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Willingess To Use Telehealth For Diabetes Management In The Rural Healthcare Setting

Andrew Kim

ABSTRACT

WILLINGESS TO USE TELEHEALTH FOR DIABETES MANAGEMENT IN THE RURAL HEALTHCARE SETTING

Diabetes is a disease that has far reaching physically and financially consequences. This disease has shown to increase morbidity and mortality, along with increasing overall healthcare costs. Optimal management of diabetes may require a multidisciplinary approach across the span of multiple encounters with the diabetic patient. Considering the nature of diabetes, integration of telehealth has the opportunity to improve diabetes management by improving healthcare outcomes, along with potential cost savings. However, the use of novel technology like telehealth is only as useful if patients are willing to use it. Thus, this survey aimed to determining whether patients within a rural family medicine clinic in Central California would be willing to use telehealth if it were made available.

Findings of this study indicated that age, smartphone ownership, and having Internet access were factors that determined whether participants were likely or not to use telehealth. Identifying determining factors provided an initial data set of the target population regarding willingness to use telehealth if made available. This data set has the potential to be used to design a potential telehealth program that would be tailor-made to cater to the preferences of patients who attend the rural family medicine clinic in Central California for care. This study provided the foundation for a possible telehealth program in the future at the site of this study.

Andrew Kim
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WILLINGNESS TO USE TELEHEALTH FOR DIABETES MANAGEMENT IN THE RURAL HEALTH CARE SETTING

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CHAPTER 1: INTRODUCTION

The subject of this capstone project is the willingness of diabetes patients to utilize telehealth for the management of diabetes in a rural health care setting. Taking into consideration that diabetes is a disease that has far-reaching effects physically and financially, novel ways from the traditional healthcare delivery system can provide an alternative option to combat diabetes in the United States (U.S.). Telehealth is one innovative way to deliver healthcare to those who have diabetes. However, a delivery system is only useful if the targeted population is willing to use the system.

Background

Diabetes is a devastating disease that has far-reaching effects from a public health standpoint in the United States. Financially, the burden of type 2 diabetes was estimated at approximately $327 billion in direct and indirect costs in 2017 and steadily rising year after year (American Diabetes Association, 2019). In 2016, nearly 23 million Americans had diabetes, with the number of new cases steadily rising (Bullard et al., 2018). Besides the financial burden, diabetes has a direct negative effect on the morbidity and mortality of individuals affected. Type 2 diabetes has been identified as a significant risk factor for cardiovascular disease, including stroke, myocardial infarctions, angina, heart failure, and atherosclerosis (Einarson, Acs, Ludwig, & Patton, 2018). Diabetes is also commonly known to be the leading cause of chronic kidney disease (CKD) and end-stage renal disease (ESRD) in developed countries (Ghaderian, Hayati, Shayanpour, & Mousavi, 2015). Due to other potential concomitant medical conditions caused by diabetes, the cost of diabetes is potentially astronomical. With the cost of healthcare already a significant expense to the gross domestic

product (GDP) in the United States, approximately 17.8% in 2016, more novel ways of healthcare delivery presents an opportunity to deliver care that is more efficient and less expensive (Papanicolas, Woskie, & Jha, 2018). Telehealth is one possible novel delivery system that has the potential to deliver with care to type 2 diabetic patients greater efficiency and less expense.

Telehealth is a healthcare delivery medium that has endless potential to increase access to healthcare and providers of healthcare (Young & Badowski, 2017). Often used interchangeably with telemedicine, telehealth is defined as the exchange of medical information from one site to another through electronic communication for the purpose of improving patient's health (Tuckson, Edmunds, & Hodgkins, 2017). Many forms of telehealth to deliver information and care may include, but not limited to, videoconference, online chat, and mobile health applications. Although growing in popularity, telehealth is not widely used across the healthcare industry. Estimates in 2016 suggest that only 61% of U.S. healthcare institutions and 40-50% of U.S. hospitals used telemedicine (Mahar, Rosencrance, & Rasmussen, 2018).

There are efforts within the healthcare industry to slowly increase the utilization and delivery of telehealth and telemedicine. One primary reason for the growing popularity in telehealth is the potential to close the gaps between access to healthcare and patients by providing more exceptional options for consumers to utilize healthcare. Many barriers currently exist in today's healthcare climate for people trying to use the healthcare system. Some identified barriers to care include high cost of care, inadequate or lack of insurance coverage, lack of available medical services, and lack of culturally competent care (U.S Department of Health and Human Services, Office of Disease Prevention and Health Promotion [HHS

ODPHP], 2019). This gap is manifesting in many parts of the United States, particularly in rural areas of the country.

In many rural parts of the United States, access to healthcare is dwindling. Approximately 20% of rural hospitals are near financial collapse, with 41% of rural hospitals operating on a negative margin (Bolin, Watzak, & Dickey, 2019). Since 2005, 155 rural hospitals have closed across the country, decreasing access to healthcare for many rural citizens seeking needed care (Bolin, Watzak, & Dickey, 2019). Due to a decrease in access to rural healthcare, the creation of disparities has been broadened between urban and rural health. Furthermore, rural health patients are found to be in poorer health, with rural areas having greater difficulty attracting trained physicians willing to practice in under-served areas compared to urban areas (Douthit, Kiv, Dwolatzky, & Biswas, 2015).

Access to quality care is instrumental in preventing individuals from having unmet health needs, delays to appropriate care, inability to obtain preventative services, financial burdens, and preventable hospitalizations (HHS ODPHP 2019). Given the potential for increased access to healthcare, telehealth could serve as a different choice to traditional medical visits, leading to improved access to healthcare in the United States. However, despite expanded selection, telehealth is only useful if consumers are willing to use such resources for the management of their health care. For this reason, this project will delve further into the willingness of diabetic patients to utilize telehealth for the management of their diabetes in a rural healthcare setting.

Problem Statement

At this current time, the rural family healthcare clinic in Exeter, California that is owned and operated by Kaweah Delta Medical Center in adjacent Visalia,

California, does not widely utilize telehealth in the management of their diabetes patients. However, this represents an opportunity to gather information regarding willingness to use telehealth before potential integration and utilization of telehealth. Kaweah Delta Medical Center is a community-based hospital located in central California in Tulare County.

Obtaining prior thoughts and willingness to use telehealth could be useful information before considering its application. In today's healthcare climate, it could be costly in terms of time and resources to implement a telehealth program if patients targeted for use do not equitably value the program. By gathering thoughts and willingness to use telehealth, this information could be used to tailor a burgeoning telehealth delivery system to an intended target audience. By not doing so, the potential for under-utilization and non-adherence can be foreseen.

Non-Adherence

Non-adherence is a constant issue seen across the United States healthcare system. Non-adherence comes in many forms, such as not taking medication correctly, unwillingness to participate in lifestyle modification, and missing scheduled medical appointments. Unfortunately, non-adherence is associated with adverse health care outcomes. For example, estimates suggest that approximately 50% of all patients do not administer their medication as prescribed (Brown et al., 2016). Non-adherence to medication and routine medical visits is associated with inadequate glycemic control, increased morbidity, and mortality, along with higher complications in the diabetic population (Polonsky & Henry, 2016). Financially, non-adherence is quite burdensome to overall healthcare costs in the United States. Cost of medication non-adherence in the United States is estimated to be between $100-$300 billion a year (Cutler, Fernandez-Llimos, Frommer, Benrimoj, &

Garcia-Cardenas, 2018). Despite the knowledge of known adverse effects and costs associated with non-adherence, non-adherence continues to be a healthcare problem.

Many identifiable factors may contribute to non-adherence to medical treatment. One factor is the perceived efficacy of therapy (Polonsky & Henry, 2016). Patients are more inclined to be adherent to medication regimens when there is a sense that the medication or treatment is contributing to immediate outcomes (Polonsky & Henry, 2016). However, the opposite is seen when medication or interventions are not seen as productive. Adherence seems to decreases as perceived efficacy decreases in previous studies (Gadkari & McHorney, 2010). Another factor is transportation. Patients often express transportation as a barrier to healthcare access (Syed, Gerber, & Sharp, 2013). Lack of transportation can lead patients to miss scheduled appointments that further contribute to delayed or lost care. Transportation is a barrier seen in more impoverished populations that can perpetuate the disparity between non-poor and poor patients (Syed, Gerber, & Sharp, 2013). Confidence in provider has also been identified as a strong predictor in regards to medical adherence. Previous research has suggested a correlation between trust in providers and patients willing to seek access to care (Thom, Hall, & Pawlson, 2010). A lack of trust has shown to have implications associated with more inadequate care, specifically among minority populations (Thom, Hall, & Pawlson, 2010). More specifically, lack of trust may contribute to lower rates of patients seeking primary, preventative, and surgical services compared to others who have a higher level of confidence. One interesting aspect regarding lack of trust is many providers believe that non-adherence is mainly due to lack of access or forgetfulness. Non-adherence, on the other hand, can be an intentional choice when trust is not firmly established

between client and patient (Brown et al., 2016). Regardless of the cause, looking for new and novel ways to deliver healthcare can potentially be a driver to increased medical adherence and improve overall health, especially among the non-adherent.

