiley.com/doi/full/10.1002/dmrr.2701>

## Appendix A



### University at Buffalo Institutional Review Board (UBIRB)

Office of Research Compliance | Clinical and Translational Research Center Room 5018

875 Ellicott St. | Buffalo, NY 14203

UB Federalwide Assurance ID#: FWA00008824

### STUDY EXEMPTION

October 5, 2020

Dear [Xiaodan Zhou](#),

On 10/5/2020, the University at Buffalo IRB reviewed the following submission:

Type of Review:	Initial Study
Title of Study:	Investigating barriers and facilitators of using telehealth in diabetic foot ulcer management among registered nurses and nurse practitioners working in wound care across the nation
Investigator:	<a href="#">Xiaodan Zhou</a>
IRB ID:	STUDY00004865
Funding:	None
Grant ID:	None
IND, IDE, or HDE:	None
Documents Reviewed:	<ul style="list-style-type: none"> <li>• Interview introduction.docx, Category: Surveys/Questionnaires;</li> <li>• recruitment email.pdf, Category: Recruitment Materials;</li> <li>• scientificreview.pdf, Category: Other;</li> <li>• Verbal consent script.pdf, Category: Consent Form;</li> <li>• XZhou HRP-503-Template Protocol _9_15_20.docx, Category: IRB Protocol;</li> </ul>

The University at Buffalo Institutional Review Board has considered the submission for the project referenced above on 10/5/2020 and determined it to be Exempt.

In conducting this study, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the Click system.

UBIRB exemption is given with the understanding that the most recently approved procedures will be followed and the most recently approved consenting documents will be used. If modifications are needed that may change the exemption determination, please contact the UB IRB Office. Also, see the Worksheet: Exempt Determination (HRP-312) for information on exemption criteria and categories.

As principal investigator for this study involving human participants, you have responsibilities to the SUNY University at Buffalo IRB (UBIRB) as follows:

1. Ensuring that no subjects are enrolled prior to the IRB approval date.

**University at Buffalo Institutional Review Board (UBIRB)**

Office of Research Compliance | Clinical and Translational Research Center Room 5018  
875 Ellicott St. | Buffalo, NY 14203  
UB Federalwide Assurance ID#: FWA00008824

2. Ensuring that the UBIRB is notified of:
  - All Reportable Information in accordance with the Reportable New Information Smart Form.
  - Project closure/completion by submitting a Continuing Review/Modification/Study Closure Smart Form in Click.
3. Ensuring that the protocol is followed as approved by UBIRB unless minor changes that do not impact the exempt determination are made.
4. Ensuring that the study is conducted in compliance with all UBIRB decisions, conditions, and requirements.
5. Bearing responsibility for all actions of the staff and sub-investigators with regard to the protocol.
6. Bearing responsibility for securing any other required approvals before research begins.

If you have any questions, please contact the UBIRB at 716-888-4888 or [ub-irb@buffalo.edu](mailto:ub-irb@buffalo.edu).



**Appendix B**

## Interview Questionnaire

1. Describe for me your organization's support for the use of telehealth and training regarding caring for patients with diabetic foot ulcers.
2. Describe for me any experiences with technical difficulties you have encountered that have affected the quality of care delivered by telehealth in the care of patients with diabetic foot ulcers.
3. Describe for me any difficulties you have experienced in collaborating with other professionals and/or staff in relation to the use of telehealth in caring for patients with diabetic foot ulcers.
4. Describe any experiences you have had using audio-based or video-based telehealth services and describe your preferences.
5. Describe for me the usability of the telehealth format in general with regard to caring for patients with diabetic foot ulcers care.
6. Tell me about how the COVID 19 pandemic has impacted your use of telehealth for caring for patients with diabetic foot ulcers.
7. Tell me about any feedback that you have received from patients with diabetic foot ulcers regarding using telehealth to provide care for them.
8. Describe for me how the use of telehealth affects your time management regarding caring for patients with diabetic foot ulcers.
9. Describe for me your experiences with the electronic documentation system associated with the use of telehealth for the care of patients with diabetic foot ulcers.
10. Describe your overall satisfaction with telehealth-based wound care.

11. Is there anything you think is important for me to know about using telehealth to care for patients with diabetic foot ulcers that we did not talk about today?

**Appendix C**

## Letter of Support from APWCA

Date: 7/10/2020

Re: Letter of Support

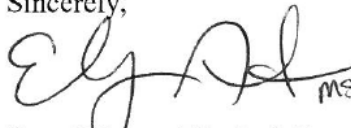
To Whom It May Concern:

It is my pleasure to write a letter in support of the proposed Doctor of Nursing Practice (DNP) project "Barriers and Facilitators of using Telehealth in Diabetic Foot Ulcer Management among Registered Nurses and Nurse Practitioners Working in Wound Care Across the Nation" being submitted to the University at Buffalo Institutional Review Board by Xiaodan Zhou.

Recent advances in digital technology have expedited the use of telehealth in wound care. Telehealth facilitates communications between the patient and healthcare providers to offer personalized intervention and ultimately improve the outcome of patients with diabetic foot ulcers. However, despite these benefits, the rate of telehealth adoption in the field of diabetic foot care is still relatively low. This project aims to find the barriers and facilitators of using telehealth. It is highly relevant to the wound care society and would increase the utilization of telehealth among nurses/nurse practitioners working in the area.

In conclusion, I fully support the DNP project as proposed by Xiaodan Zhou and agree to allow the DNP project to be implemented among members of the American Professional Wound Care Association.

