2019

Telehealth and Type 2 Diabetes Management

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
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2019

Abstract

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BSN, Goldfarb College of Nursing, 2009

Project Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Nursing Practice

Walden University

May 2019

Abstract

The use of telehealth in healthcare has grown in recent years; however, little is known about the effectiveness of this delivery method in the management of Type 2 diabetes mellitus (T2DM). Guided by the chronic care model and telehealth in chronic disease model, the purpose of this systematic literature review was to explore evidence related to lowering hemoglobin A1c levels and managing T2DM using telehealth in the outpatient setting. The practice-focused questions explored telehealth interventions used in T2DM management and their effectiveness. The Joanna Briggs Institute (JBI) method for conducting systematic literature reviews was the process, and data were compiled using the PRISMA evidence-based minimum set for reporting. Eighteen studies met the inclusion criteria for this project. Data were extracted, analyzed, and synthesized using JBI tools for data extraction and critical appraisal. Article appraisals revealed numerous telehealth interventions for management of T2DM including telephone, Internet-based, clinical video, remote monitoring, and smart phones/applications. Overall, telehealth interventions showed statistically significant improvement in the hemoglobin A1c levels of participants compared to traditional outpatient care. Success of the interventions is associated with components of evidenced-based diabetes management such as education, self-management, support, and feedback loop. The implications of this project for positive social change include the integration of telehealth interventions in the outpatient setting to manage T2DM with enhanced access to care, reduction in health disparities, and improved health outcomes for society.

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Dedication

I dedicate this project to my wonderful and precious family, Kelly, Jaden, Ethan, Breindel, and my mother, Lucy. Thank you for your unwavering support throughout this journey.

Acknowledgments

First, I want to give thanks and praises to God, all the glory belongs to Him, for He brought this DNP dream to fruition with his guidance and strength. I want to acknowledge the loves of my life (Kelly, Jaden, Ethan, Breindel and mama), you were patient with me even when the desperately needed attention from me was not as forthcoming. You encouraged me, prayed for and with me. I love you guys. I want to also thank my preceptors Dr. Eve Holzemer and Aaron Herr, thank you both for being instrumental to this success story. Special thanks to Dr. Edna Hull for being alongside me as I took this journey. I cannot thank you enough for your guidance, support, words of encouragement and prompt feedback. I also thank Dr. Trinity Ingram-Jones and the rest of the committee members for your guidance and feedback. I also thank Dr. Ebele Oraka, we started as colleagues, but you later became my good friend and second reviewer, thank you for your insight. Antwonette Hilliard thank you my sister for your words of encouragement and my reality check. Finally, my extended family and colleagues at work for their continuous support.

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Section 1: Overview of the Doctor of Nursing Capstone Project

Introduction

While the use of telehealth in healthcare is becoming more prominent, it is not known if it can be used in the management of type 2 diabetes (T2DM). Diabetes has become a global public health problem. It is the seventh leading cause of death in the United States, playing a large contributory role in the long-term list of complications that remain costly to all healthcare systems (Gervera & Graves, 2015; Heron, 2018). Some of the potentially fatal complications of diabetes include but are not limited to cardiovascular diseases, kidney failure leading to dialysis, vision problems, and amputation of limbs (American Diabetes Association [ADA], 2018a; Burchard & Sadarangani, 2014). Keeping blood glucose levels as close to normal limits as possible remains the main aim of diabetes management in order to improve symptoms and minimize complications (Lee, Greenfield, & Pappas, 2018). To achieve this aim, close monitoring of blood glucose and a working relationship between patients and their healthcare providers are very crucial. This means that the conventional face-to-face outpatient care is not sufficient in meeting this aim, and this is where telehealth can be useful in improving diabetes management (Lee et al., 2018). Reducing the burden of diabetes and improving quality of life for patients with diabetes and those at risk of becoming diabetic remains a goal of Healthy People 2020 (2018).

The use of information technology is becoming more dominant in the management of chronic diseases including diabetes, allowing consumers to receive healthcare services from the comfort of their homes. This is particularly true in telehealth,

which is defined as the exchange of information from one site to another via electronic communication to improve patient health outcomes (Tuckson, Edmunds & Hodgkins, 2017). There is the need for the inclusion of alternative methods, such as telehealth, in the management of patients with T2DM given the potential long-term complications and rising health care costs (Burchard & Sadarangani, 2014).

Telehealth is described as having the potential to not only improve the quality of care but also the accessibility, uses, and effectiveness of healthcare (Van Dyk, 2014). Despite this fact, the adoption of telehealth remains slow and many factors such as resistance to change are contributory barriers to adopting telehealth by healthcare providers (Kruse et al, 2016). The aim of this DNP capstone project was to perform a systematic literature review evaluating telehealth interventions in the management of patients with T2DM in the outpatient setting with resultant improvement in glycemic control (HgA1c).

The nature of this DNP capstone project was to conduct a systematic literature review by extracting data from various evidence-based sources, seeking to find sources using telehealth in the management of T2DM and their findings. This capstone project correlates with DNP Essentials I and IV, which are scientific underpinnings for practice and information systems/technology and patient care technology for the improvement and transformation of health care (American Association of Colleges of Nursing [AACN], 2006). This DNP capstone project holds the potential for positive social change because it presented the state of evidence on the effectiveness of telehealth in the management of T2DM.

Problem Statement

Despite advances over the years in diagnosing, treating and preventing the progression of T2DM, it remains prevalent, with many T2DM patients still not reaching optimal glycemic levels (ADA, 2018a). In recent years, telehealth has emerged as a delivery method for providing oversight of patients diagnosed with diabetes and other chronic illnesses. At the DNP student's site of employment where a remote monitoring telehealth program is practiced, resistance to change by the primary care providers can be attributed to the slow adoption of the program in T2DM management. Traditionally, management of T2DM patients is done via face-to-face visits, which can be resource intensive, costly, and very time consuming for both providers and patients (Burchard & Sadarangani, 2014). To date, there is evidence that the integration of telehealth in the management of diabetic patients can assist with improving health outcomes (Steventon, Bardsley, Doll, Tuckey, & Newman, 2014). This raises the question of which telehealth interventions have been shown to be effective in the care management of the diabetic patient. Using a systematic literature review approach, the focus of this DNP capstone project was the identification and evaluation of telehealth interventions that have been shown to be effective in lowering the glycemic levels in T2DM.

Purpose Statement

There are many documented barriers to the adoption of telehealth by healthcare providers of which resistance to change is one, even with evidence of telehealth's promise to increase access and efficiency of care (Burchard & Sadarangani, 2014). Cund (2018) argued that even though providers are using technology in the care of patients,

they are not using technology to its full potential. A recent report estimated the total economic burden of diagnosed diabetes at $327 billion in 2017, which is a 26% increase from $245 billion in 2012 (ADA, 2018b). To combat this public health challenge, a multifaceted approach (not just the traditional health care approach) is needed including the use of telecommunication modalities (Lee et al, 2017). Hence, the purpose of this DNP project was to examine and evaluate modalities used by telehealth providers to lower glycemic levels and thus improve patient outcomes in those diagnosed with T2DM.

Practice-Focused Questions

Using a systematic literature review approach, the practice-focused questions guiding this DNP project were:

PFQ1: What evidence-based modalities used by telehealth providers have emerged in the literature from 2013 to 2018 for lowering glycemic levels in adult clients diagnosed with T2DM?

PFQ2: Using an evidence hierarchy system, how do these evidence-based telehealth modalities rate in terms of effectiveness?