Conceptual Framework

Researchers have examined some of the factors that impact the diffusion of innovation (Van Dyk, 2014). As medical technology and innovations like telehealth evolve, so has the interest in studying how this technology disseminates. Diffusion of Innovation Theory is a well-known theory used to study and gain understanding about the adoption of technology and understanding how innovation spreads within a community (Zhang, Yu, Yan, & Spil, 2015). Initially used in the field of rural sociology, Diffusion of Innovation Theory has been used within medical research to study attributes and adaptation patterns of innovation. Everett Rogers, an American sociologist, developed this theory.

Diffusion of Innovation Theory, developed by Everett Rogers, describes four main determinants of successful adoption of innovation: (a) communication channels, (b) attributes of innovation, (c) characteristics of adopters and (d) the social system (Zhang et al., 2015). Communication channels refer to means in which people obtain information regarding the innovation and usefulness of the change (Zhang et al., 2015). Examples of this may include Internet sources and personal communication with others. Attributes of innovation describe qualities of the change that are viewed as desirable in the view of the potential user. Rogers' theory described different characteristics seen amongst different types of adopters and seen with innovation used to describe how quick adopters are willing to adapt

(Zhang et al., 2015). Within the theory, the higher the compatibility of innovation to co-exist with current values, the higher likelihood of adoption by users.

Rogers categorized adoption innovators into five categories: (a) innovators, (b) early adopters, (c) early majority, (d) late minority, and (e) laggards (Van Dyk, 2014). These categories go in numerical order from the earliest adopters to those who are more resistant to change, which are referenced by Rogers as laggards. Within the Diffusion of Innovation theory, a social system is in place that involves sets of interrelated units that come together to achieve a common goal (Zhang et al., 2015). The common goal is what Rogers describes as the diffusion of innovation. The 'social system' established is what will ultimately steer attitudes towards innovation and the rate of adoption of innovation (Zhang et al., 2015).

Rogers' theory will be applied in this project by gaining greater understanding from target participants as to where the participants are located along the spectrum of acceptance regarding telehealth. Different reasons, responses, and readiness to use of telehealth will be investigated with the guidance of Rogers' theory. Lastly, Rogers' theory will help shape ideas and recommendations to improve nursing practice as it relates to the readiness for the use of telehealth.

This conceptual framework is the lens that will be used to study the willingness of participants to use telehealth in this particular study. Rogers' theory is useful by using his theory to obtain greater understanding with regards to willingness and provide philosophical guidance throughout the study.

Research Questions

There are a few research questions that this project will address in regards to telehealth.

- Are patients who receive treatment for diabetes in a rural clinic setting willing to incorporate telehealth into their chronic care?
- If so, what types of platforms in telehealth are of interest to the targeted population?
- What are some attitudes and feelings that people have regarding telehealth overall?

Significance of the Study

This study is essential to help understand patient preferences regarding telehealth and thoughts regarding telehealth from patients within a rural setting in Central California. This data will help contribute to the body of knowledge regarding preferences and ideas that can be used when considering the development of a potential telehealth program. Possible adverse outcomes, such as spending additional capital on a program or product that is unpopular, could be avoided if a study of the targeted population took place before implementation of an intervention. Taking into consideration the growing popularity of telehealth and growing legislation taking place nationwide regarding telehealth, assessment of willing participation is warranted.

Summary

As rates of diabetes continue to grow by staggering proportions in the United States, greater novel and creative ways are needed to provide optimal care to those directly affected. Lack of access and non-adherence are a few identified barriers to optimal healthcare among the diabetic population. Telehealth provides an opportunity to have a far greater reach than traditional healthcare provides currently. However, successful dissemination begins with willing participation by those who have diabetes. Rogers' Diffusion of Innovation Theory presents the idea

that a patient's willingness to adopt new technology may reside between early adoption and non-willing. This project is specifically targeted to identify willingness to use telehealth among a rural population in Tulare County. The information gathered in this project will contribute to the broader body of knowledge used to provide optimal nursing care to patients within Tulare County.

CHAPTER 2: LITERATURE REVIEW

Introduction

A review of the literature was performed to identify willingness to use telehealth and preferences with use within the general, rural, and diabetes population. Search for previously published qualitative and quantitative studies were performed through the Cumulative Index of Nursing and Allied Health Literature (CINAHL), PubMed, and Google Scholar. Only studies published in 2015 and later were considered for review. Keywords used during the search include *willingness, telehealth, diabetes, rural health,* and *preference*. Search within CINAHL yielded 390 results, PubMed yielded approximately 4,800 results, and Google Scholar with approximately 19,800 results. Articles published before 2015 and without a study component were excluded. With a large number of results, articles deemed most relevant to this project were selected.

Definition of Telehealth

Telehealth, used interchangeably with telemedicine, is defined as the exchange of medical information through electronic mediums to improve health (Tuckson, Edmunds, & Hodgkins, 2017). Telehealth can take place through many different platforms, which may include, but not limited to, email, video conferencing, phone, remote wireless monitoring, mobile applications, web portals, and games (Tuckson, Edmunds, & Hodgkins, 2017). Typically, telehealth is also sub-categorized as synchronous or asynchronous. Synchronous refers to the interaction between the healthcare professional and patient in real-time (e.g., live video chat), with asynchronous delivering delayed interaction (e.g., remote monitoring) that may or may not involve direct provider interaction (Elliott & Yopes, 2019).

Preference of Telehealth Use

In comparison to traditional medical visits, telehealth visits can provide comparable satisfaction. For example, there are retail pharmacy clinics throughout the country that offer telemedicine visits through video conferencing for non-emergent medical issues. When assessing for patient satisfaction within telehealth visits at a retail pharmacy setting, one study by Polinsky et al. (2016) revealed 95% (n=1691) of survey participants reported their visit as "very satisfactory," with one-third of those surveyed preferring a telehealth visit over a traditional face-to-face medical visit. In Polinsky's study, "very satisfactory" rated 5 out of 5 on a Likert scale. An additional 57% of participants stated that they "liked" their experience (Polinsky et al., 2016). Video conferencing is one of many modalities that have been used within many different specialties in healthcare with success when measuring satisfaction (Kruse et al., 2017).

Growing support for telehealth is being observed in the medical community. When taking a closer look at underserved communities, willingness to use telehealth shows the potential to have a positive impact on direct healthcare. Van Veen et al. (2019) conducted a cross-sectional survey of 560 patients within an urban emergency room that served an underserved population in Michigan. These researchers surveyed the patients' willingness to use mobile health (mHealth) tools for health guidance. A majority (69%, n=379) of respondents stated the pattern of seeking care would have veered towards a lower level of care if an mHealth tool advised that their health problem was identified as low risk (Van Veen et al., 2019). Results from this study suggest that willingness to use mHealth could lead to increasingly proper triage of medical seeking patients.

Another study in 2016 by Serrano et al. looked into the willingness of patients to exchange health information using a mobile device from various cancer

treatment centers across the United States. Results showed that an overwhelming number of participants were willing to use mobile devices to exchange information such as symptoms, lifestyle behaviors, test results, and schedule reminders (Serrano et al., 2016). However, noticeable differences in willingness were seen between different age, education, and income groups. Individuals who were older, less educated, and from lower-income levels was less apt to exchange information (Serrano et al., 2016). Those less apt to engage in mHealth within this study seem to represent the demographic seen more readily in the rural population. These findings may suggest conflicting results to the Van Veen et al. study by showing that certain segments of a target population may not favor the use of telehealth.

Nonetheless, results from both the Van Veen et al. and Serrano et al. study shows high potential for mHealth as a potential platform for healthcare delivery through mobile and similar devices. A requirement that would be mandatory for this type of system would be the widespread availability of mobile devices. One potential concern regarding the implementation of telehealth and systems using mHealth is the availability of devices, especially among people with limited resources or income. However, current data from the Pew Research Center (2019) showed that an overwhelming majority of Americans, approximately 96%, own a cellphone of some kind. Over 8 in 10 Americans own a smartphone (Pew Research Center, 2019). Besides mobile phones, over 75% of all Americans currently own a desktop or laptop computer, with over 50% of all Americans owning a tablet (Pew Research Center, 2019). Considering these figures, lack of accessibility to technological devices seems not to be a general barrier within the U.S.

Variables

Age

Current support for telehealth vary to some degree based on other factors. One factor is age. More specifically, one study showed individuals 50 years of age and older seem willing to integrate technology into their healthcare if felt by the individual that the technology will provide benefit and if access is easy (Chang, Lee, & Mills, 2017). In another study, individuals over age 65 were shown to prefer telehealth to be a part of their comprehensive care, with the ability to have healthcare in a traditional setting (Kaambwa et al., 2016). This preference is thought to be due to the wide variability in familiarity with technology among patients within the elderly population (Kaambwa et al., 2016). Changes in hearing and memory among older adults can also play a factor in older adults choosing telehealth. Situations where the quality of audio equipment is subpar or patients need to use increased effort to listen and comprehend information delivered during telehealth interaction could be undesirable to many older patients (Willoughby & Zendel, 2017). Thus, acceptance of technology and telehealth is seen as a potential barrier for many older individuals.