Sincerely,

 *Elizabeth Faust*  
MSN, CRNP, CWOCN-AP, CWS, DAPWCA

Typed Name: Elizabeth Faust, MSN, CRNP, CWOCN-AP, CWS, DAPWCA

Title: Vice President APWCA

## **Appendix D**

### **Recruitment Email**

My name is Xiaodan Zhou and I am a Doctor of Nursing Practice (DNP) student in the Family Nurse Practitioner (FNP) program in the School of Nursing at the University at Buffalo (UB). I am in the process of recruiting participants for my DNP project which is a program requirement for all DNP students.

The purpose of my DNP project is to qualitatively explore the facilitators and barriers of using telehealth for the management of diabetic foot ulcers among registered nurses (RN) and nurse practitioners (NP) working in wound care. The project aim is to promote the utilization of telehealth in diabetic foot care and to improve the outcome of patients with diabetic foot ulcers.

I invite you to participate in a phone or Zoom-based interview session with me scheduled at a day and time of your convenience to explore your views of the facilitators and barriers of using telehealth for the management of diabetic foot ulcers among RNs and NPs working in wound care. To be eligible for study participation, you must be 18 years and older, a member of the APWCA, and an RN or NP working with patients with diabetic foot ulcers using telehealth. Your participation is completely voluntary and all of your responses will be kept confidential. The interview is expected to take about one hour of your time. The interview session will be recorded and will take place via telephone or password protected Zoom videoconferencing. The audio recorded interview session will be transcribed as de-identified by me and assigned a number for data analysis purposes. No one will know who participated in the interview session except for me.

If you are interested in participating in this study, please email me or leave me a voicemail with your phone number and a day and time to call you so I can answer any questions

you may have and to schedule an interview day and time. Once an interview day and time are scheduled, a copy of the verbal consent document will be emailed to you for your review prior to your scheduled interview day. On the day of your scheduled interview, prior to the interview session, I will answer any questions you have about study participation and will obtain your verbal consent.

Your participation is vital to helping me successfully complete my DNP project. Thank you for your time and consideration.

Xiaodan Zhou, DNP Family Nurse Practitioner student

University at Buffalo, School of Nursing

Email: [xiaodanz@buffalo.edu](mailto:xiaodanz@buffalo.edu)

Phone: 716-906-4978

## **Appendix E**

### **HRP-502 Verbal Consent Document**

***Title of Research Study:*** Barriers and Facilitators of using Telehealth in Diabetic Foot Ulcer Management among Registered Nurses and Nurse Practitioners Working in Wound Care Across the Nation

***Version Date:*** September 8, 2020

***Investigator:*** Xiaodan Zhou, DNP Project Student, Principal Investigator (PI)

***Key Information:*** The purpose of my DNP project is to qualitatively explore the facilitators and barriers of using telehealth for the management of diabetic foot ulcers among registered nurses (RN) and nurse practitioners (NP) working in wound care. The project aim is to promote the utilization of telehealth in diabetic foot care and to improve the outcome of patients with diabetic foot ulcers.

***Why am I being invited to take part in a research study?***

You are being invited to take part in this research study because you are an RN or NP aged 18 years and older who is a member of the American Professional Wound Care Association (APWCA) and who works with patients with diabetic foot ulcers using telehealth.

***What should I know about a research study?***

Your participation is voluntary.

Whether or not you take part is up to you.

You can choose not to take part.

You can agree to take part and later change your mind.

Your decision will not be held against you.

You can ask any questions you want before you make your decision to participate.

You can ask any questions you want at any point in time during the study.

***Why is this research being done?***

This research is being done to qualitatively explore the facilitators and barriers of using telehealth for the management of diabetic foot ulcers among registered nurses (RN) and nurse practitioners (NP) working in wound care. The project aim is to promote the utilization of telehealth in diabetic foot care and to improve the outcome of patients with diabetic foot ulcers.

***How long will the research last and what will I need to do?***

Your participation in this study involves participating in a one-time individual interview session with the study's primary investigator (PI) that will take approximately one hour of your time.

Individual interviews will be conducted by telephone or by password protected Zoom videoconferencing, will be recorded, and will take place during a date, time, and location of your choosing.

***What are my responsibilities if I take part in this research?***

If you take part in this study, your responsibility will include participating in a one-time individual interview session with the study's PI that will take approximately one hour of your time.

***What happens if I say yes, I want to be in this research?***

By voluntarily and verbally consenting to participate in this study, you agree to participate in a one-time recorded individual interview session with the PI that will be conducted either by telephone or password protected Zoom videoconferencing during a date, time, and location of

your choosing. The interview session will last approximately one-hour.

All information and responses shared with the PI during the individual interview will be kept private and confidential. No personal information regarding your participation in this study will be shared. There are no right or wrong answers to any question asked during the interview session, and you can refuse to answer or skip any question asked of you. If at any time you feel uncomfortable for any reason, you are free to withdraw from the study without fear of reprisal or penalty.

To ensure participant privacy and confidentiality, the recorded interview session will be kept on the PI's personal password protected laptop computer for the duration of the study. The interview session will be transcribed by the PI verbatim onto paper for data analysis purposes, and will be de-identified and assigned a number with no personal identifiers. No person other than the PI will know who participated in the study. All transcriptions will be read and re-read by the PI while listening to the recorded interview session to ensure accuracy, thoroughness, and quality. Once all transcriptions are checked for accuracy, thoroughness and quality, all audio recordings will be destroyed by the PI.

***What happens if I say yes, but I change my mind later?***

You are free to withdraw from this study at any time without fear of reprisal or penalty. Should you choose to withdraw, all identifiable data will be deleted.

***Is there any way being in this study could be bad for me?***

While breach of privacy and confidentiality is always a risk, all participant information will be



kept private and confidential on the PI's personal password protected laptop computer for the duration of the study. No other individual will have access to participant information, and no personal identifiers will be shared during the data analysis and dissemination of findings. No one but the PI will know who participated in the study.