Nature of the Doctoral Project

Literature suggests the potential of telehealth in realizing the quadruple aims of health care, which include improved patient experience, improved population health, reduced cost, and improved care experience (Tuckson et al., 2017). To answer the practice-focused questions, I completed an exhaustive and comprehensive search of databases such as CINAHL, Medline, PubMed, and Embase for relevant literature using key search terms. This systematic review entailed the review of literature from multiple

sources of evidence. Examples of evidence include randomized controlled trials (RCTs) and case, quasi-experimental, and other studies.

I utilized key search terms such as *telehealth, hgA1c,* and *type 2 diabetes mellitus* to locate relevant evidence-based sources. The search was focused on sources written between 2013 and 2018 in order to be informed of more recent evidence-based sources on the phenomenon of interest. Inclusion criteria were original studies with participants 18 years of age and older diagnosed with type 2 diabetes, studies comparing standard or usual care (outpatient) to telehealth interventions, and reported outcomes on glycated hemoglobin levels. Sources were excluded if they were not written in English, participants were less than 18 years of age, participants had type 1 diabetes, or if there were no reported outcomes on glycated hemoglobin. I appraised studies for quality of data extracted, and I analyzed, synthesized, and interpreted results for applicability.

Significance

The stakeholders for this capstone project include the patients diagnosed with T2DM, their families, and the health care professionals around the globe providing care for such patients. For the patients with T2DM, this project presented telehealth interventions available to assist them with increasing and mastering self-management skills and providing easy access to their health care providers. For healthcare providers, this capstone project served as a presentation of the current state of evidence to assist them in applying nontraditional approaches in the management and support of patients diagnosed withT2DM. This DNP capstone project contributed to the body of evidence-based resources for the care of adults with T2DM. Hence, there is the potential of

transferability of this doctoral project to reviewing the impact of telehealth to other chronic disease conditions and mental health problems.

This doctoral project has implications for the nursing profession and for positive social change because diabetes remains a global issue. In the United States alone, attributable medical expenditure for diabetes increased from $116 billion in 2007 to $176 billion in 2012 (Olson et al, 2015). As health information technology advances, telehealth can possibly be a means of managing chronic conditions such as diabetes. Increased access to care via telehealth modalities can reduce disparities and improve care locally, nationally, and internationally. Harnessing the potential of technology can provide better access to information in patients with chronic disease, thereby improving self-management skills (Salisbury et al., 2015). Thus, exploring all possible options in the control of diabetes is imperative in reducing the increasing morbidity and mortality rates associated with diabetes.

Summary

This section introduced the topic of the DNP capstone project, which is to present the state of evidence regarding the effectiveness of telehealth interventions in the management of T2DM. This section provided an overview of the nature of the DNP project including problem statement, purpose, practice-focused questions, and the social change implications of the project. In Section 2 I explore the model/framework for the DNP project, relevance of the DNP project to nursing practice, local background and context, and my role as the DNP student.

Section 2: Background and Context

Introduction

T2DM affects millions of people worldwide and comes with significant personal and social implications, which include increases in mortality and morbidity rates (Bagnasco et al, 2014). The use of technology has been deemed promising in offsetting some of the challenges healthcare providers face in providing self-management care and support to patients with chronic diseases including diabetes (Nundy et al, 2014). Despite strides in health information technology, healthcare providers are not utilizing it to its full potential. This is particularly true in telehealth, which has the potential to increase accessibility and quality of care provided beyond the traditional face-to-face appointments between patients and healthcare providers. I focused this DNP capstone project on performing a systematic literature review to present the current state of evidence on the effectiveness of telehealth in the reduction of glycemic levels in T2DM patients. In this section I discuss the concepts and models that served as frameworks for this DNP project. Also included are the relevance of the problem to the nursing profession, local background and context, and my role as the DNP student.

Concepts, Models and Theories

Joanna Briggs Institute's Systematic Review Process

The Joanna Briggs Institute's (JBI) systematic review process approach served as the framework for this DNP systematic review project. JBI describes the systematic review and synthesis of evidence as the core of evidence-based practice (Peters et al. 2015). It is also viewed as the analysis of available literature in order to determine how

effective or ineffective a given practice is. It comprises of the following stages: developing a rigorous proposal, stating the question(s), identifying inclusion criteria, detailing strategies to use in identifying relevant literature, assessing quality of the literature, extraction of data and finally synthesis and summary of the literature (Godfrey & Harrison, 2015; JBI, 2018; Peters et al. 2015). JBI concerns itself with the appropriateness, meaningfulness, feasibility and delivery of healthcare practices and as such view results of well-designed research studies of any methodology as potential sources of credible evidence, not just RCTs (Peter et al. 2015). Below is further expansion on the stages of the JBI's systematic review process:

- Develop review proposal: This serves as a guideline and assists with maintaining focus on the topic throughout the review process. This stage briefly included research questions, inclusion/exclusion criteria, and databases to search, assessing quality of studies, data extraction methodology, and the strategies for synthesis of data.
- Develop review question(s): This stage encourages the use of PICO in formulating the question in order to provide clarity regarding the review focus, guidance in the literature search, and data extraction.
- Identify inclusion and exclusion criteria: The PICO process assists with determining inclusion and exclusion criteria. The inclusion criteria in this case addressed participants, interventions, outcomes, and research methodologies considered such as RCTs, case studies, and many others.

- Search strategy: The search process detailed the keywords, initial search, subsequent search, selecting studies, and maintaining a record of searches. Use of a decision tree tool such as the PRISMA remains crucial.
- Critical appraisal: This phase is aimed at limiting biases and establishing the validity of the article.
- Data extraction: This phase involves the summarization of pertinent information from each study, which includes methods, interventions, and outcomes.
- Data synthesis: This involves capturing the essence of the phenomenon of interest and following the three steps: identifying findings, grouping them into categories, and grouping categories into synthesized findings.