Time

Another variable seen regarding willingness to use telehealth is the reduction in time associated with waiting for scheduled appointments. One recent cross-sectional study looking at patient willingness to use telehealth for chronic musculoskeletal conditions showed 57% (n=48) of participants cited the reduction of time waiting to attend scheduled appointments as a reason to participate in telehealth services (Cottrell, Hill, O'Leary, Raymer, & Russell, 2018). A study by Seidman et al. (2017) showed an overwhelming majority of study participants

(92%, n=233) who engage in pulmonary rehabilitation due to chronic obstructive pulmonary disease (COPD) were currently using or willing to participate in telerehabilitation. Convenience and reduction in wait time were the most popular responses among participants currently or willing to use telerehabilitation (Seidman et al., 2017). Within the context of this study, forms of telerehabilitation included receiving texts to promote compliance with exercise, receiving reminders, available interaction with applications, and other short message service (SMS) technologies (Seidman et al., 2017).

Relationship Strength

Along with many positives being expressed regarding telehealth, concerns and challenges have been expressed regarding particular aspects of the telehealth experience. Patients have expressed that video conferencing is less personal, leading to a weaker patient-provider relationship (Gordon, Solanki, Bokhour, & Gopel, 2020). Weak patient-provider relationships can be problematic. Thus, this factor has been associated with medical non-adherence (Van Der Laan et al., 2017).

Difficulty With Use

A common complaint is the difficulty of using available telehealth interfaces (Andrews et al., 2017). Another common complaint that is witnessed currently within telehealth is the lack of individual, comprehensive telehealth models that are tailored to the individual needs of patients. These challenges propose that telehealth communication may need to be as individualized as traditional visits and not present as a one-size-fits-all model.

Telehealth and Diabetes

Considering the nature of optimal diabetes management, the opportunity to utilize telehealth in diabetes care is abundant. In the interdisciplinary care model, diabetes management may include multiple disciplines such as primary care, endocrinology, nursing, dietary science, pharmacy, and social work. Many patients that have experience with interdisciplinary care in diabetes management have expressed this model as a great approach and considered the disease too complicated for one discipline to manage alone (Berkowitz, Eisenstat, Barnard, & Wexler, 2018). Any of the involved disciplines have an opportunity to engage in diabetes management with patients.

One form of asynchronous telehealth that is increasingly becoming commonplace in diabetes management is continuous glucose monitoring (CGM). CGM allows for data collection from an external sensor placed on the patient's skin to record blood glucose within interstitial fluid continuously and in real-time. This data reflects greater accuracy of diabetes control than commonly used variables such as hemoglobin A1C (HgA1c). Data from CGM's may be downloaded from the sensor to a computer spreadsheet that provides numeric and graphic data of recorded blood glucose.

Data from CGM have shown to be used by rendering professionals to improve HgA1c in adults with type-2 diabetes (Park & Le, 2018). In a clinical setting, downloaded data can be used as teaching points to discuss the nature of a patient's diabetes and strategies to combat blood glucose levels that are suboptimal. Previous meta-analysis of randomized controlled trials and cohort studies by Park and Le (2018) have shown the use of CGM by health care professionals to be associated with modest but statistically significant reduction of HgA1c when compared to the controls. Besides lowering HgA1c, CGM has also

shown to help patients increase time in range (TIR) of acceptable glucose levels and reduction of hypo- and hyperglycemia through greater lifestyle counseling and intensification of therapy (Martens, Bergenstal, Johnson, Davidson, & Simonson, 2019). TIR is the ultimate goal for control in diabetes management, which is universally acknowledged to range between 70 to 180 mg/dl (Petrie et al., 2017).

Conflicting studies have also indicated that no significant differences are seen between those who participate in telehealth management versus traditional management for type-2 diabetes (Vadheim et al., 2017). In the study by Vadheim et al. (2017), the target population was a rural community in Montana, United States, with measured primary endpoints identified as participation, diet, physical activity, and weight loss. The comparison groups were those who received video conferencing versus traditional, on-site medical visits. In this large study, with 894 participants, the endpoints are interventions that require voluntary lifestyle modification versus Park and Le's study, which measured improvement from direct primary management. A sound argument could be made that lifestyle modification is tougher to comply with than the automated use of CGM. Nonetheless, overall data did not show significant differences between the comparison groups in the study by Vadheim et al (2017).

Perception Among Diabetics

In another study by Saddik and Al-Dulaijan (2015), surveys were used to look at diabetic patients' willingness to use tele-technology to manage their disease. Dissemination of surveys took place in Saudi Arabia. Data was collected by a tool that was an adaptation of the original "Telemonitoring Attitude and Readiness Questionnaire" by Buysse et al. (2010). Face and content validity was created by sending out the survey used in Saddik and Al-Dulaijan's study for

expert commenting and review. Data collected in this study included patient demographics, Internet accessibility, quality of the information received from the physician, self-management habits, and willingness to use tele-technology through an Internet-based self-management system. Participants predominantly identified as Saudi. Findings indicated that a majority of patients were willing to use tele-technology to self monitor their diabetes. However, a minority of participants was willing to use a system daily, and approximately half indicated preference to use it once a week. Patients that seem more willing to use tele-technology were generally younger, had higher educational levels, were employed, possessed Internet access, and had type 2 diabetes (Saddik & Al-Dulaijan, 2015). The authors concluded that results from this study could serve as a baseline for further investigation to develop targeted interventions using telehealth on a targeted diabetic population.

There were a few limitations from Saddik and Al-Dulaijan's study. The descriptive cross-sectional design and convenience sampling utilized makes the results obtained less generalizable over a longer period of time. Also, a reliability index of the tool used was not provided. However, despite being a study conducted overseas, this study did provide a baseline to how patients who seek medical care for their diabetes view other potential modalities in healthcare delivery. Data from the study did reveal positive willingness from certain demographic groups that provide groundwork for further potential study.

Patient perceptions of telehealth among people with diabetes are mixed based on different factors. Despite the potential for improved outcomes based on measurable data, perceived barriers do exist among patients that may limit the effectiveness of electronic technology. Besides previously mentioned difficulty interacting with program interfaces, the perceived vulnerability of sensitive

information is commonly expressed among patients dubious of telehealth use. An example of one patient's perception of data safety is expressed in one study from Lee, Greenfield, and Pappas in 2018, "I do not like all my details like that for everybody to be monitoring. You don't know who is on the other side."

Concerns from patients regarding data privacy is a valid concern that may lead some patients to balk at using telehealth. These concerns may stem from past experiences with data breaches or fear of potential breaches.

Patient Preference Theory

Patient preferences can differ and can be as unique as each individual making the decisions to use telehealth. One theory, the Technology Acceptance Model (TAM) theory, introduced by Fred Davis, attempts to provide a basis to help explain the phenomenon of technology acceptance from potential users. Fred Davis initially presented TAM theory in 1986 as a doctoral project that was an adaptation from the Theory of Reasonable Action (Lai, 2017). Through his theory, Davis suggests that successful integration and use of technology from individuals hinges on the users' perceived usefulness of proposed technology, along with perceived ease of use (Davis, Bagozzi, & Warshaw, 1989). According to Davis and TAM, ease of use and perceived usefulness are the most critical variables that will determine whether an individual will adopt a system for use (Surendran, 2012).

Davis delved deeper into TAM to explain other external variables that potential users of technology considered when deciphering ease of use and perceived usefulness. The main external factors identified that affect perceived ease of use and usefulness are social, cultural, and political (Surendran, 2012). These variables play an integral role in technology adoption. In a study by

Mutahar, Daud, Ramayah, Putit, and Isaac (2017), the effects of external variables within TAM were examined in potential users of mobile banking technology in Yemen. At the time of this particular study, mobile banking in Yemen was still entirely novel to the majority of its citizens. The population and social climate set the perfect opportunity to witness the principles of TAM in action in a non-medical setting. In this descriptive study, analysis of the data showed that social factors such as the use of technology by someone seen as essential or having strong social influence weighed heavily into someone's decision to integrate the use of technology into their own lives. In today's domestic climate, political influence can be observed first hand regarding its influence on technological acceptance. In an April 2018 article in Forbes magazine, Twitter reported substantial profits for two quarters in a row, along with adding 6 million users over the previous quarter (Bowles & Satariano, 2018). This increase in uses and profits came after a down year of monetary losses and during a year of extensive account use from the current president of the United States. This one example shows the potential of political influence on technology use. Despite the complexities involved in the decision-making process to accept the use of technology, TAM offers a guiding light towards a greater understanding of this process.

Summary

Despite an abundance of previous study delving into preference and variables influencing telehealth use, and some that conducted studies among rural populations in other countries, no previous study has been found that investigated willingness to use telehealth among a rural target population within Exeter, California. Investigating preferences and variables that affect willingness to use

among the target population in this study would contribute valuable information that can be used in designing an optimal telehealth program in the future in rural Exeter, California. Understanding perceptions of other studied populations allows for the ability to draw similar comparisons to the target population in this study and to possess a basic understanding of similar subjects elsewhere.

CHAPTER 3: METHODOLOGY

Introduction

Within this chapter, many characteristics that are unique to this target population are introduced. The recruitment of potential participants from the target population is discussed. Many other essential components of the methodology, including inclusion/exclusion criteria, instruments, and procedures, are laid out in this chapter. Types and methods of analysis of data are also explained.