***Will being in this study help me in any way?***

There are no direct benefits to you for participating in this research. Your answers however may contribute to promoting increased insight, knowledge, and understanding regarding utilization of telehealth in diabetic foot care to improve the outcome of patients with diabetic foot ulcers.

***What happens if I do not want to be in this research?***

Your participation in this study is completely voluntary. You may choose not to enroll in this study, and/or you may choose to withdraw from the study at any time without fear of reprisal or penalty.

***Can I be removed from the research without my OK?***

There are no foreseeable circumstances for which you would need to be removed from this study.

***How many people will be studied?***

The PI expects to enroll between five and 12 RN and NP participants recruited from September to November, 2020.

***What happens to the information collected for the research?***

Efforts will be made to maintain your privacy and confidentiality throughout the entirety of the study. All data and information obtained from the individual interview session will be kept confidential by the PI. No other individual will have access to your personal information, and all

data will be de-identified by the PI prior to its analysis by the research team. No personal identifiers or information will be shared during the reporting of this study's findings.

At the conclusion of this study, all de-identified study data and materials will be stored in a locked file cabinet in the PI's DNP Project Advisor's office located on the South Campus at the University at Buffalo, School of Nursing. No other individual will have access to the locked cabinet. All de-identified study data and materials will be destroyed by the PI's DNP Project Advisor after a period of three years following the conclusion of the study as per UB's approved Institutional Review Board protocol.

Study findings will be disseminated via publication in a peer reviewed journal.

***What else do I need to know?***

Participants will not be compensated for participating in this study.

***Who can I talk to?***

If you have questions, concerns, complaints, or think the research has hurt you in any way, you may contact the research team's PI:

Xiaodan Zhou, Family Nurse Practitioner (FNP) DNP student, University at Buffalo, School of Nursing

Email: [xiaodanz@buffalo.edu](mailto:xiaodanz@buffalo.edu)

Phone: 716 906 4978

You may also contact the research participant advocate at 716-888-4845 or

[researchadvocate@buffalo.edu](mailto:researchadvocate@buffalo.edu).

This research has been reviewed and approved by an Institutional Review Board (“IRB”). An IRB is a committee that provides ethical and regulatory oversight of research that involves human subjects. You may talk to them at (716) 888-4888 or email [ub-irb@buffalo.edu](mailto:ub-irb@buffalo.edu) if:

You have questions about your rights as a participant in this research.

Your questions, concerns, or complaints are not being answered by the research team.

You cannot reach the research team.

You want to talk to someone besides the research team.

You want to get information or provide input about this research.

Your verbal consent to participate in this study will be obtained by the PI prior to implementation of the interview session on the day of your scheduled interview. A copy of this verbal consent document should be retained for your personal record.

## Appendix F

### Interview Introduction and Informed Verbal Consent Script

**Welcome:** Good morning/afternoon/evening. My name is Xiaodan Zhou and I am a Doctor of Nursing Practice (DNP) student in the Family Nurse Practitioner program at the University at Buffalo. I would like to thank you for joining me this morning/afternoon/evening, and for participating in this study.

**Introduction:** The purpose of my DNP project is to qualitatively explore the facilitators and barriers of using telehealth for the management of diabetic foot ulcers among registered nurses (RN) and nurse practitioners (NP) working in wound care. The project aim is to promote the utilization of telehealth in diabetic foot care and to improve the outcome of patients with diabetic foot ulcers.

**Participation:** Before we begin, I would like to remind you that your participation in this interview session is completely voluntary. The interview will take approximately one hour of your time and will be audio recorded and transcribed as de-identified for data analysis purposes. There are no right or wrong answers, and you can refuse to answer any question I ask of you. If at any time you feel uncomfortable for any reason, you are free to withdraw from the interview session without fear of reprisal or penalty. No personal information regarding your participation in this study will be shared.

**Ground Rules:** I ask that you do not use any personal identifiers during the interview session.

Did you have a chance to review the verbal consent document?

Do you have any questions before we begin the interview?

Do you give your verbal consent to participate in this study?

Thank you again for taking the time to participate in this study. We will now begin the interview session.

## **Appendix G**

### Demographic Questionnaire (voluntary)

1. How old are you?
3. What is your race?
4. What is your gender?
5. Are you an RN or NP?
5. How many years have you been practicing as a RN or NP?
6. What clinical setting do you work in?
7. What is your highest educational degree?