Chronic Care Model

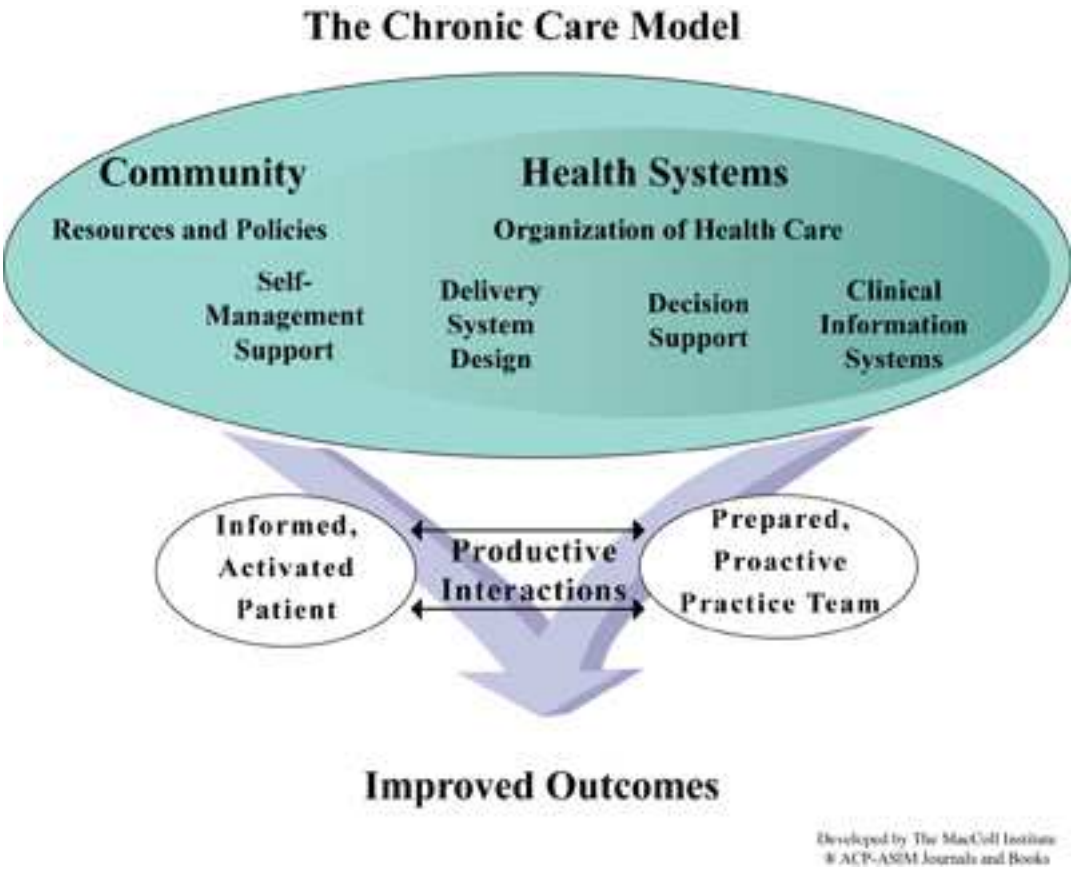


Figure 1. The chronic care model. Used with permission from ACP-ASIM Journals and Books (see Appendix F). Source: Wagner, E. H. (1998). Chronic disease management: What will it take to improve care for chronic illness? *Effective Clinical Practice, 1*(1), 2-4.

The chronic care model is a call for changes in the healthcare system that are based on evidence in order to meet the care needs of patients with a chronic disease. Wagner (1998) purported that management of chronic illnesses should not be the sole effort of the primary provider but rather that of an integrated and sometimes expanded team. The model is composed of six components that have the potential to affect outcomes in disease management (Baptista et al. 2016; Stellefson, Dipnarine, & Stopka, 2013). These authors purported that the components serve to create a more effective

health care delivery system that will make available comprehensive self-management support services for patients with chronic disease such as diabetes using all available resources (Stellefson et al., 2013). These components include:

- the organization of health care, which is making available resources and minimizing barriers to access to care;
- self-management support, which is teaching patients self-management skills and empowering them;
- decision support, which is providing necessary guidance for evidence-based care implementation;
- delivery system design, which is coordinating care processes;
- clinical information systems, which are tracking progress and reporting outcomes; and
- community resources and policies, which involve using community-based resources to sustain care.

Organization of health care details the importance of support from healthcare organizational leaders. Their support facilitates strategic changes that will promote a culture of high-quality care, effectively manage quality control issues, reduce barriers to access to care, and facilitate communication (Baptista et al. 2016; Stellefson et al., 2013). With self-management support, interventions are provided and examined to evaluate the client's recognition of their role in their health care and their ability to assume self-responsibility. To be effective, the patient and the health care provider identify the problem, set priorities and goals, develop care plans, and then monitor effectiveness of

self-care (Baptista et al. 2016). Introducing scientifically based clinical guidelines to decision support systems promotes attention to daily healthcare practice. The clinical decision support systems should include alerts, reminders, and feedback to be effective (Baptista et al. 2016). The delivery system design requires that health care needs, roles, and tasks be defined so that care can be structured and provided by a multidisciplinary team. The delivery system design also implies that new forms of provision of care that are beyond the face-to-face visits need to be implemented in order to sustain attention from a distance (Baptista et al. 2016). Clinical information systems should be efficient and effective, with alerts, reminders, and feedback for users. It should also summarize clinical information enabling identification of at-risk groups and monitor system performance and quality of service. Finally, the community resources and policies component should aim at using community resources and partnerships to improve health care (Baptista et al. 2016).

This model fits perfectly because telehealth in the context of this project is considered to have the potential to positively impact the management of chronic diseases such as T2DM. Applying the chronic care model is feasible in the sense that the support of organizational leaders in providing the necessary resources to implement, maintain and reduce possible barriers lead to high adoption and use of programs. Most remote monitoring telehealth programs have the solid foundation of the provision of self-management education and support for the patients enrolled in the program. The systems are also equipped with clinical decision support with alerts, reminders, and feedback

mechanisms. With telehealth, there are identified healthcare professionals with defined roles within a multidisciplinary team to promote and maintain the health of participants.

The TElehealth in CHronic Disease Model

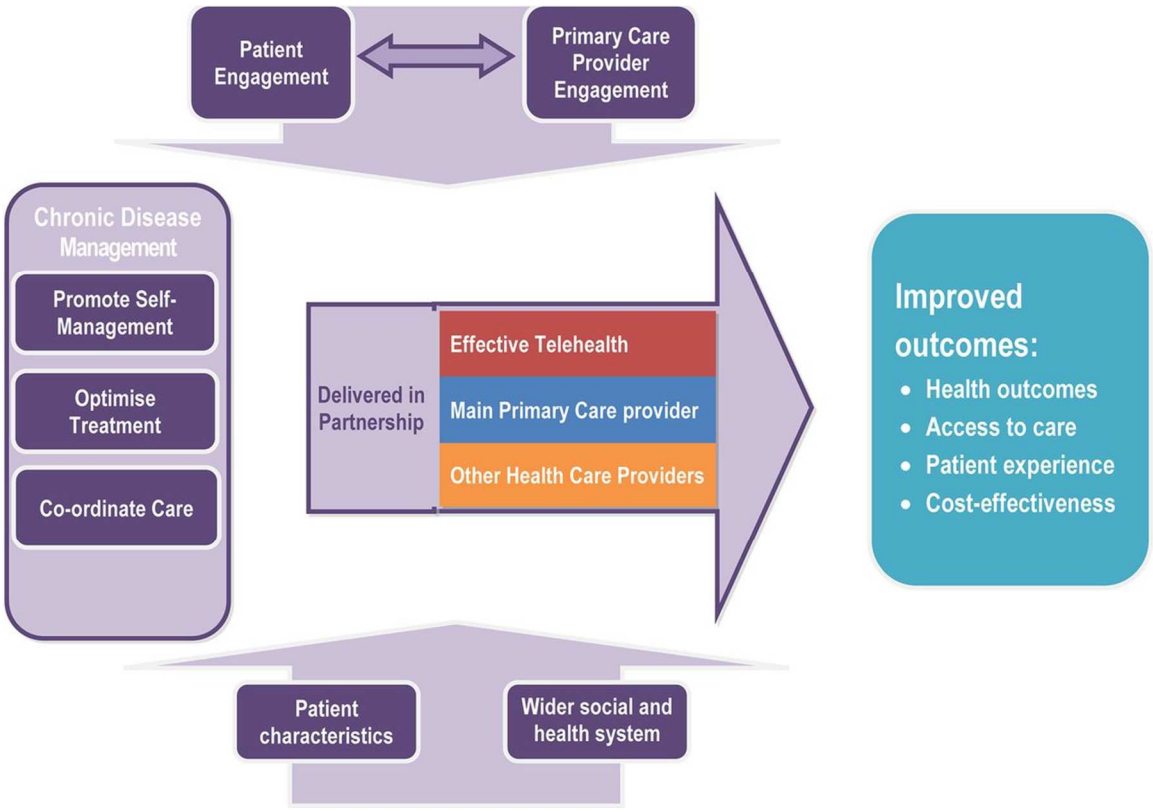


Figure 2. The TElehealth in CHronic disease (TECH) model for telehealth to support patients with chronic conditions. Used with permission from *BMJ Open* (Appendix G). Source: Salisbury et al. (2015). TElehealth in CHronic disease: Mixed-methods study to develop the TECH conceptual model for intervention design and evaluation. *BMJ Open, 5*(2). e006448.