Sample/Target population

The target population for this study is the diabetic patients who seek diabetes management at a rural family medicine healthcare clinic in Exeter, California. The clinic is affiliated with a community hospital in adjacent Visalia, California, which is approximately 10 miles west of Exeter. The family medicine clinic provides approximately 175-200 visits with patients each day. Many common diagnoses that are treated within the clinic include, but not limited to, diabetes, hypertension, hyperlipidemia, gout, major depressive disorder, and hypothyroidism. Many student-athlete sports physicals, well-woman exams, preventative screenings, and annual wellness visits take place within this clinic.

Exeter is located in Tulare County, California, and is widely known for its burgeoning agricultural industry and above-average poverty rate. Tulare County has a sizable Hispanic population, with approximately 65% of Tulare County residents identifying as Hispanic or Latino (U.S. Census Bureau, 2019). Approximately 24% of residents in Tulare County are considered to be at or below the poverty level, with approximately 8.8% of residents within the county medically uninsured (U.S. Census Bureau, 2019). Tulare County also possesses

the highest percentage of Medi-Cal recipients per capita in California among all counties, with 56% of its residents under the state's Medicaid system (Xu, 2017).

Target Population Recruitment

Potential participants were asked to participate in the clinic before their scheduled appointments while waiting for their healthcare provider. Participants were identified by the principal investigator the day prior from a chart review of all patients scheduled to be seen by their primary care provider in the clinic the following day. Those potential participants who met inclusion criteria had a clipboard prepared to disseminate to them at the time of check-in for participation in the survey. The clipboard included a letter of information, a recruitment flier, and a survey. The flier is a single 8.5" x 11" paper with visible illustrations and text that describe the purpose of the study, how data were going to be used, and the contact information of the principal investigator. Additional fliers were made available by the strategic placement of fliers throughout the clinic. All forms on the clipboard were available in English and Spanish. A certified Spanish interpreter from Kaweah Delta helped create all Spanish language material.

Inclusion and Exclusion Criteria

Potential participants in this study were at least 18 years of age. Participants must also be able to read and write either English or Spanish. Considering this study is targeting individuals with diabetes, subjects must have a previous diagnosis of any diabetes and must be receiving treatment for diabetes management within the study setting for a minimum of 6 months. This time frame was chosen to ensure some care continuity within the clinic. Participants were expected to be able to express on the letter of information or verbally that they agree to participate in the study. Exclusion criteria included individuals less than

18 years of age and those who could neither read nor write English or Spanish. Individuals who could not express consent on the letter of information or verbally were also excluded from participation.

Protection of Human Subjects

Precautions were taken to protect human subjects in the study. One precaution taken was the elimination of a consent form. In place of a consent form, which could increase the risk of harm through potential subject identification, a letter of information was used with institutional and university IRB approval. The letter of information described the nature and purpose of the study, along with how the gathered data will be used in the study. The letter of information had checkboxes that allowed a potential participant to answer whether or not the participant agreed or not agree to participate without a signature of their name. Within the letter of information and recruitment flier, it was made explicitly clear that participation is strictly voluntary. Willingness to participate would not affect the level of medical care received at the rural clinic. If any questions or concerns needed to be addressed, the contact information of the principal investigator and project chairperson were made available to all participants.

Also, no personal identifiers such as name, date of birth, or medical record numbers were recorded as data collected in this study. After data collection, data was safeguarded in a secure location, and analysis of data took place on a dedicated computer protected by a password. Furthermore, university and institutional IRB reviewed the protocol and research design to add a layer of oversight to ensure proper precautions were proposed to protect human subjects. Throughout the data collection and study, no questions or concerns were presented

to the principal investigator or the project chairperson from a targeted subject in the study.

Instruments

The survey instrument used in this study is an adaptation of a survey used in a previous study by Saddik and Al-Dulaijan (2015) that surveyed willingness of diabetic patients to use tele-technology to manage their disease. The study conducted by Saddik and Al-Dulaijan was conducted in Saudi Arabia, which is quite a different demographic than subjects in this study. However, like the U.S., Saudi Arabia currently faces a growing diabetic population that continues to grow due to increasing rates of obesity, the popularity of fast food, and a sedentary lifestyle (Al-Dawish et al., 2016). With the approval of Dr. Saddik, an adaptation of the validated tool used in her study was used to conduct this study.

The first eight questions in the adapted tool are demographic questions inquiring about the participant's age, gender, race, marital status, education level, occupation, diabetes type, and time of diabetes diagnosis. Questions regarding demographics were quite similar between both tools except for the nationality/race question. In the study by Saddik and Al-Dulaijan, the question regarding nationality asked whether the participant is Saudi or non-Saudi. This study asked whether the participant identified themselves as White, Hispanic or Latino, African-American, Asian, or other. No questions regarding income were asked in this study, whereas the question of income was posed in the Saddik study.

Questions 9 through 15 explored the accessibility of the Internet, ownership of a smartphone, willingness to use tele-technology or telehealth for diabetes management, and which type of modality a participant is most likely to use. Two additional open-ended questions in the tool inquired about participant's feelings

regarding potential use and why a participant would or would not be willing to use telehealth.

The tool by Saddik and Al-Dulaijan ensured face and content validity by sending the survey to experts for commenting. The expert panel reviewed content for accuracy, clarity, and comprehensiveness. Two additional open-ended questions were added to the survey of this data.

Procedure

Once institutional and university IRB approval was obtained, a meeting took place between the principal investigator and director of the clinic, along with multiple front office staff members from the clinic. It was mutually agreed upon that the clinic would allow the study to take place within their clinic. Front office staff would be utilized to disseminate the surveys to participants at the time of arrival for scheduled appointments. A second meeting took place between the front office staff and the principal investigator to discuss details of the survey and training of front office staff. Staff was instructed to read off a pre-printed script made available in English and Spanish when presenting clipboards with the study information and survey to ensure uniformity. Staff was instructed to defer all questions regarding the study to the contact information listed on the recruitment flier, which included the phone number and email address of the principal investigator.

Data collection started in the first week of October 2019 and took place during operational hours of the clinic, 8:00 A.M. to 5 P.M. Monday through Friday, for five weeks. Clinic schedules of all providers for the following day were reviewed to see if patients on the schedule met inclusion criteria for possible participation. Subjects identified as potential participants through chart review had

a clipboard with a survey, letter of information, and recruitment flier prepared for dissemination. Clipboards were given to potential participants at the time of check-in for their scheduled appointments. Front office staff read from a script that was created to provide consistency when disseminating clipboards. If a targeted subject declined participation, then clipboards were handed back to front office staff with the checkbox of "Do not agree" filled in on the letter of information. If a potential participant agreed to participate, the subject was kindly asked to fill out the survey and check the appropriate box on the letter of information, the "agree" box. After completion, participants were asked to place letters of information and surveys in a letter envelope provided and drop in a designated locked box adjacent to the window of the front office staff. The principal investigator collected surveys within the locked box daily.

Treatment of Data/Outcomes/Evaluation Plans

Evaluation Measures

Quantitative data from surveys underwent evaluation of frequency counting, chi-square testing, and correlation testing. Chi-square testing and correlation analysis were used to analyze different participant demographic groups and types of telehealth that participants were willing to use. This analysis was used to identify whether the target population in this study were willing to use telehealth and whether a potential correlation existed between certain demographic groups within the population and characteristics of willingness.

Method of Analysis. SPSS Version 26 was utilized to analyze data from participants in this study. Chi-square and correlation testing were utilized to assess the degree of association between demographic variables and participant willingness to use telehealth. Cross-tabulation of descriptive statistics took place,

specifically looking at Pearson's Chi-square and Pearson's R to identify the strength of correlation between the target population and the response from the target population regarding willingness to use telehealth.

Qualitative data underwent a review of obtained data by the principal investigator. Data collected was organized, categorized, and coded by prevailing themes seen from participants. Data was then interpreted to provide greater depth and understanding of the participant's willingness to participate in telehealth. A certified Spanish interpreter from Kaweah Delta interpreted data in Spanish.

Treatment of Data. Hard data on surveys and letters of information is stored in a designated safe within the home of the principal investigator. Data transferred for analysis was stored in a designated computer for this study that is password protected.

Summary

The target population for this study is the diabetic patients at a rural family medicine clinic in Exeter, California. This population is particularly more impoverished than most other parts in California. Meticulous patient recruitment took place with standard inclusion and exclusion criteria to partially aid in protecting human subjects. The use of a designed instrument during the study was utilized under an instituted procedure to ensure uniformity. Data collected underwent a planned protection process, analyzed, and protected once more after analysis. This process was executed to try and ensure that data for this study was gathered properly and accurately.

CHAPTER 4: RESULTS

Introduction

The purpose of this chapter is to introduce the unique demographic features of the target and sample population. Frequency data of preferences from participants are gathered as well. Chi-Squared Goodness of Fit testing and Pearson's R Correlation analysis was utilized to analyzed data in this study. Certain demographic factors show a stronger dependence on the willingness to use telehealth than others. Qualitative data gathered also provides some depth to quantitative data gathered in this study.