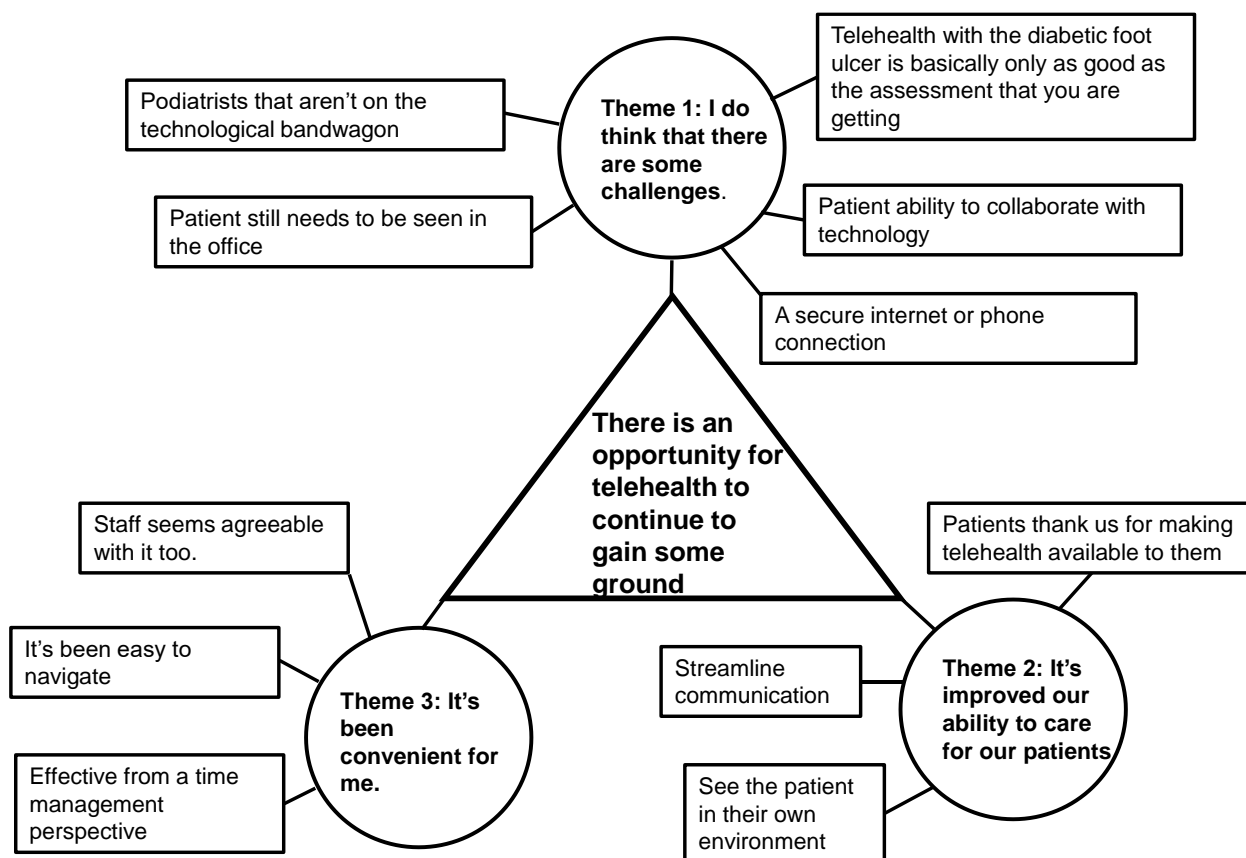
**Appendix H**

## Demographic information of participants


Participant	1	2	3
Age	50s	40s	40s
Race	White	White	White
Education	B.S.	M.S.	D.N.P.
Years of experience	>20	>10	>20
State	OK	PA	LA
Gender	Female	Female	Male
Role	RN	NP	NP
Setting	Home-care	Hospital	Clinic

**Appendix I**

## Thematic Map








 University at Buffalo The State University of New York

## **BARRIERS AND FACILITATORS OF USING TELEHEALTH IN DIABETIC FOOT ULCER MANAGEMENT AMONG REGISTERED NURSES AND NURSE PRACTITIONERS WORKING IN WOUND CARE ACROSS THE NATION**

Xiaodan Zhou, RN, DNP student  
Dec. 9, 2020




 University at Buffalo The State University of New York

 University at Buffalo The State University of New York

### Introduction

- It is estimated that 9.1 million to 26.1 million people developed diabetic foot ulcers worldwide (Diabetes Atlas, 2015).
- The 5-year mortality of a patient with a diabetic foot ulcer is 2.5 times higher than that of diabetic patients without a foot ulcer (Armstrong et al., 2017).
- Preventative care plays an essential role in diabetic foot management (Bus & van Netten, 2016).
- Recent advances in digital technology have enabled more frequent communications between patients and healthcare providers.
- However, studies have shown that telehealth adoption in the field of diabetic foot care is still very slow (Hazenberget al., 2020).


2

 University at Buffalo The State University of New York

### Background and Significance

- Telehealth is effective in the management of chronic disorders, including chronic wounds (Abbott et al., 2019; Koziatsek et al., 2020; Skafjeld et al., 2015).
- The three major themes of nurse-led telehealth-based foot care are education, consultation, and monitoring (van Netten et al., 2016).
- Telehealth is not widely adopted in diabetic foot care (Foong et al., 2020).
- Most studies on facilitators and barriers in telehealth implementation in wound care were published over three years ago.
- The Covid-19 pandemic has abruptly changed healthcare delivery system (Mann et al., 2020).
- It is important to offer updated information on the barriers and facilitators for utilizing telehealth for diabetic foot care.

3

 University at Buffalo The State University of New York

### Project Purpose, Aims and Objectives

- Purpose: Qualitatively explore the facilitators and barriers of using telehealth for the management of diabetic foot ulcers among registered nurses (RN) and nurse practitioners (NP) working in wound care.
- Aim: Increase the utilization of telehealth in diabetic foot care and improve the outcome of patients with diabetic foot ulcers.
- Objectives
  - 1) Conduct an extensive review of the literature examining the implementation of telehealth in wound care practice;
  - 2) Create a semi-structured interview questionnaire based on findings resulting from the literature review;
  - 3) Conduct individual interviews with RNs and NPs working in diabetic wound care to understand the use of telehealth in practice;
  - 4) Qualitatively analyze and summarize the facilitators and barriers with recommendations on how to promote telehealth usage among RNs and NPs.