The TElehealth in CHronic disease (TECH) model was developed with the premise that as the population ages, there will be increasing number of people with chronic diseases. Their needs will pose the risk of overwhelming the ability to provide the conventional scheduled face-to-face appointments between patients and their providers (Salisbury et al., 2015). The authors also indicated that they developed this

conceptual model because telehealth is a complex intervention requiring interacting components, such as the technology, infrastructure, available human support, and patient capabilities. This model contains four components with key outcomes including improved access, health, patient experience, and cost. The components include:

- engaging patients and health professionals;
- including subcomponents of self-management, treatment optimization, and care coordination for effective management of chronic diseases;
- effective partnership between providers; and
- patient, social, and health system context.

Engaging patients and health care providers are very important in the success of any telehealth program. The authors noted low enthusiasm and sometimes resistance or hesitance towards adoption of telehealth interventions by healthcare providers (Salisbury et al., 2015). Engaging health care professionals with evidence of telehealth interventions, eliminating concerns for duplication of care, employing technology that is user friendly, clearly defining roles of traditional and telehealth providers, and maintaining good communication between providers will greatly influence their participation (Salisbury et al., 2015).

Relevance to Nursing Practice

Diabetes has become a growing global issue due to increasing morbidity and mortality rates (ADA, 2017). As the number of people with diabetes continues to grow despite increases in traditional care, so does the urgency to find alternative methods that can supplement conventional care for this chronic disease. The use of information

technology in providing healthcare is becoming very prevalent but there is ongoing evidence of barriers to adopting them or using them to its full extent. Amongst the barriers is the reluctance to change by healthcare providers. This barrier could be as a result of caseloads and time pressures causing providers not to automatically think of using available technology (Taylor & Coates, 2015).

Telehealth solutions have the potential to increase self-management and empowerment in patients, improve communication between patients and their healthcare providers including nurses, and enhance patient-centered care (Koivunen & Saranto, 2018). The increasing focus on outpatient care instead of inpatient care and decreasing rates of hospital length of stay is creating the need to adopt new tools such as telehealth in nursing practice (Koivunen & Saranto, 2018). The Institute of Medicine's report titled *The Future in Nursing, Leading Change, Advancing Health,* recommended that nurses expand their roles in health care and master the use of information technology systems to improve inter-professional relationships and coordination of care (IOM, 2011). This doctoral project advances nursing practice by presenting the state of evidence after conducting an exhaustive systematic literature review on the lowering of glycemic levels in T2DM patients using telehealth.

Type 2 Diabetes Mellitus

Diabetes is a health condition where the blood glucose is higher than normal values, caused by insulin deficiency, and is usually diagnosed when hgA1c is equal to or greater than 6.5% (ADA, 2018a, 2018b, 2018c). The Center for Disease Control and Prevention in 2016 estimated that 1 in every 11 people have diabetes which comes out to

be approximately 29.1 million people (CDC, 2016). The financial burden of diabetes cannot be overlooked; the ADA in 2017 published a report titled the economic cost of diabetes in the U.S. This report detailed the increased financial burden of care and health resources (ADA, 2018a).

There are other types of diabetes but Type 2 is the most prevalent with diagnosis including testing of fasting blood glucose, hgA1c and 2-hour postprandial glucose during a 75gm oral glucose tolerance test (ADA, 2018c). For most patients with T2DM, a reasonable hgA1c goal is less than 7.0%. Reports have shown though that most T2DM patients are not reaching this goal, in fact about only 50% of patients in the U.S. diagnosed with this condition are reaching the goal of hgA1c less than 7.0% (ADA, 2018a).

T2DM as previously stated is associated with increased morbidity and mortality. Some of the associated complications include vision problems (including blindness), neurological disorders, cardiovascular disorders, non-healing wounds leading to amputations, kidney disease leading to dialysis, and many others. The treatment or management of T2DM involves the use of glucose lowering medications and lifestyle modification. The goal of management is to teach self-management skills, which include self-monitoring of blood glucose (SMBG), and provide support to assist in maintaining self-management skills. The use of diabetes self-management education and support has proven to be evidence-based in the management of diabetes and can help with improving outcomes (ADA, 2018c).

Telehealth

Telehealth is described as the delivery of healthcare services from a distance using information and telecommunication technologies to exchange valid information for diagnosis, treatment, health-related education and the advancement of public health (Health Resource and Service Administration, 2015; World Health Organization, 1998). Telehealth can be used to provide remote patient monitoring and provide education in the management of chronic disease processes. Telehealth has also been described as being associated with reduced hospital admissions and emergency department (ED) visits, reduced length of hospital stays and overall reduction in mortality rates (AHRQ, 2016; Xiang, Li, & Liu, 2013). Nursing care is increasingly being delivered at home than in institutions and telehealth makes it possible for patients to remain in their home while receiving quality care for chronic disease and communicate effectively over a distance with their health care providers (Koivunen & Saranto, 2018). Telehealth services or interventions can be deployed via telephones including mobile phones, computerized internet-based devices, remote monitoring devices such as automated self-monitoring devices, telemeasuring devices, video cameras and wireless Bluetooth devices (Kalankesh, Pourasghar, Nicholson, Ahmadi, & Hosseini, 2016).

In the management of T2DM, the Agency for Healthcare Research and Quality (2016) described telehealth as validating the improvement of adherence to diabetes self-management. Coughlin (2017) purported that the introduction of telehealth in the management of T2DM is very crucial due to the potential for improving clinical outcomes, care coordination and patient satisfaction. This is because telehealth makes

provision for patients to communicate with their healthcare providers regarding their glycemic control and for providers to monitor glucose levels and provide feedback in real-time. This feedback loop allows for the provision of self-management skills education, modification of treatment and monitoring of outcomes (Coughlin, 2017).

The Veteran Health Administration (VHA) adopted the use of telehealth interventions in the management of veterans with chronic diseases such as diabetes. The VHA's home telehealth has the basis of the chronic care model, connecting disease management to home. This model of care in the VA is referred to as care coordination home telehealth (CCHT). The CCHT program in the VA is considered successful in managing T2DM due to the provision of ongoing assessment, monitoring, and case management of veterans from their home providing "just in time" care (Gervera & Graves, 2015). Diabetic veterans enrolled in the program transmit biometric data (blood glucose, blood pressures and weights) via a home monitoring device, in addition to responses to assessment questions. The data, transferred through a secure portal are reviewed by an RN care coordinator, who interprets data, provide interventions as needed and documents in the electronic health record for other clinicians to view (Gervera & Graves, 2015). The current data on the increasing number of adults 18 years and older diagnosed with T2DM require the exploration of other management methods such as telehealth in addition to the conventional face-to-face meetings with health care providers.

Context and Role of the Doctor of Nursing Practice Student

This DNP project served as a systematic literature review and as such was not bound by a setting. Inclusion and exclusion criteria for selecting evidence-based literature were used in place of designating a setting. The inclusion criteria as shown below in Table include literature written between 2013 and 2018, studies of adults 18 years and older diagnosed with T2DM, and the use of telehealth interventions in managing T2DM with resultant effect on the hemoglobin A1c. Exclusion criteria include literature not written in English, systematic reviews, studies with children younger than 18 and patients with type 1 DM. The level of evidence of the selected literature was categorized accordingly using the level of evidence for effectiveness by the JBI (2014).