Demographics

One hundred thirty-two participants filled out a survey. One hundred twenty-six potential participants refused to participate in the study. Females represented approximately 57% of willing participants (n=75), with an overwhelming majority of participants (71%) identifying themselves as being 50 years of age or older (n=92). Over 55% of participants identified themselves as Hispanic or Latino (n=73), which is similar to the proportion of identified Hispanics within Tulare County, California. Caucasians were the next highest identified ethnicity at 34.8% (n=46). A majority of patients (n=68, 52%) identified as married. 53% of participants identified as having high school or less as their highest level of education (n=71). Regarding occupation, the highest response from participants (n=49, 37%) was retired. An overwhelming majority of participants (n=101, 80%) identified themselves as suffering from type-2 diabetes, with 95% of participants (n=120) responding that their diabetes was diagnosed in their adult years. Twenty-three out of the 132 surveys (17%) obtained from participants were in Spanish. The rest of the surveys were completed in English.

Technology/Preference Frequencies

A majority of participants (54%) identified as having easy Internet access (n=72). Approximately 38% answered that Internet use was frequent (n=46), with the frequency of use being several times a week daily. Interestingly, 14% identified as never using the Internet (n=17). Over two-thirds (n=88, 68%) of respondents answered yes when asked about smartphone ownership. When asked whether respondents would use an Internet-based self-management system to monitor diabetes, 53% of respondents answered no (n=66). On the other hand, when asked if willing to use a phone-based system to monitor diabetes, 55.0% responded yes (n=70). An overwhelming majority of participants admitted to possessing no previous experience with telehealth to manage health (n=116, 94%). Of different types of tele-health modalities most likely to be used with a provider for diabetes management, the most popular response at 43% was telephone conversation (n=48), with FaceTime or Skype as the next popular response at 20% (n=22).

Frequency Table. See Appendix A.

Relationship of Demographics and Willingness to Use

Quantitative Results

Chi-Square (X^2) Goodness of Fit testing was used to view how likely the observed distribution of collected data is due to chance. Pearson's Correlation (r) analysis was utilized to measure the strengths between demographic variables and the willingness to use a phone or Internet-based system to monitor diabetes.

Age. In this study, age appears to be one variable that is a factor regarding patients willing to use telehealth for diabetes management. Collected data illustrates that individuals under the age of 50 had a higher percentage of

willingness to use an Internet-based system to manage diabetes over individuals over the age of 50 (n=28, 78% vs. n=30, 34%). Except for the small sample in the age of 18-29 group, as age increased, the percentage of participates willing to use inversely decreased. Thus, data in Table 1 showed that the younger the individual, the more likelihood of willingness to use an Internet-based system.

Chi-Square Goodness of Fit testing showed that it is quite unlikely that this answer distribution happened by chance. The data in this study illustrates further that age and willingness to use an Internet-based self-management system to monitor diabetes were dependent on each other in this study. The correlation analysis of these two variables shows a moderate positive strength of their linear relationship (r=0.361, p=<0.001).

Table 1

Age/Willing to Use Internet-Based Self-Mgmt System to Monitor DM?

Age	Yes	No	Total
18-29	0	1	1
30-39	14	2	16
40-49	14	5	19
50+	30	57	87
Total	58	65	123

Note. X^2=22.316 df=3 p=<0.001. r=.361 p=<0.001

Age was also a significant factor in whether individuals expressed willingness or dissent in using a phone-based self-management system to monitor their diabetes. As previously seen in the data regarding age and willingness to use an Internet-based system, the data in Table 2 illustrates a pattern that suggests that the younger the participant, the higher likelihood of willingness to use a phone-

based system by the user. A point of demarcation in the data exists between those under age 50 and those above age 50. Those under age 50 had a higher percentage of users who expressed willingness (n=30, 81%) when compared to participants over age 50 (n=39, 44%). Thus, in this study age and willingness to use a phone-based self-monitoring system to monitor diabetes is likely dependent on each other in this study. Strength of linear regression is modestly less than seen between age and willingness to use an Internet-based system (r=0.299, p=0.001)

Table 2

Age/Willing to Use Phone-Based Self-Mgmt System to Monitor DM?

Age	Yes	No	Total
18-29	0	1	1
30-39	14	2	16
40-49	16	4	20
50+	39	50	89
Total	69	57	126

Note. X^2=17.576 df=3 p=.001, r=0.299 p=.001

Smartphone Ownership. Ownership of a smartphone was a significant factor regarding whether someone was willing to use an Internet-based self-monitoring system to monitor his or her diabetes. Among participants who identified themselves as smartphone owners, a majority (n=54, 64%) also identified as willing to use an Internet-based system. On the other hand, a vast majority of identified non-smartphone owners in the study (n=34, 87%) identified themselves as not willing to use an Internet-based self-monitoring system for diabetes monitoring. Thus, the data analysis in Table 3 suggested that smartphone owners are more likely to use an Internet-based self-management system to

monitor his or her diabetes over non-smartphone owners. The goodness of Fit analysis shows an extremely low likelihood that the data distribution is by chance. Correlation analysis shows a moderate strength of positive linear correlation (r=0.471, p=<0.001).

Table 3

Smartphone/Willing to Use Internet-Based Self-Mgmt System to Monitor DM?

Smartphone Ownership	Yes	No	Total
Yes	54	31	85
No	5	34	39
Total	59	65	124

Note. X^2=27.562 df=1 p=<0.001, r=0.471 p=<0.001

Frequency counts show that a majority of smartphone owners (n=63, 72%) in this study are willing to use a phone-based self-monitoring system to monitor their diabetes. On the other hand, a majority of non-smartphone owning participants (n=31, 82%) expressed an unwillingness to use a phone-based self-monitoring system. When combining both groups of ownership, an overall majority of participants expressed willingness to use a phone-based system. Therefore, the results in Table 4 suggested that smartphone owners are more likely than non-smartphone owners to use a phone-based self-monitoring system to monitor diabetes willingly. A moderate positive linear correlation exists in this data between smartphone ownership and willingness to use a phone-based system (r=0.491, p=<0.001).

Table 4

Smartphone/Willing to Use Phone-Based Self-Mgmt System to Monitor DM?

Smartphone Ownership	Yes	No	Total
Yes	63	25	88
No	7	31	38
Total	70	56	126

Note. X^2=30.387 df=1 p=<0.001, r=0.491 p=<0.001

Internet Access. Internet access was a significant variable that factored into whether a participant identified as willing or not willing to use an Internet-based self-management system to monitor diabetes. A majority of participants with easy Internet access (n=45, 67%) expressed a willingness to use an Internet-based system. A vast majority of participants who had difficulty with Internet access or no access altogether expressed an unwillingness to use an Internet-based system (n=7, 30%) and (n=5, 17%). These figures seen in Table 5 suggest that those with easy Internet access are more likely to use an Internet-based self-management system to monitor diabetes over those with difficult or no access to the Internet. Moderate strength positive linear correlation exists between Internet access and willingness to use an Internet-based self-management system (r=0.443, p=<0.001).

Table 5

Internet Access/Willing to Use Internet-Based Self-Mgmt System to Monitor DM?

Internet Access	Yes	No	Total
Yes, easy access	45	22	67
Yes, hard to access	7	16	23
No access	5	25	30
Total	57	63	120

Note. X^2=24.512 df=2 p=<0.001, r=0.443 p=<0.001

A majority of participants with easy Internet access (n=51, 73%) expressed a willingness to use a phone-based self-management system to monitor their diabetes. However, a majority of those participants who identified as having difficulty with access or no Internet access expressed non-willingness to use a phone-based system, (n=11, 50%) and (n=25, 83%). The data in Table 6 suggest that those participants who have easy Internet access had a higher likelihood of willingness to use a phone-based self-monitoring system to monitor his or her diabetes over those who had difficulty with access or no Internet access.

Table 6

Internet Access/Willing to Use Phone-Based Self-Mgmt System to Monitor DM?

Internet Access	Yes	No	Total
Yes, easy access	51	19	70
Yes, hard to access	11	11	22
No access	5	25	30
Total	67	55	122

Note. X^2=27.043 df=2 p=<0.001, r=0.469 p=<0.001

Other Demographic Variables

Data collected on other demographic variables such as gender, ethnicity, marital status, education, occupation, and type of diabetes did not show to be a factor regarding participant's willingness to use an Internet or phone-based self - monitoring system to monitor diabetes. Correlation analysis between these stated variables and willingness showed weak correlation values.

Qualitative Results

One hundred thirty-four participants were asked two qualitative questions on the survey. Question 1 posed the question of the participant's feelings about the potential use of telehealth to manage diabetes. Question 2 inquired if the participant would be willing to use telehealth if made available, along with why or why not a participant was willing to use it. There were participants who were for and against telehealth, with a myriad of differing opinions regarding attitudes and willingness to use. Many participants left brief, binary "yes/no" answers. However, specific themes were extrapolated from more comprehensive answers. Prevailing themes emerging from participants include (a) level of technical skills, (b) level of communication, (c) convenience, and (d) improved health.

Level of Technical Skills. Among respondents with different technical skills, individuals who identify as having less technical and computer skills were less likely to consider integration to telehealth for the management of diabetes. Individuals with less technical skills were also more likely to feel cynical about telehealth. One participant responded, "Not very knowledgeable in the electronic field. Probably wouldn't help me much." Another participant with technological skills expressed, "No, I am computer or tech illiterate."