4

### DNP Essentials Addressed

- This project was well aligned with the eight DNP Essentials (AACN, 2006).
- Essentials I Scientific Underpinnings for Practice and III Clinical Scholarship and Analytical Methods for Evidence-Based Practice
  - *Addressed through a comprehensive literature review of current scientific evidence in diabetic foot care and how telehealth can be integrated in practice.*
- Essential II Organizational and Systems Leadership for Quality Improvement and Systems Thinking
  - *Addressed through summarizing and disseminating the research findings on the facilitators and barriers to inform future clinical practice.*
- Essential IV Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care
  - *Addressed through surveying the latest telehealth technologies on diabetic foot care, evaluating opinions from RNs and NPs, and offering suggestions for future technology development.*

5

### DNP Essentials Addressed

- Essential V Health Care Policy for Advocacy in Health Care
  - *Addressed by researching policy and licensure barriers and facilitators in telehealth-based foot care with the goal of advocating for nursing professions working in diabetic foot care.*
- Essential VI Interprofessional Collaboration for Improving Patient and Population Health Outcomes
  - *Addressed by examining inter-professional facilitators and barriers in telehealth implementation with the goal of improving communication and collaboration in the care team.*
- Essential VII Clinical Prevention and Population Health for Improving the Nation's Health
  - *Addressed by facilitating telehealth-assisted preventative care to improve the health of both individuals and communities.*
- Essential VIII Advanced Nursing Practice
  - *Addressed by offering evidence-based information to guide nursing practice on telehealth.*

6

### APN Contribution to Scholarship and Practice Through Project Implementation

- This project aims to improve the utilization of telehealth among RNs and NPs in working in diabetic foot care.
- The analytical themes derived from the project will enhance clinical practice in telehealth and diabetic wound care.
- The finding from the project might also influence policies related to telehealth.
- The project will inform nursing science as it contained an extensive literature review to find the scientific evidences in diabetic foot care and telehealth implementation.

7

### Theoretical Framework

- The Chronic Care Model (CCM) served as the theoretical framework for this DNP project (Glasgow et al., 2001).
- The CCM contains six interrelated elements: organization of the health care, self-management support, decision support, delivery system design, clinical information systems, and community resource and policy.
- Combining all six elements of CCM would lead to better health outcome (Baptista et al., 2016)
- As the diabetic wound is among the most challenging chronic conditions, the management of diabetic wound fits the scope of the CCM.

8

## Theoretical Framework

- The project is particularly related to the delivery system design element and the clinical information system element.
- Other elements of the CCM are also relevant to the project
  - *The implementation of telehealth in the organization → the health system organization element.*
  - *Research on evidence-based guideline for telehealth practice → the decision support element.*
  - *A main goal of telehealth → the self-management support element.*
  - *Better support for patients who receive telehealth care → the community resources and policies element.*

9

## Literature Review: Process

- Keywords: facilitators, barriers, telehealth, telemedicine, telemedical, tele-homecare, remote care, nurse, nurse practitioner, nursing practice, diabetes, wound, ulcers, and foot care.
- Database: PubMed and Embase.
- Year range: 2015 to 2020.
- Screening: title and abstract.
- Results: ten articles were identified and classified into three major categories: diabetic foot ulcer care, telehealth applications, and barriers and facilitators of telehealth implementation.

10

## Literature Review: Findings I

- Diabetic foot ulcer care (Adiewere et al., 2018; Armstrong et al., 2017; Fonseca et al., 2016)
  - *Use of innovative technologies improves patients' self-management skills and adherence to treatment plans.*
  - *Patient education needs to be combined with other interventions to improve overall effectiveness.*
  - *Factors promote ulcer healing include individualization of care, patient-provider relationship, pain control, control of the exudate, education for health self-management, self-care, therapeutic adherence, and implementation of guidelines of good practice.*

11

## Literature Review: Findings II

- Telehealth Applications for Diabetic Foot Care (Abbott et al., 2019; Hazenberg et al., 2020)
  - *Telehealth applications can be classified into five areas:*
    - *Dermal thermography (effective)*
    - *Hyperspectral imaging (experimental stage)*
    - *Digital photographic imaging (effective)*
    - *Audio/video/online communication (effective)*
    - *Insole pressure monitoring (effective)*
  - *Combination of traditional telehealth with new monitoring approaches leads to better wound healing and prevention.*

12

### Literature Review: Findings III

- Barriers and facilitators to telehealth practice (Foong et al., 2020; Koivunen & Saranto, 2018; Mataxen, 2019; Radhakrishnan et al., 2016; Shelton & Reimer, 2018).
  - *A systematic review identified three analytical themes: impact of digital technology, the role of digital technology in ulcer care, and the organization of ulcer care delivery.*
  - *For patients: technical problems and preference for in-person care.*
  - *For nurses: lack of training and orientation, perceptions on the effectiveness of tele-homecare, and lack of inter-professional collaboration.*
  - *For NPs: clinician education and training, technical support, level of involvement of a local champion, and cost-benefit analyses.*

13

### Literature Review: Conclusion

- Diabetic foot ulcers have been a major burden to diabetic patients.
- The management of foot ulcers requires frequent communication between patients and healthcare providers.
- The telehealth approach could transform traditional practice to more accessible ulcer care (Hazenberg et al., 2020).
- Current studies on the facilitators and barriers of telehealth were either too early (conducted over five years ago) or too generic (not nursing specific).
- This project filled the gap in previous studies by conducting a qualitative interview among nurses and NPs to explore the facilitators and barriers of implementing telehealth in diabetic foot ulcer management and care.

14

### Project Design

- Qualitative descriptive study
- Qualitative semi-structured interview questions with demographic questionnaire
- Key findings were utilized to provide recommendations to promote the use of telehealth in diabetic wound care.

15

### Methods and Design: Setting and Recruitment

- Participants were recruited from the American Professional Wound Care Association (APWCA).
- APWCA administrator forwarded the recruitment email twice to all nurse and nurse practitioner members in APWCA. Interested participants contacted the project PI for the interview.
- Additional recruitment was also conducted through the PI's local network.