Table 1

Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Articles published between 2013 to 2018	Participants less than 18 years old
Focus on original study, not review of many studies	Systematic reviews
Participants 18 years and above	HgA1c not being the principle outcome measure
Participants are diagnosed with T2DM	Non-English article
Article written in English	Specificity is not to T2DM

HgA1c is the principle or one of the principle outcome measures	Not comparing telehealth to usual care in outpatient setting
Full text articles	Focus on EHR and not on telehealth technology
	Abstract only articles

I am a master's prepared registered nurse with over twenty-two years of varied experience in the profession. I have had the opportunity to use telehealth interventions in providing care to patients with chronic diseases such as T2DM. In this service, I observed that healthcare providers (physicians, RNs and pharmacist) are not utilizing this service to its full potential for varied reasons including resistance to change. I saw this lack of use as an opportunity to seek improvement in the management of T2DM patient population using technology. I served as the leader of this DNP capstone project and completed a systematic review in order to present the current state of evidence regarding telehealth and T2DM management and also to answer the practice focus questions.

Definition of Terms

Prisma: Preferred reporting items for systematic reviews and meta-analyses (Moher et al. 2009).

Hemoglobin A1c (HgA1c): An indirect measure of average blood glucose levels (ADA, 2018c).

Self-management skills: This the development of a generic set of skills that has proven successful in allowing individuals to effectively manage their chronic illness and improve health outcomes (Grady & Gough, 2014).

Care coordination: The deliberate organization of patient care activities and sharing of information among all of the participants concerned to achieve safer and more effective care (AHRQ, 2018).

Self-monitoring blood glucose (SMBG): Self-monitoring of blood glucose levels by patients to evaluate their individual response to therapy and assess whether glycemic targets are being achieved (ADA, 2018c).

Certified diabetes educator: Certified health care professional who applies in-depth knowledge of diabetes and skills to enable diabetic patients to manage daily and future challenges (Burke, Sherr, & Lipman, 2014).

Diabetes self-management education/support (DSME/S): Collaborative process to educate diabetic patients, helping them to gain knowledge and skills necessary to self-manage the disease process and its related conditions (Burke, Sherr, & Lipman (2014).

Summary

This chapter discussed models that informed this DNP capstone project (the chronic care model and the TECH model) including the use of the JBI for systematic review as the framework. Also discussed was the background of T2DM and Telehealth, and various terms used in the understanding of the project itself. Relevance to nursing practice, context and the role of the DNP student were also discussed. The next chapter will discuss the sources of evidence, collecting and analyzing sources of evidence.

Section 3: Collection and Analysis of Evidence

Introduction

Telehealth interventions have the potential to improve outcomes in the management of chronic diseases, but despite this potential, there are still barriers in adopting its use. My aim in this DNP capstone project was completing a systematic literature review presenting the current state of evidence regarding the use of telehealth interventions in the management of T2DM. For this DNP capstone project, I used the JBI systematic review process as a framework. This chapter presents the sources of evidence used, the tools for collection, and the analysis and synthesis of data.

Practice-Focused Questions

Diabetes is a global health concern and the aim of management remains to keep blood glucose as close to normal as possible, improve symptoms, and minimize long term complications (Lee et al., 2018). The urgency for improvement of diabetes management means that the conventional outpatient care is no longer sufficient. A growing body of evidence supports the use of innovative technologies such as telehealth in the monitoring and management of patients with diabetes over a distance and as frequently as necessary (Burchard & Sadarangani, 2014; Lee et al., 2018). Despite this growing body of evidence, telehealth technologies are not being used by healthcare providers to their full potential in the management of T2DM (ADA, 2018a). Using a systematic literature review approach, the practice-focus questions that guided this evidence-based DNP project were:

PFQ1: What evidence-based modalities used by telehealth providers have emerged in the literature from 2013 to 2018 for lowering glycemic levels in adult clients diagnosed with T2DM?

PFQ2: Using an evidence hierarchy system, how do these evidence-based telehealth modalities rate in terms of effectiveness?

Sources of Evidence

The sources of evidence came from the exhaustive searches of prominent electronic databases for peer-reviewed literature in an attempt to answer the practice-focused questions. The focus of the search was to identify literature with the strongest evidence, and that included RCTs, case studies, and quantitative studies. I evaluated the level of evidence of the selected literature using the JBI's (2014) levels of evidence for effectiveness and were categorized accordingly.

Relationship of Evidence to Purpose

My goal for this capstone project was to present the state of evidence on the use of telehealth interventions in the management of T2DM with resultant improvement in hgA1c. With the increasing number of adults diagnosed with T2DM, there is the need to employ other methods of management that is beyond the traditional face-to-face provider visits. Key search terms as identified below were used to identify as much literature as possible that focused on the use of telehealth in the management of T2DM.

Collection and Analysis of Evidence

As stated in the inclusion criteria, I collected literature written between 2013 and 2018 to make sure that the most current evidence was reviewed. I reviewed titles and

abstracts and included articles if they had relevant information regarding the phenomenon of interest and could assist in answering the practice-focused questions. The goal was to collect and analyze studies that can assist in presenting the current state of evidence in the use of telehealth to manage T2DM and subsequently reducing the glycated hemoglobin.

Published Outcomes and Research

To complete this DNP capstone project, I conducted an exhaustive and comprehensive literature search using databases such as Cumulative Index of Nursing and Allied Health Literature (CINAHL), MEDLINE, PubMed, ProQuest and Embase. Key search terms used include *telehealth, type 2 diabetes,* and *hemoglobin A1c.* I used Boolean operators (and, or and not) to identify relationships between the search terms and narrow the search results. I used a matrix table (see Appendix I) to summarize results from the sources. The search focused on literature written between 2013 and 2018 in order to provide the most recent schools of thought on the phenomenon of interest. I applied inclusion and exclusion criteria in the selection of literature.

Protections

This DNP capstone project is a systematic literature review. No collection of data from human subjects occurred. However, I followed the steps in the systematic literature review manual in seeking the approval of the Walden University's Institutional Review Board for the completion of this project (Walden Institutional Review Board approval no. 01-10-19-0290222).

Analysis and Synthesis

I selected and reviewed literature meeting the inclusion criteria. Organization is very crucial throughout a literature search process (Holly, Salmond & Saimbart, 2017). I used a search log to track search strategies, as well as a decision tree (PRISMA tool). I used a literature matrix (Appendix I) to record and organize evidence. The involvement of another independent investigator was necessary to assist with the review of titles and abstracts. All literature meeting the inclusion criteria were subject to JBI's level of evidence for effectiveness in order to rate the evidence and establish validity of the literature. I grouped findings into categories and categories into synthesized findings. Categories in this case were groups of findings that had similar relationships among variables or circumstances and informed the practice (Godfrey & Harrison, 2015).

Summary

The DNP capstone proposal discussed diabetes becoming a global health issue and due to the advancement in health technologies, telehealth interventions present opportunities for improved management of diabetes (So & Chung, 2017). Despite the growing evidence of telehealth's potential, it is not being used to its full potential. I also discussed the practice-focused questions that guided this DNP capstone project. I reviewed the sources of literature evidence, inclusion and exclusion criteria, and methods of data organization, analysis, and synthesis. In the next chapter, I discuss the findings of the systematic literature review, as well as recommendations, strengths, and limitations of the project.

Section 4: Findings and Recommendations

Introduction

Telehealth has been described as having the potential to improve the quality, accessibility, utilization, and effectiveness of care (Van Dyk, 2014). The question is what role it can play in managing T2DM, which is now a complicated, multifaceted and global chronic disease process. Keeping glycemic levels as close to normal as possible for T2DM patients is crucial in their management in order to improve symptoms and minimize complications. Identifying outpatient interventions that have been proven to improve health outcomes in T2DM patients such as lowering hgA1c is imperative. The conceptual models for this DNP project were the chronic care model and the TECH model; I discussed both in detail in Chapter 2. This DNP capstone project was guided by the following questions:

PFQ1: What evidence-based modalities used by telehealth providers have emerged in the literature from 2013 to 2018 for lowering glycemic levels in T2DM?