Those individuals who claim to possess an elevated level of technical or computer skills were more willing to consider the integration of telehealth for

diabetes management, as manifested in one participants quote, “I would give it a try. I would use my phone. I do everything on my phone.” Possessing an elevated level of technical skill was associated with a more positive outlook regarding the potential of telehealth integration as well. Another participant expressed greater outlook regarding telehealth among individuals having an elevated level of technical skill by this quote, “ Interested in using more technology, I feel comfortable using.”

Level of Communication. Participants perceived that the level of communication would play a factor regarding feelings of potential use. A perceived increase in communication resulted in positive feelings regarding telehealth, along with participants having an increased willingness for potential use. One Spanish-speaking study participant expressed the following, “Si se puede uno comunicar con un Dr. diretamente seria genial” (If able to communicate directly with a doctor, would be great).

Despite the potential for increased accessibility to a telehealth provider from a remote location, not all participants were keen on the idea of communicating through telehealth communication. Many expressed preference to meet their provider in person. One participant responded, “No, rather see doctor”, while another participant expressed, “Prefer face to face with doctor.” A participant kept their response short by expressing, “Nope, doctor only.”

A perceived decrease in communication was associated with higher negative feelings regarding telehealth, along with the decreased potential for use among participants. Communication with physicians and primary providers were mostly identified as the contact person most relevant to the participants.

Convenience. Convenience was a prevailing them among participants who see telehealth positively and as a potential benefit for users. Many see

opportunities to access their provider on their terms and at a location of their choosing. One participant responded with the following, “I think it would make it easier to talk to her and not take time off to get here.” A study participant who expressed difficulty with fulfilling the need to care for family and themselves at the same time expressed telehealth as a potentially greater convenience to diabetes self-management. “I have a small child and my mother at home to care for. Would be easier from home now that I have diabetes under control, and have gotten all information needed and to help control my diabetes.” Another participant expressed the savings of time and resources through the following quote, “It would be easier than appointments and would save me gas”.

Improved Health. Some participants considered the theme of improved health as a positive affect that telehealth could potentially provide as a benefit. One study participant expressed this potential positive effect in this manner, “Yes I would want to use it to help keep on track with my health in regards to diabetes.” This perceived benefit of improved health led some participants to state a willingness to participate if telehealth would equate to improved health with use. Another participant expressed the following regarding potential improved health, “Yes to see how it would benefit me and my diabetes.”

Other participants also perceived telehealth as having the potential to harm their health as well. The potential harm was expressed from one participant by the following written statement from the survey, “No, I feel more confident controlling my A1C in person with my doctor.” The perception from participants seems to express that the same quality of care that participant has grown accustomed to could not be provided through telehealth modality. A participant expressed the skepticism regarding quality of telehealth by this statement, “No,

I've had diabetes long enough that I don't trust someone who doesn't know me to manage my care. Want to see my doctor"

Summary

The quantitative data in the study suggests that age, Internet access, and smartphone ownership have a significant factor in whether targeted participants are willing to use an Internet or phone-based self-management system for diabetes management. More specifically, individuals younger than 50 years of age have easy Internet access and possess a smartphone, express an increased willingness to use these modalities over those in opposing categories. Other demographic variables such as gender, ethnicity, marital status, education, occupation, diabetes type, and time of diagnosis did not have a significant role in whether participants expressing willingness to use telehealth modalities. Qualitative data expressed a myriad of answers that ran across the spectrum of willingness. Prevailing themes, such as communication, technical skill, convenience, and health improvement, were seen in the answers of the participants. Overall, baseline data from this study provided valuable information regarding target demographics, characteristics of demographics, and willingness to use telehealth for diabetes management.

CHAPTER 5: DISCUSSION

Introduction

The rural family medicine clinic for Kaweah Delta Medical Center in Exeter, California, is a place where many patients go to obtain care for diabetes management. At the time when this study took place, there was not a telehealth program available as an option to patients for their diabetes management. Telehealth presents an opportunity to provide comprehensive diabetes management in a rural setting. Before this study, there was no available information on whether the intended target population would accept a telehealth program. Thus, information gathered from this study provided insight into this question.

Findings and Discussion

Age

In this particular study, age was identified as a significant factor in determining whether a target participant was willing to use an Internet or phone-based system for diabetes management. More specifically, data points to a pattern that the younger the individual, the higher likelihood of the participant to willingly use telehealth for diabetes management. This trend is strikingly similar to previous studies by Chang, Lee, and Mills (2017) and Saddik and Dulaijan (2015) that looked at age as a factor regarding whether patients are willing to adopt the use of telehealth

The consistent finding regarding age within this study suggests that when considering the design and advertising of a potential future telehealth program, the age of the targeted population should be considered as a focused demographic to

target. An example of this would be to gather further data regarding what patients in a younger demographic (e.g., under age 50) are looking for in a useful telehealth platform.

Internet Access

Another demographic characteristic that was found to be a factor in whether a targeted patient is willing to use an Internet-based or phone-based platform for diabetes management is Internet access. This finding seems correct considering many telehealth platforms require Internet access. Findings in this study suggest that individuals with Internet access were more likely to engage in a telehealth platform for diabetes management. This finding is consistent with finding in the previous study regarding willingness to use telehealth for diabetes management by Saddik and Al-Dulaijan (2015).

One noteworthy observation unique to this study is the number of targeted participants identified as not having Internet access. Over 25% of participants (n=32) reported not having Internet access. This percentage represents a higher proportion than what is reported in 2017 data that over 87% of the population in the U.S. has Internet access ("Percentage of Population," 2020). Considering this target population may have less Internet access, availability to other modalities of telehealth may be valuable to many within this population who may be interested in telehealth use. Frequency data of this population regarding Internet access provide great insight into this characteristic unique to this rural population in Exeter.

Smartphone Ownership

Like Internet access, smartphone ownership is identified as a significant factor regarding a participant's willingness to use an Internet-based or phone-

based system for diabetes management. Findings from this study suggest that smartphone owners in this sample are more likely to use a telehealth platform over participants who do not own a smartphone. This finding appears to be plausible considering specific telehealth platforms perform on a smartphone interface, like mHealth applications.

One finding in this study regarding smartphone ownership that is noteworthy is the lower percentage to target participants identifying as smartphone owners compared to the general U.S. population. As previously mentioned, over 8 in 10 Americans own a smartphone (Pew Research Center, 2019). However, only 68% of participants (n=88) in this study reported owning a smartphone. This finding provides valuable insight into what types of telehealth modalities this targeted population may access. This data suggests that other modalities of telehealth that do not require smartphone use may be valuable to this targeted population as an option for use.

Other Demographics

Other demographic factors such as ethnicity, gender, occupation, marital status, and education do not show to be strong determinants in whether participants are willing to participate in telehealth in this study. One key difference found in this study that differs from other previous studies is the influence of education on willingness to use telehealth. A previous study by Lee, Black, and Held (2019) of rural populations suggests that individuals with a higher educational level are more likely to utilize telehealth services. However, higher levels of education are associated with higher income, which may increase access to telehealth technology due to affordability. This disparity of income could

explain the difference in willingness between those with a lower and higher educational level, and ability to pay to use telehealth.

Contributions of the Study

This study provides valuable insight into which factors are significant regarding which patients are willing to participate in telehealth within the targeted diabetes population at a rural family medicine clinic in Exeter, California. Previous similar studies have been performed on other rural populations throughout the United States and the rest of the world. However, many other similar studies do not target a population with a particular disease like this study with the diabetes population in a rural clinic from which the sample was derived. Many focused on the general target population and willingness to participate in telehealth for any health-related reason. The author and investigator of this study believe that this study is the first of its kind targeting any rural clinics in Exeter, California. This data has the capability of being used in the future when considering and designing future potential telehealth programs for the rural clinic where this study took place in Exeter, California.

Theoretical Framework

Rogers' Diffusion of Innovation Theory provides a useful structure that broadens the depth of findings in this study. As previously mentioned, Diffusion of Innovation Theory describes four main determinants of successful adoption of innovation: (a) communication channels, (b) attributes of innovation, (c) characteristics of adopters and (d) the social system (Zhang et al., 2015).

By performing this study, the data allows for the potential for optimal dissemination of a potential telehealth program. Proper and effective

communication channels can be utilized to relay information regarding telehealth in a like manner to the intended target audience.

The essence of this study is to investigate which attributes of telehealth that are most useful and desired by the target population. Doing so through the lens of the Rogers Theory provides greater strength to the findings in this study.

Other key findings in the study provided information on which demographic characteristics were more likely to use a telehealth platform for diabetes management. Characteristics such as age, smartphone ownership, and Internet access are identified as common characteristics that provide insight to potential adopters of telehealth.

Frequency data obtained in this study provides valuable insight into how many potential participants may consider using telehealth, along with how many are not willing to use. These conflicting values illustrate the social system of the target population that would allow possible gross estimations into how many participates may be considered earlier adopters versus late adopters of telehealth.

Overall, Rogers' Diffusion of Innovations Theory illustrates many significant findings that help support the reasons behind participant willingness to use telehealth. This model also provides a rich, more in-depth understanding of the data obtained in this study.