#### Inclusion criteria

- *Greater than or equal to 18 years old.*
- *Registered nurses or nurse practitioners.*
- *Works in wound care setting or in primary care setting with experience in diabetic wound care.*
- *Has experience using telehealth.*
- *Speaks fluent English.*

#### Exclusion criteria

- *Less than 18 years old.*
- *Not a registered nurse or nurse practitioner.*
- *No experience in wound care or telehealth.*

16

### Protection of Human Rights and Ethical Considerations

- This project has been reviewed and approved by UB IRB.
- Two minor risks are data breach and loss of confidentiality
  - Preventing data breach: all the audio files were saved in a password-protected computer. After confirming the accuracy of transcription, the audio files were permanently deleted.
  - Protecting confidentiality: all participants were assigned with unique numeric codes.
- Post project completion, the data will be kept in the project advisors office for 3 years in a locked cabinet and then destroyed.

17

### Data Collection: Interview Questions

1. Describe your organization's support for the use of telehealth and training regarding caring for patients with diabetic foot ulcers?
2. Describe for me any experiences with technical difficulties you have encountered that have affected the quality of care delivered by telehealth in the care of patients with diabetic foot ulcers.
3. Describe for me any difficulties you have experienced in collaborating with other professionals and/or staff in relation to the use of telehealth in caring for patients with diabetic foot ulcers.
4. Describe any experiences you have had using audio-based or video-based telehealth services and describe your preferences.
5. Describe for me the usability of the telehealth format in general with regard to caring for patients with diabetic foot ulcers care.

18

### Data Collection: Interview Questions

6. Tell me about how the COVID 19 pandemic has impacted your use of telehealth for caring for patients with diabetic foot ulcers.
7. Tell me about any feedback that you have received from patients with diabetic foot ulcers regarding using telehealth to provide care for them.
8. Describe for me how the use of telehealth affects your time management regarding caring for patients with diabetic foot ulcers.
9. Describe for me your experiences with the electronic documentation system associated with the use of telehealth for the care of patients with diabetic foot ulcers.
10. Describe your overall satisfaction with telehealth-based wound care.
11. Is there anything you think is important for me to know about using telehealth to care for patients with diabetic foot ulcers that we did not talk about today?

19

### Data Collection: Demographic Questions

#### Age

Under 30 years old  
30-39 years old  
40-49 years old  
50-59 years old  
60 and above

#### High educational degree

Associate's degree  
Bachelor's degree  
Master's degree  
Doctorate degree

#### Race

Caucasian  
African American  
Asian  
American Indian or Alaska Native  
Native Hawaiian or Pacific islander  
Other race

#### Role

Registered nurse  
Nurse practitioner

#### Years of experience in wound care

#### Clinical setting

20

### Participant Demographics

Participant	1	2	3
Age	50s	40s	40s
Race	White	White	White
Education	B.S.	M.S.	D.N.P.
Years of experience	>20	>10	>20
State	OK	PA	LA
Gender	Female	Female	Male
Role	RN	NP	NP
Setting	Home-care	Hospital	Clinic

21

### Data Collection: Procedure

- Interviews were all conducted through Zoom.
- The data collection procedures were as follows.
  - Obtain verbal informed consent.
  - Obtain demographic questionnaire.
  - Audio recording starts
  - Go through the 11 interview questions
  - Transcribe audio into text.
  - Verify transcription accuracy.
  - Destroy audio recordings.

22

### Data Analysis: Overview

- The six-phase reflexive thematic analysis was utilized for data analysis (Braun et al., 2019).
- Data analysis started right after the interview and continued until all themes are defined.
- The six phases were conducted as a reflexive and recursive process.
- Aims:
  - Identify meaning-based patterns across a dataset.
  - Provide coherent and compelling interpretation of data.

23

### Data Analysis: the Six Phases

- Familiarization phase: Read transcribed textual data, make casual notes.
- Generating codes phase: Organize data and generate concepts
- Constructing themes phase: Build candidate themes and subthemes.
- Revising themes phase: Review and reorganize themes.
- Defining themes phase: Review and define themes. Find connection among themes.
- Producing the report phase: Make a final analysis, write the report, and make connections to existing literature.

24

## Key Findings

- Overarching Theme
  - *There is an Opportunity for Telehealth to Continue to Gain Some Ground*
- Key Themes
  - *I do think that there are some challenges*
  - *Telehealth has improved our ability to care for our patients*
  - *Telehealth has been convenient for me*

25

## Overarching Theme

- There is an Opportunity for Telehealth to Continue to Gain Some Ground
  - *"So I think it's a great idea. I'm actually working with another group where they're utilizing nurse practitioners to help us and do virtual wound consults. And since, you know, we have had a hard time getting our patients to the wound care center in non-pandemic times and we feel like there's an opportunity for telehealth to continue to gain some ground." #1*

26

## Key theme 1: I do think that there are some challenges

- Patient still needs to be seen in the office
- Podiatrists that aren't on the technological bandwagon
- Telehealth with the diabetic foot ulcer is basically only as good as the assessment that you are getting
- Patient ability to collaborate with technology
- A secure internet or phone connection

27

## Supporting Quotes

- "I do think that there are some challenges if we are only utilizing telehealth." #1
- "I feel the patient still needs to be seen in the office of a podiatrist or qualified clinician, and in order to complete, you know, testing and debridement if necessary. And so there's always be a necessary brick and mortar consultant for these patients." #1
- "...the collaborating piece. I think, for one, I don't think people are used to requesting any type of tele help." #2
- "Part of, I would say, the biggest problem that we've encountered as a health care system has been poor photo quality or the inability to truly assess the wound over telehealth...So I think just the quality of the photograph is one of the biggest." #2
- "...I would say, I'm going to say 60% of our patients have the ability to collaborate with technology. However, the rest of them, we scheduled the appointment, either with the primary care or wound care center to have that telehealth meeting when we're available in the home." #1
- "The biggest technical difficulty is a, just a secure, either internet connection or our phone connection." #3