PFQ2: Using an evidence hierarchy system, how do these evidence-based telehealth modalities rate in effectiveness?

To answer the practice-focused questions, I performed a systematic literature review to appraise current evidence to determine the use and effectiveness of telehealth in the management of T2DM in the outpatient setting. The search for evidence included scholarly publications from 2013 to 2018 including articles from CINAHL, Medline, PubMed, ProQuest and Embase. I used a PRISMA flow chart diagram (Appendix A) as a

decision tool to review abstracts and full-text articles and to exclude articles that did not meet study criteria (see Table 1). Articles meeting the inclusion criteria were selected, analyzed and critically appraised using the JBI (2018) data extraction form (Appendix B) and critical appraisal forms (Appendices C, D, & E), then grouped into categories of interventions. To achieve rigor and validity, a second reviewer (doctoral prepared) was invited to participate in article selection and data extraction. Eighteen articles met criteria for this doctoral capstone project, and in this chapter, I discuss the findings, implications for nursing practice/social change, recommendations, strength, and limitations of the project.

Findings and Implications

Eighteen articles met the inclusion criteria, fifteen articles were RCTs, one study was quasi-experimental, one an exploratory study, and one was a case study. The quality of evidence for grading these studies was based on the JBI's Level of Evidence for Effectiveness (2018). A review of selected articles noted the application of several telehealth interventions or modalities in the management of T2DM, including telephone, Internet, remote telemonitoring equipment, clinical video telehealth (CVT), and smart phones/apps. Some studies applied a single telehealth intervention, while some used multiple telehealth interventions at the same time. I discuss each in detail below. It's also important to point out that in all the included studies, hgA1c was either the primary outcome measure or one of the primary outcome measures. Overall, most of the evidence indicates effectiveness in using telehealth in the management of T2DM with a resultant decrease in the hemoglobin A1c.

Telehealth Interventions/Modalities

Telephone interventions. Telephone intervention is defined as an intervention that makes it possible for a healthcare professional to verbally communicate remotely with patient or caregiver (Corry, Smith, Neenan, & Brabyn, 2017). Telephonic intervention is considered the most basic form of telehealth intervention, where the healthcare provider assumes the role of the facilitator, helping the patient on the other end to determine what is more important for them to address health wise (Niemczewski, Polivka, Clark, 2016). In my review, four studies discussed the use of telephonic intervention in the management of T2DM in the outpatient setting as a single modality (Niemczewski et al., 2016; Odnoletkova et al., 2016), with two of them combining the use of another telehealth modality (Crowley et al., 2016; Nicolucci, Cercone, Chiriatti, Muscas, & Gensini, 2015). The telephonic interventions in these studies all aimed at providing quality diabetes self-management education and coaching patients through self-determined or preset goals with resultant decrease in hgA1c. This telephone interaction between the healthcare providers who are primarily nurses and the patient enhance communication, providing a means of assessing patients' ability to manage their own care at home with resources provided. The participants in the telephone intervention from both studies (n= 303) achieved a reduction in their hgA1c (7.9% to 6.8%) at the end of the study (Niemczewski et al., 2016; Odnoletkova et al., 2016).

Crowley et al. (2016) and Nicolucci et al. (2015) used telephone interventions in combination with remote monitoring intervention. The remote monitoring allows for transmission of vitals including blood sugar regularly, followed by telephone calls, which

are either scheduled or unscheduled due to high stratification of data transmitted. These researchers determined that scheduled phone calls where structured or comprehensive diabetes education is provided help patients with staying on track with their goals, empowering them to gain independence in self-management. Unscheduled phone calls assist the patient to determine the cause of the abnormal reading or response and set goals or activities to minimize the frequency of abnormal readings. Results in both studies showed significant reductions in hgA1c in the intervention groups. These studies concluded that telehealth is effective in managing T2DM patients in the outpatient setting, and any improvement in hgA1c by 1.0% can reduce microvascular complications by 37% (Crowley et al., 2016).

Internet interventions. Internet-based interventions are described as treatments that are delivered through an Internet connection with some therapeutic tasks done through the computer (Andersson & Titoy, 2014). The majority of the studies reviewed used this telehealth intervention method to manage T2DM in the outpatient setting (Istepanian et al., 2014; Kempf et al., 2017; Kim et al., 2016; Lim et al., 2014; Tang et al., 2013; Wang et al., 2017; Zhou et al., 2014). The Internet is a worldwide communication tool. These researchers found that the use of this methodology, which included Internet-based blood glucose monitoring systems, allowed for automatic upload of vital signs and other data as required by the program via an Internet connection. The feedback loop allows for communication via Internet between the patients and the healthcare providers. With this means, the patients had frequent interaction with the healthcare providers, receiving patient-specific diabetes education. Recommendations or

changes in medications, frequency of blood glucose testing, modification of lifestyle, and encouragement were also made based on the recent data. At the end of the studies, participants in the intervention groups saw and maintained significant decreases in hgA1c. The researchers concluded that the use of this methodology is effective because timely recommendations appeared to be more effective in managing T2DM in the outpatient setting compared to the face-to-face outpatient or traditional care.

Smart phones/applications. This is the provision of healthcare services using wireless/mobile devices (Parker et al., 2018). The studies using this methodology evaluated the ease of use of smart phone applications to target reduction in hgA1c in the outpatient setting (Fortmann et al., 2017; Orsama et al., 2013). The application allowed for manual entry or automatic transmission of blood sugar readings. Using a decision support system, automatic feedback was generated depending on the readings and responses (Orsama et al., 2013). One of the studies investigated the use and effectiveness of this methodology in an underserved Hispanic population with poor blood glucose control (Fortmann et al., 2017). These researchers noted that in this day of technology where almost everyone has some form of smart phone, this methodology served to increase acessibility to care for this population. With the application on the phone, the patients were able to upload blood sugar readings and other vitals, complete health sessions, receive diabetes education that is evidenced-based, and receive and sent feedback in the form of text messages to their healthcare providers. Istepanian et al. (2014), in their case study of T2DM patients in postwar Iraq, combined this methodology with Internet modality. With an application on their smart phone, participants also

received a wireless glucometer that was paired with the phone. It allowed for daily transmission of readings to a remote server via Internet link. This modality allowed for monitoring of progress of the T2DM patients, added no restrictions to their day to day activites, and increased communication between patients and their healthcare providers. At the conclusion of these studies, the intervention groups all achieved significant decreases in their hgA1c.

Remote monitoring. Remote patient monitoring is the use of technology to collect health data from patients in one location, such as the home, and transmitting the data electronically to healthcare providers in a different location for review and recommendation (Vegesna et al., 2017). A total of four studies used the remote monitoring telehealth intervention, two of the studies (already discussed above) combined its use with other telehealth modalities (Crowley et al., 2016; Nicolucci et al. 2015). Two of the reviewed studies demonstrated the use and effectiveness of remote monitoring telehealth interventions in the management of T2DM to reduce hgA1c (Greenwood, Blozis, Young, Nesbitt, & Quinn, 2015; Warren, Carlisle, Mihala, & Scuffham, 2017). Remote monitoring equipment in the form of a tablet device or hub can be placed in the patient's home; some may have bluetooth compatibility with peripherals such as glucometer, blood pressure device, scale, and so forth. Some had video capability as well and could provide video conferencing with patient and healthcare providers. Just like the rest of the modalities, it also allowed for automatic upload or transmission of the vitals including blood glucose and other data as required. Data received were reviewed by healthcare providers (RNs, pharmacists, and physicians), and evidence-based diabetic

education was provided via daily health sessions. The healthcare providers were available by phone, clinical video, or messages via the remote monitoring equipment for support. At the end of the studies, participants in the intervention groups achieved significant decrease in their hgA1c approximately 0.9% to 1.13% (Greenwood et al., 2015 & Warren et al., 2017), validating the effectiveness of this telehealth intervention.