Limitations

This study does have limitations worth considering. Since convenience sampling was used, there is an inability to generalize the findings in this study to the broader population. Convenience sampling has the potential for elevated levels of outside influences beyond the control of the researcher. This study also had a relatively lower willing participation rate that was slightly above 50 %, which can

lead to non-participation bias. Non-participation bias may hide traits from the target population within the sample population. For example, only 23 of the 132 surveys from participants were in Spanish. Data in 2018 from Tulare County Health and Human Services (TCHHS) found that 47% of Tulare County residents are Spanish speakers ("Data Update," 2018). Despite the TCHHS data not distinguishing whether those who speak Spanish also understanding English, having an under 10% Spanish participation rate seems low, considering the demographics of the targeted population.

Another limitation in the survey was sampling bias due to the possibility of willing participants in the study, potentially having a greater willingness to participate in the study than those less willing to utilize telehealth. The use of self-reported surveys also possesses the potential for an exaggeration or omission of truth due to perceived embarrassment. Despite these acknowledged limitations, this study did provide great initial insight to the thoughts regarding the topic of this study from the target rural population in Exeter, California.

Implications for Advanced Practice Nursing

Within the rural healthcare setting where this study took place, advanced practice nurses (APN's) are primarily in the role of primary care providers. As primary care providers, APN's have the opportunity to care for and manage diabetes for those within the rural population. Many barriers to optimal care may exist within this population, including infrequent clinic visits, lack of motivation, decreased medication adherence, and other negative psychosocial factors (Blonde et al., 2017). APN's in primary care are in a position to educate, understand motivational factors, and learn optimal learning modalities in patients served. It is conceivable that individual patients may best learn about their diabetes through

telehealth modality and electronic interaction. Keeping this in mind, APN's who are not already engaging in telehealth have the opportunity to familiarize themselves with different ways patient-provider interaction can take place. APN's may also advocate and help lead in the design and implementation of telehealth platforms within their organizations by providing expertise in nursing informatics.

Impact of COVID 19

SARS-CoV-2 is a virus that has caused a global pandemic starting in late 2019 that is currently going on at the time of this writing. This pandemic has lead to the shutdown of many businesses, schools, and places of social gathering. These shutdowns have been in place by the local and national leadership to try and slow down the rate of dissemination of this deadly virus throughout communities in the United States. Another consequence of this virus at the organizational level was the swift implementation of telephone and video conferencing capability at the site of this study starting in late March 2020. Swift implementation of video and telephone conferencing was placed due to the necessity of keeping potential and confirmed cases of COVID 19 outside the walls of the clinic. Keeping patients out of the clinic also mitigates the risk of infecting other patients and staff within the clinic.

The goal of swift implementation of a telehealth program was to target all patients within the clinic, not specifically diabetic patients. However, providers in the clinic have used the newly implemented program for diabetes management. Nonetheless, patient preference was not taken into consideration before implementation, and swift implementation was necessary despite possible consideration from patients in the clinic. Once the pandemic passes, it is unknown

whether the telehealth capability will continue to be offered within the rural clinic at Kaweah Delta - Exeter.

Looking Ahead

At this time, Kaweah Delta Medical Center, which owns and operates the family medicine rural clinic where this study took place, has four rural family medicine clinics throughout Tulare County. There is an opportunity to do a study in all clinics to see if the characteristics are similar or different between them. One compelling reason for the study at all the rural clinics is due to the possibility of implementation of a uniform telehealth program utilized by all the clinics. Considering the clinics are all within a 20-minute drive, the demographics at all the clinics could be similar to each other (e.g., predominantly Hispanic, a high percentage of Medi-Cal recipients). A uniform program could potentially service more patients within the county and have a far-reaching effect than just at one individual clinic.

A retrospective analysis of the successes and failures of the implemented telehealth program in the rural clinic during the COVID-19 pandemic can also provide valuable information regarding whether patients are receptive to use. Analysis can also be used to gather information regarding which aspects of the program patients enjoyed and which parts of the program that patients did not enjoy. This analysis could be used to help design an optimal targeted telehealth program in the future or modify a potential ongoing telehealth program for rural health clinics for Kaweah Delta.

Furthermore, an opportunity for a cost/benefit analysis will allow the organization to see if the benefits of a targeted telehealth program outweigh the cost of a program. If the benefit of higher compliance results in tighter A1C

control, this could reflect positively on the reputation of the organization. This boost in reputation is difficult to quantify. However, with overall healthcare going towards a pay-for-performance model and away from pay-for-service models, greater A1C control may reflect in higher monetary compensation from medical payers in the future.

Conclusion

Age, Internet access, and smartphone ownership are demographic characteristics in this study that factored into the willingness of participants to use an Internet or phone-based system for diabetes management if available. Other demographic factors such as gender, education, type of diabetes, time of onset of diabetes, marital status, occupation, and ethnicity were not found to be significant factors regarding willingness to use. These findings are unique to a target sample population at a rural family medicine clinic in Exeter, California. Data collected in this study illustrates the vital characteristics of the population that is useful for the potential design and implementation of a future telehealth program within the study setting. This study has laid the initial foundation for potential further investigation regarding this subject. Also, this project has provided an initial dataset of this population by gathering information that can be useful in determining whether a potential telehealth program designed to improve diabetes care can be implemented. Hopefully, the goal of implementing optimal diabetes management in the rural clinic setting in Exeter is one step closer due to this study contributing to the more magnificent body of knowledge regarding this subject.

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APPENDICES

APPENDIX A: DEMOGRAPHICS

Table 7

Demographics

Characteristic	n	Valid Percent
Age		
18-29	1	0.8
30-39	16	12.4
40-49	20	15.5
50+	92	71.3
Gender		
Male	57	43.2
Female	75	56.8
Ethnicity		
White	46	34.8
Hispanic/Latino	73	55.3
African-American	5	3.8
Asian	4	3
Other	4	3
Marital Status		
Single	40	30.5
Married	68	51.9
Divorces	7	5.3
Widowed	16	12.2
Highest Education		
≤ High School	71	56.3
Undergrad College	34	27

≥ Graduate Degree	21	16.7
Occupation		
Homemaker	31	23.7
Employed	20	15.3
Retired	49	37.4
Other	31	23.7
Diabetes Type		
Type 1	14	11
Type 2	101	79.5
I don’t know	12	9.4
Time DM Diagnosed		
As child/teenager	7	5.5
As an adult	120	94.5
Internet Access		
Yes, easy access	70	56
Yes, difficult access	23	18.4
No access	32	25.6
Internet Use		
≤ 1x/month	35	28.9
At least weekly	23	19
Several times weekly	46	38
Never	17	14
Own Smartphone		
Yes	88	67.7
No	42	32.3

Internet-based system monitor DM		
Yes	59	47.2
No	66	52.8
Phone-based system monitor DM		
Yes	70	55.1
No	57	44.9
Telehealth Experience?		
Yes	8	6.5
No	116	93.5
Interface most likely to use		
Video with computer	7	6.2
FaceTime/Skype	22	19.5
Phone Convo	48	42.5
Email	19	16.8
Other	17	15.2

APPENDIX B: ENGLISH LETTER OF INFORMATION

Letter of Information

You are invited to participate in a study being conducted by Andrew Kim, a student at the School of Nursing at California State University, Fresno. The purpose of the study is to learn about diabetic patient's willingness to use telehealth. Participation should take approximately 5-10 minutes to complete.

PARTICIPATION

Your participation in this survey is voluntary. You may refuse to take part in the research or exit the survey at any time without penalty. You may skip any question you do not wish to answer for any reason. Declining care will not affect your care in any way.

BENEFITS & RISKS

You will receive no direct benefits from participating in this research study. However, your responses may help us learn more about *w*hat patients, like yourself, want in their healthcare service. There are no foreseeable risks involved in participating in this study other than those encountered in day-to-day life.

CONFIDENTIALITY

Your survey answers will be stored initially in a secure briefcase, then electronically within a designated laptop for this project in a password protected electronic format.

CONTACT

If you have further questions concerning the study, contact the principal investigator, at (559) 967-0072 or by email at blondkorean@mail.fresnostate.edu or my Responsible Faculty Dr. Nisha Nair at (559) 278-8854 or by email at nishanair@csufresno.edu

Please select your choice below.

- You have read the above information
- You voluntarily agree to participate
- You are 18 years of age or older
- You have diabetes and being treated at Exeter Rural Family Medicine Clinic
- You can read and write either English or Spanish

☐ Agree

☐ Disagree

APPENDIX C: SPANISH LETTER OF INFORMATION

Carta de Informacion

Les invitamos a participar en un estudio llevado a cabo por Andrew Kim, un estudiante de la Escuela de Enfermería de California State University, Fresno. El propósito del estudio es conocer la voluntad del paciente diabetico con telesalud. Participación debe tomar aproximadamente 5-10 minutos para completer.

PARTICIPACIÓN
Su participación en esta encuesta es voluntaria. Usted puede negarse a participar en la investigación o salir de la encuesta en cualquier momento sin penalización. Puede saltar cualquier pregunta que usted no desea responder por cualquier razón. La disminució de la atención no afectará su atención de ninguna manera.

BENEFICIOS Y RIESGOS
No recibirá ningún beneficio directo porsu participación en este estudio de investigación. Sin embargo, sus respuestas nos pueden ayudar a aprender más de lo que los pacientes, como usted, quieren en su servicio de salud. No hay ningún riesgo previsible involucrado en participar en este estudio sean encontrados en la vida cotidiana.

CONFIDENCIALIDAD
Las respuestas de la encuesta seran almacenadas inicialmente en un maletín seguro, entonces electrónicamente dentro de un ordenador portátil designado para este proyecto en formato electrónico protegido con contraseña.