28

### Key theme 2: It's Improved our Ability to Care for Our Patients

- Patients thank us for making telehealth available to them
- See the patient in their own environment
- Streamlined communication

29

### Supporting Quotes

- "...I feel like it's improved our ability as a home care agency to care for our patients because we have more accessibility to the specialist, such as podiatrist , then we did before. " #1
- "Yes, we have had a multitude of patients verbally express gratitude to us as well as send us written letters thanking us for making telehealth available to them." #3
- "...they [Patients] are actually more open to it, simply because they're not having to travel and wait to see that physician. They're not having to sit in a waiting room and have that travel time involved..." #1
- "Another advantage has been we could see the patient in their own environment, whether or not they have steps that they're having to walk up or down, if they have poor lighting in their house or their home setting. Those little things become very beneficial to myself and my colleagues and how do we care for the patient." #3
- "I have found that it actually has expanded the dialogue between myself, my clinicians and the provider... because we're all there together...we can always make sure that you know, there's clarification....Streamlined communication!" #1

30

### Key theme 3: It's Been Convenient for Me

- Staff seems agreeable with it too.
- It has been easy to navigate
- Effective from a time management perspective.

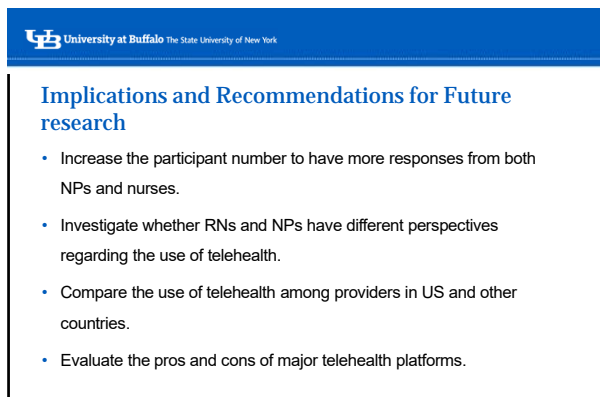
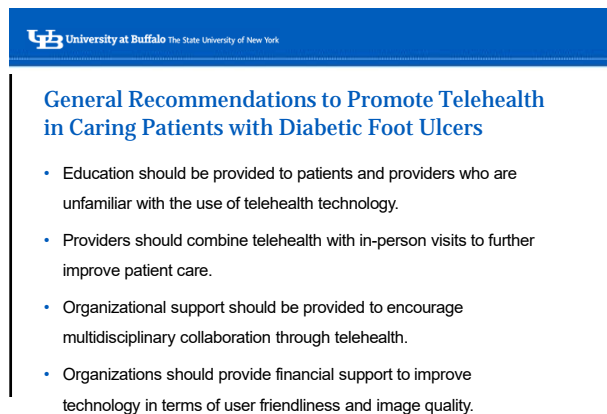
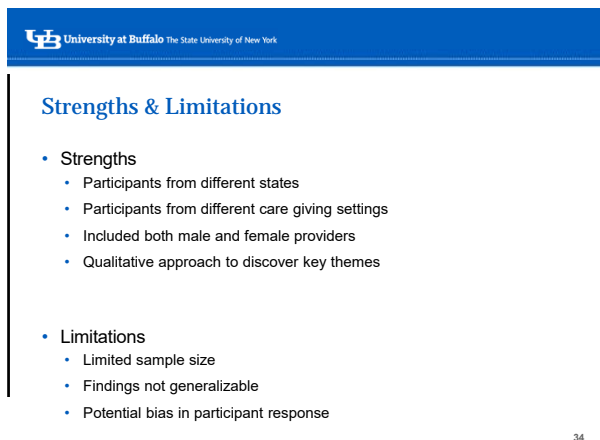
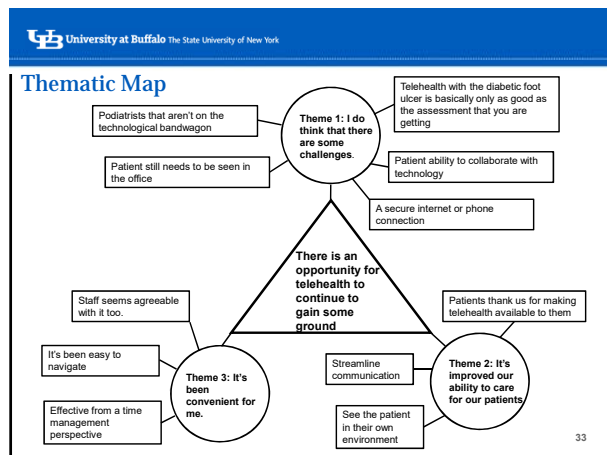
31

### Supporting Quotes

- "...I haven't had any problems with it [telehealth]. It's been convenient for me. And or staff seems to be pretty agreeable with it too...so far I like it." #1
- "...I'm very comfortable with the EHR. It's been easy for me to navigate." #2
- "the telehealth is separate from my EHR, but I'm able to document at the same time I am conducting that telehealth visit and it becomes more effective from a time management perspective on my end than it would otherwise." #2
- "Extremely satisfied. No regrets. All of both myself and my other fellow nurse practitioner providers in our group practice thoroughly enjoy the use of Telehealth " #3

32





## Conclusion

- Telehealth has increased the nurse's ability to care for patients with diabetic foot ulcers.
- Telehealth has found to be convenient for both nurses and patients.
- The Covid pandemic has significantly increased the utilization of telehealth.
- Future studies are still needed to address the challenges in telehealth.
- The themes identified from the study will lead to better understanding of facilitators and barriers in telehealth-based ulcer care.