Clinical video telehealth. CVT is described as real-time two-way video interaction between a patient and a healthcare provider over a distance in setting such as a patient's home and the outpatient clinic, clinic to clinic, or hospital to clinic (Abel et al., 2018). Two of the included studies (Rasmussen, Lauszus, & Loekke, 2016; Threatt & Ward, 2017) examined the use of CVT in the management of T2DM in the oupatient setting with resultant decrease in hgA1c. Diabetes education was provided one-on-one via an online video connection between the healthcare providers and the patients. With each visit, blood glucose readings were reviewed, medication adjustments made if necessary, and self-care goals reviewed for progress or barriers. At the conclusion of the studies, the particpants in the intervention groups achieved significant reduction in their hgA1c compared to the usual care group (Rasmussen et al., 2016; Threatt & Ward, 2017). These studies concluded that even though patients can achieve lowering of their hgA1c, the use of telehealth interventions offers an easy and effective method for managing T2DM in the outpatient setting (Rasmussen et al., 2016).

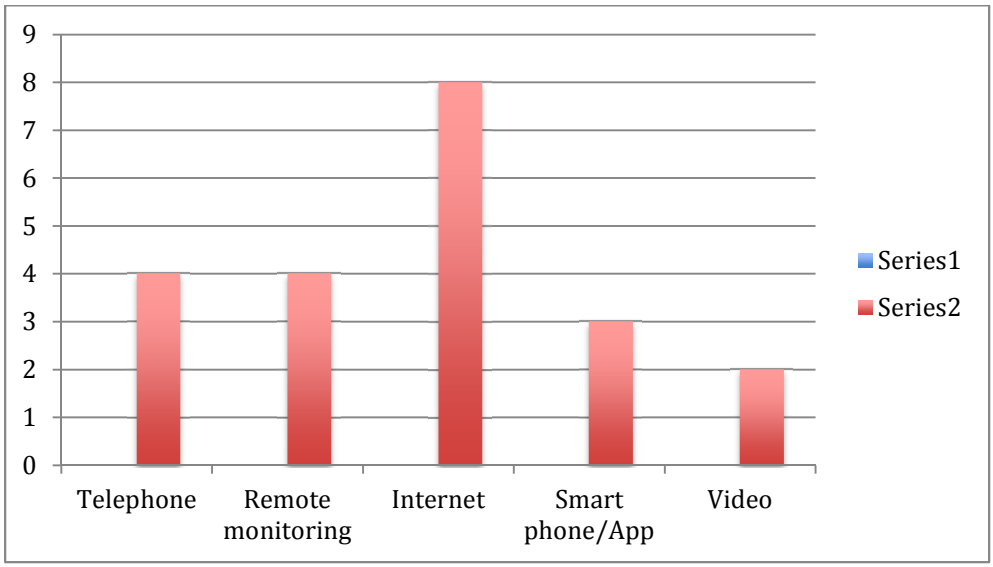


Figure 3: Telehealth interventions in the systematic literature review.

Telehealth interventions are described as being effective in improving the management of chronic illnesses such as diabetes (Coughlin, 2017). This systematic review identified studies that addressed the use of multiple telehealth interventions in the management of T2DM in the outpatient setting. In answering the first project-focused question, this systematic review noted many evidence-based telehealth interventions used in the management of T2DM clients, which included telephonic interventions, Internet-based interventions, remote monitoring, clinical video telehealth, and smart phone/applications. A few themes were noted in all the interventions including the provision of self-management education, monitoring of blood glucose levels, and, most importantly, a feedback loop.

Self-management remains the cornerstone of controlling T2DM, hence the provision of some form of Diabetes Self-Management Education (DSME) in all the studies reviewed (Kempf et al., 2017; Nicolucci et al., 2015; Niemczewski et al., 2016; Warren et al., 2017). Many studies reviewed, indicated that the provision of frequent education and support is crucial to achieving and maintaining glycemic control in T2DM patients. Telehealth interventions can be used to provide structured diabetes education and support to T2DM patients in the outpatient setting compared to frequent face-to-face outpatient visits. Another element that proved crucial to the success of the studies is the feedback loop. This feedback loop has been determined to maintain communication between clients and their telehealth providers, providing the support needed for successful management of T2DM (Cho et al., 2017; Greenwood et al., 2015; Lim et al., 2015; Niemczewski et al., Orsama et al., 2013; 2016; Rasmussen et al., 2016; Wang et al., 2017).

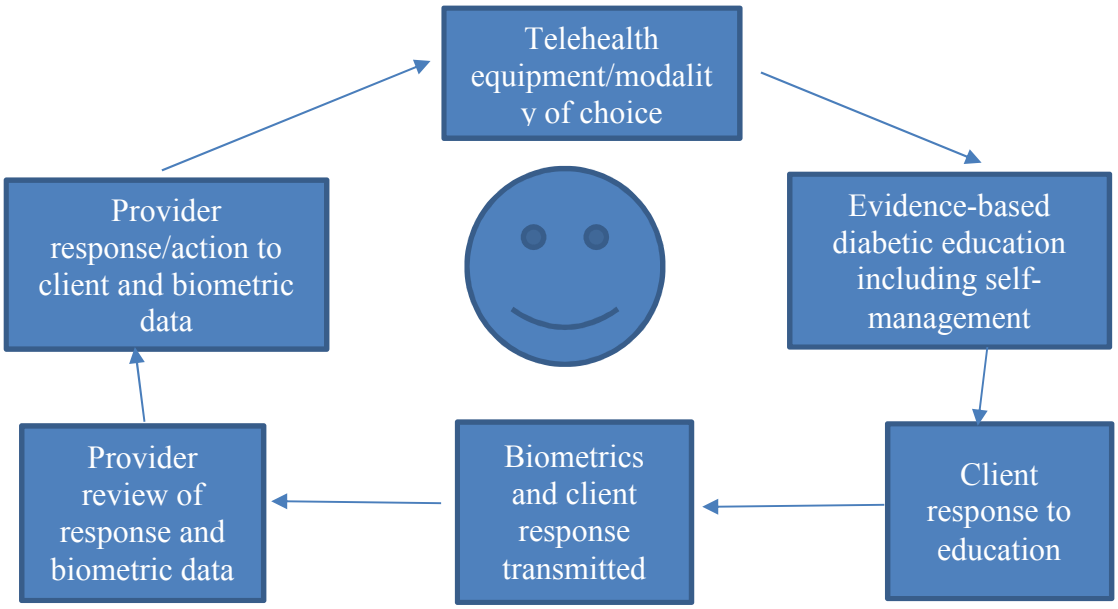


Figure 4: Sample feedback loop in telehealth management of diabetes. Developed by B. Ikpeama.

The second practice-focused question sought information on how telehealth interventions rank in effectiveness. This question was answered using the JBI level of evidence for effectiveness as seen in Table 3 below.