CONTACTO
SI usted tiene otras preguntas referentes al estudio, puede contacttaral investigador principal, llamando al (559) 967-0072 o por correo electrónico a blondkorean@mail.fresnostate.edu, o mi Facultad responsible Dr. Nisha Nair en (559) 278-8854 o por correo electrónico a nishanair@csufresno.edu

CONSENTIMIENTO: Por favor seleccione su opción abajo.

- Ha leído la información anterior.
- Se compromete voluntariamente a participar.
- Tiene 18 años de edad o más.
- Usted tiene diabetes y esta siendo tratado en la clínica de Medicina Familiar Rural de Exeter.
- Puede leer y escribir en ingles o español.

☐ De acuerdo

☐ No esta de acuerdo

APPENDIX D: ENGLISH RECRUITMENT FLYER

Willingness To Participate in Telehealth Study

If you are 18 years of age or older, you may qualify to participate in a research study

Willingness to Participate in Telehealth Study

Andrew Kim, a nurse practitioner at this clinic, is interested in learning whether you would be interested in using telehealth services if it were available to help manage your diabetes.

Your valuable input could be useful in helping us design better healthcare delivery to you in the future.

Participants will be asked to:

- Fill out a survey during your visit in the clinic

Location

- Survey to be filled out at Kaweah Delta Family Medicine Clinic in Exeter, California. Estimated time to fill out survey is approximately 5 to 10 minutes.

Are you eligible?

- 18 years of age or older
- Diabetic who receives management at Kaweah Delta Exeter Clinic for at least 6 months
- Able to read and write English or Spanish
- Able to give individual consent for study

If you're unsure if you meet the requirements, call or email a member of the study team:

Andrew Kim
MSN, NP-C
Principle Investigator
ankim@kdhcd.org
559-967-0072

APPENDIX E: SPANISH RECRUITMENT FLYER

Deseo de Participar en el estudio de Telesalud

Si eres mayor de 18 años de edad, usted puede ser elegible para participar en un estudio de investigación

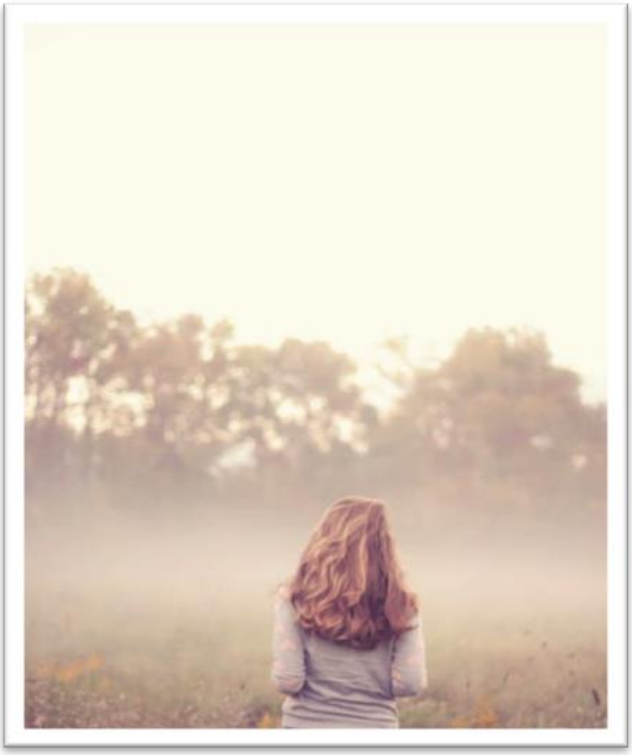
Deseo de Participar en Estudio de Telesalud

Andrew Kim, un practicante de enfermería en la clinica, está interesado en investigar si usted estaría interesado en utilizar servicios telehealth si estuviera disponible para ayudar a manejar su diabetes.

Su valiosa opinión podria ser útil para ayudarnos a diseñar la mejor atención de salud para usted en el futuro.

Se le pedirá los participantes que:

- Llenen una encuesta durante su visita en la clínica.



Ubicación

- Encuesta para ser llenada en la clinica de medicina familiar de Kaweah Delta en Exeter, California. El tiempo estimado para completer encuesta es aproximadamente de 5 a 10 minutos.

¿Es usted elegible?

- 18 años de edad o más
- Diabético que recibe management en Kaweah Delta Exeter clínica durante al menos 6 meses
- Capaces de leer y escribir ingles o español
- Capaces de dar consentimiento individual para el esudio

Si no está seguro si cumple con los requisites, llame o envíe un correo electrónico a un miembro del equipo de estudio:

Andrew Kim
MSN, NP-C
Investigador principal
blondkorean@mail.fresnostate.org
559-967-0072

APPENDIX F: ENGLISH SURVEY

Willingness to Participate in Telehealth Study

(Your participation in this questionnaire means you are accepting to be part of this study)

1. Age
    a. 18-29
    b. 30-39
    c. 40-49
    d. 50+

2. Gender
    a. Male
    b. Female
    c. Other

3. Nationality
    a. White
    b. Hispanic or Latino
    c. African-American
    d. Asian
    e. Other

4. Marital Status
    a. Single
    b. Married
    c. Widowed

5. Highest Educational Level
    a. High school or less
    b. Undergraduate college level
    c. Graduate degree or higher

6. Occupation
    a. Student
    b. Homemaker (stay at home)
    c. Employed
    d. Retired
    e. Other

7. Diabetes type
    a. Type 1
    b. Type 2
    c. Other (i.e. gestational, LADA, MODY)
    d. I don’t know

8. When were diagnosed with diabetes
    a. As a child or teenager
    b. As an adult

9. Do you have access to the Internet?
    a. Yes I have easy access
    b. Yes but it is hard to access
    c. No I do not have access

10. How often do you use the Internet?
    a. Sometimes, once a month or less
    b. Regularly, at least once a week
    c. Often, several times a week or daily

11.Do you own a smart phone?
    a. Yes
    b. No

12. I would use an Internet based self-management system to monitor my diabetes?
    a. Yes
    b. No

13. I would use a phone based self-management system to monitor my diabetes?
    a. Yes
    b. No

14. Do you have experience with using telehealth in the past to manage any health conditions?
    a. Yes
    b. No

15. If available, which tele-health visit type would you most likely use for a visit with your provider in regards to diabetes management?
    a. Video conferencing with a computer
    b. Face time or Skype
    c. Telephone conversation
    d. Email
    e. Other: Please specify _____

16. How do feel about potentially using telehealth to help manage your diabetes overall?
_____
_____
_____
_____
_____

17. If telehealth was available from your provider for diabetes management, would you be willing to use it? Why or why not?

_____
_____
_____
_____
_____

APPENDIX G: SPANISH SURVEY

Deseo de Participar en el estudio de Telesalud

(Su participación en este cuestionario significa que está aceptando ser parte de este estudio)

1. Edad

    a. 18-29 b. 30-39 c. 40-49 d. 50+

2. Género
    a. varón
    b. mujer
    c. otro

3. Nacionalidad
    a. Blanco
    b. Hispano o Latino
    c. Afroamericano
    d. Asiático
    e. Otro

4. Estado civil
    a. Soltero
    b. Casado
    c. Viudo

5. Nivel educativo más alto
    a. Escuela secundaria o inferior
    b. Nivel universitario pregrado
    c. Escuela posgrado o superior

6. Ocupación
    a. Estudiante
    b. Ama de casa (estancia en casa)
    c. Empleados
    d. Jubilado
    e. Otro

7. Tipo de diabetes
    a. Tipo 1
    b. Tipo 2
    c. Otro (i.e. gestacional, LADA, MODY)
    d. No sé

8. ¿Cuando fue diagnosticados con diabetes?
    a. Como un niño o adolescente
    b. Como un adulto

9. ¿Tiene acceso a Internet?
    a. Sí tengo fácil acceso
    b. Sí, pero es difícil acceso
    c. No no tengo acceso

10. ¿Con qué frecuencia utiliza el Internet?
    a. A veces, una vez al mes o menos
    b. Regularmente, al menos una vez por semana
    c. A menudo, varias veces una semana o un día
    d. Nunca

11. ¿Tiene un teléfono inteligente?
    a. Sí
    b. No

12. ¿Usaría un sistema de autogestión basado en el internet para controlar mi diabetes?
    a. Sí
    b. No

13. ¿Usaría un sistema de autogestión basado en telefono para controlar mi diabetes?
    a. Sí
    b. No

14. ¿Tiene experiencia usando la telesalud en el pasado para manejar sus condiciones de salud?
    a. Sí
    b. No

15. ¿Si está disponible, que tipo de la visita que tele-salud probablemente usaría para una visita médica en cuanto al manejo de la diabetes?
    a. Video conferencia con una computadora
    b. Video cara a cara o Skype
    c. Conversación telefónica
    d. Correo electrónico
    e. Otros: Especifique _____

16. ¿Cómo se siente sobre el uso potencial de telesalud para ayudar a manejar su diabetes en general?

_____
_____
_____
_____

17. ¿Si telesalud estuviera disponible con su proveedor de control de la diabetes, usted estaría dispuesto a utiizario? ¿Por qué o por qué no?

_____
_____
_____
_____