37



38

## References

- Abbott, C. A., Chatwin, K. E., Foden, P., Hasan, A. N., Sange, C., Rajbhandari, S. M., Reddy, P. N., Vileskyte, L., Bowling, F. L., & Boulton, A. J. (2019). Innovative intelligent insole system reduces diabetic foot ulcer recurrence at plantar sites: A prospective, randomised, proof-of-concept study. *The Lancet Digital Health*, 1(6), e308-e318.
- Adiewere, P., Gillis, R. B., Jiwani, S. I., Meal, A., Shaw, I., & Adams, G. G. (2018). A systematic review and meta-analysis of patient education in preventing and reducing the incidence or recurrence of adult diabetes foot ulcers (DFU). *Heliyon*, 4(5), e00614.
- American Association of Colleges of Nursing. (2006). *The essentials of doctoral education for advanced nursing practice*. <https://www.aacnursing.org/Portals/42/Publications/DNPEssentials.pdf>
- Armstrong, D. G., Boulton, A. J., & Bus, S. A. (2017). Diabetic foot ulcers and their recurrence. *New England Journal of Medicine*, 376(24), 2367-2375.
- Baptista, D. R., Wiens, A., Pontarolo, R., Regis, L., Reis, W. C. T., & Correr, C. J. (2016). The chronic care model for type 2 diabetes: A systematic review. *Diabetology & Metabolic Syndrome*, 8(1), 7.
- Braun, V., Clarke, V., Hayfield, N., & Terry, G. (2019). Thematic Analysis. In P. Liamputtong (Ed.), *Handbook of Research Methods in Health Social Sciences* (pp. 843-860). Springer Singapore. [https://doi.org/10.1007/978-981-10-5251-4\\_103](https://doi.org/10.1007/978-981-10-5251-4_103)
- Bus, S. A., & van Netten, J. J. (2016). A shift in priority in diabetic foot care and research: 75% of foot ulcers are preventable. *Diabetes/Metabolism Research and Reviews*, 32, 195-200.
- Diabetes Atlas. (2015). International diabetes federation. *IDF Diabetes Atlas, 7th edn. Brussels, Belgium: International Diabetes Federation*. <https://www.idf.org/e-library/epidemiology-research/diabetes-atlas/13-diabetes-atlas-seventh-edition.html>

39

- Fonseca, C., Lopes, M., Ramos, A., Santos, V., Esquinas, A., & Pereira, P. (2016). Nursing interventions in prevention and healing of leg ulcers: Systematic review of the literature. *Journal of Palliative Care & Medicine*, 5(6), 1000238.
- Foong, H. F., Kyaw, B. M., Upton, Z., & Tudor Car, L. (2020). Facilitators and barriers of using digital technology for the management of diabetic foot ulcers: A qualitative systematic review. *International Wound Journal*, Advance online publication. <https://doi.org/10.1111/ijwj.13396>
- Glasgow, R. E., Tracy Orleans, C., Wagner, E. H., Curry, S. J., & Solberg, L. I. (2001). Does the chronic care model serve also as a template for improving prevention? *The Milbank Quarterly*, 79(4), 579-612.
- Hazenberg, C., Aan de Stegge, W., Van Baal, S., Moll, F., & Bus, S. (2020). Telehealth and telemedicine applications for the diabetic foot: A systematic review. *Diabetes/Metabolism Research and Reviews*, 36(3), e3247.
- Koivunen, M., & Saranto, K. (2018). Nursing professionals' experiences of the facilitators and barriers to the use of telehealth applications: A systematic review of qualitative studies. *Scandinavian Journal of Caring Sciences*, 32(1), 24-44.
- Koziatek, C., Klein, N., Mohan, S., Lakdawala, V., Swartz, J., Femia, R., Press, R., & Caspers, C. (2020). Use of a telehealth follow-up system to facilitate treatment and discharge of emergency department patients with severe cellulitis. *The American Journal of Emergency Medicine*, Advance online publication. <https://doi.org/https://doi.org/10.1016/j.ajem.2020.01.061>
- Mann, D. M., Chen, J., Chunara, R., Testa, P. A., & Nov, O. (2020). COVID-19 transforms health care through telemedicine: Evidence from the field. *Journal of the American Medical Informatics Association*, Advance online publication. <https://doi.org/10.1093/jamia/ocna072>
- Mataxen, P. A. (2019). Licensure barriers to telehealth nursing practice. *Nursing*, 2020, 49(11), 67-68.

40

- Radhakrishnan, K., Xie, B., Berkley, A., & Kim, M. (2016). Barriers and facilitators for sustainability of tele-homecare programs: a systematic review. *Health Services Research*, 51(1), 48-75.
- Shelton, A., & Reimer, N. (2018). Telehealth wound applications: Barriers, solutions, and future use by nurse practitioners. *Online Journal of Nursing Informatics*, 22(2). <https://www.hjimss.org/resources/telehealth-wound-applications-barriers-solutions-and-future-use-nurse-practitioners>
- Skaafeld, A., Iversen, M. M., Holme, I., Ribu, L., Hvaal, K., & K  lhovd, B. K. (2015). A pilot study testing the feasibility of skin temperature monitoring to reduce recurrent foot ulcers in patients with diabetes - a randomized controlled trial [Article]. *BMC Endocrine Disorders*, 15(1). <https://doi.org/10.1186/s12902-015-0054-x>
- van Netten, J. J., Price, P. E., Lavery, L. A., Monteiro-Soares, M., Rasmussen, A., Jubiz, Y., Bus, S. A., & International Working Group on the Diabetic Foot. (2016). Prevention of foot ulcers in the at-risk patient with diabetes: A systematic review. *Diabetes/Metabolism Research and Reviews*, 32, 84-98. <https://onlinelibrary.wiley.com/doi/full/10.1002/dmrr.2701>