Table 2

Levels of Evidence for Effectiveness

Levels of Evidence	Number of Articles
Level 1.a – Systematic review of RCTs	
Level1.b – Systematic review of RCTs and other study designs	
Level 1.c - RCT	15
Level 1.d – Pseudo-RCTs	
Level 2.a – Systematic review of quasi-experimental studies	
Level 2.b – systematic review of quasi-experimental and other lower study designs	
Level 2.c – Quasi-experimental prospectively controlled study	1
Level 2.d – Pretest or historic/retrospective control group study	

Level 3.a – Systematic review of comparable cohort studies	
Level 3.b systematic review of comparable cohort and other lower study designs	
Level 3.c – Cohort study with control group	1
Level 3.d Case controlled study	
Level 3.e – Observational study without control group	
Level 4.a Systematic review of descriptive studies	
Level 4.b – Cross-sectional studies	
Level 4.c – Case series	
Level 4.d – Case study	1
Level 5.a – Systematic review of expert opinion	
Level 5.b – Expert consensus	
Level 5.c – Bench research/single expert opinion	

Adapted with permission from: Joanna Briggs Institute (2013). New JBI levels of evidence and grades of recommendation working party 2013. Retrieved from http://joannabriggs.org/assets/docs/approach/JBI-Levels-of-evidence_2014.pdf

JBI level of evidence, when asking a clinical question can provide information on the appropriate study design to search for, providing a ranking based on the available best evidence (JBI, 2014). The majority of the studies included in this systematic review used most of all the telehealth interventions with rankings higher up on the JBI's level of evidence (level 1c). Therefore, this systematic review concludes that none of the interventions are more superior than the other. Hence, any of the telehealth interventions mentioned above can be effective in managing T2DM in the outpatient setting, but consideration must be given to the setting and population before making a choice. Table 4 below lists advantages and possible disadvantages of the telehealth interventions discussed.

Table 3

Advantages and Disadvantages of Each Discussed Telehealth Intervention

Telehealth Interventions	Advantages	Disadvantages

Telephone	-Increased access to care, -can be used to address service underutilization, -less expensive, -decrease use of primary and emergency care, -increased patient satisfaction as a result of receiving care without over burdening health care providers.	-Some patients may be less invested and treat as a social call (though can be mitigated by maintaining structure and regularity). -Patients may miss calls, difficulty providing care over the phone if patient in crisis -risk of privacy violation (can be mitigated by having patient answer calls in a secure room).
Internet-Based	-done from comfort of the home -automatic feedback using the CDSS -graphical representation of data can be viewed by both patient and health care provider -access to 'just in time' education regarding diabetes self-management -improved access to evidence-based care -cost effective compared to usual care -may receive help faster from healthcare provider before the development of crisis	-Need to have internet connection at home -be able to navigate the internet -privacy and security issues as with evolving technology
Clinical Video	-Increases access to care -real time or live video conferencing between patient and healthcare provider -allows for assessment and strategizing of patient care without being in the same room	-patient and caregiver must be capable of using provided or existing equipment to complete visits -privacy and security issues as with evolving technology
Remote Monitoring	-Transmit data in real time to healthcare providers	- privacy and security issues as with evolving technology

	-improves quality of life for chronically ill patient by allowing them to spend more time at home and still be followed by their healthcare providers -cost effective due to reducing frequent face-to-face visits	- deployment is sometimes based on extensive wireless telecommunications infrastructure which may not be available in rural areas
Smart Phones/Applications	- increases access to care - can be used anywhere and any time - reduces traveling or physical presence of patients in remote areas into urban areas for health care - can be used in underserved or underinsured population	- factors related to the telecommunication industry such as sustainability of connections, service interruption of network service, energy consumption or efficiency of the device - threats to privacy and confidentiality

Nursing Roles

The Institute of Medicine recommended that nurses expand their roles in healthcare, incorporate and master the use of information technology to improve inter-professional relationships and improve coordination of care (IOM, 2011). Nurses are quite often the frontline healthcare providers in the community, positioning them to support all aspects of telehealth in the continuum (Fathi, Modin & Scott, 2017). Nurses are in the forefront of providing DSME/S to T2DM patients, and can use telehealth equipment to coach and monitor progress of self-care. Telehealth interventions provide the perfect opportunities for nurses in collaboration with other disciplines, to provide care in the outpatient setting for T2DM patients to decrease health disparities and improve outcomes such as hgA1c.

Relationship to Models

The telehealth interventions are in congruent with the components of the Chronic Care and TECH Models guiding this DNP project. The results of this literature review have shown the positive impact of telehealth interventions in the management of chronic diseases such as T2DM. The telehealth interventions all provided diabetes education, feedback, collaboration with patient and healthcare providers, including multidisciplinary teams. These and more components played major roles in improving health outcomes in T2DM participants in the studies reviewed. Below is Table 4 detailing telehealth interventions relationship to these models.

Table 4

Relationship of Models to Telehealth Interventions

Chronic care model	TECH model	Telehealth interventions
Organizing healthcare – making resources available and minimizing barriers	Effective partnership between providers; providers and patients	Integration can help reduce the ever-increasing burden of primary care providers (Fortmann et al., 2017)
Self-management support – providing patients with education and empowerment	Includes subcomponents of self-management and treatment optimization	Able to provide personalized self-management education (Kempf et al., 2017; Tang et al., 2013)
Decision support – providing guidance for evidence-based practice		Most interventions have a decision support system that triggers certain feedback based on the uploaded data (Lim et al., 2016)
Delivery system design – coordinating care processes	Engaging providers and patients; Care coordination for effective management	Allows for real time feedback loop enhancing communication between patients and healthcare staff (Nicolucci et al.,

		2015); Orsama et al., 2013)
Clinical information systems – tracking progress and reporting outcomes		Most systems have the ability to track and report glycemic readings for outcomes (Greenwood et al., 2015)
Community resources – using community-based resources to sustain care	Takes into consideration patient, health system and social contexts	Interventions can be chosen to match patient's skills and ease of use. Can also be used to address some health disparities (Crowlet et al., 2016; Kim et al., 201; Threatt & Ward, 2017; Istapanian et al., 2014)

Implications for Practice

This systematic literature review served to provide evidence of the effectiveness of telehealth in managing T2DM in the outpatient setting. At the community and institution levels, the implication of this project is such that adding to the knowledge base of healthcare providers regarding use of telehealth in T2DM management will assist them in effectively managing their patients with T2DM. When healthcare providers or health systems implement these evidence-based telehealth interventions in the management of T2DM patients, it increases access to care, engages patients to participate and learn self-management skills, thereby improving their health outcomes. Reports indicate that only 50% of patients with T2DM patients are reaching the goal of hgA1c less than 7.0% (ADA, 2018c). Implementing and using telehealth interventions can improve these numbers and improve health outcomes for patients with T2DM.

Implications for Social Change

Implications of this systematic literature review support the implementation or integration of telehealth interventions in the management of T2DM in the outpatient setting. Diabetes is a global health problem, and in the U. S. alone, the medical expenditure of diabetes is overwhelming (Olson et al, 2015). The results of this doctorate level project indicate that telehealth interventions can be implemented in urban areas, rural areas, to care for underserved or underinsured population with T2DM. This project also shows that telehealth interventions can increase access to care potentially reducing health disparities and improve care locally, nationally and internationally.

Recommendations

The findings of this systematic review indicate that the integration of telehealth interventions in the management of T2DM in the outpatient setting are promising in meeting the needs of these clients. According to the United Kingdom Prospective Diabetes Study (UKPDS), hgA1c remains the golden standard of controlling blood glucose in the long term (Zhou et al., 2014). Significantly reducing the number of face-to-face visits means a significant saving of time and community resources, helping the already over-burdened primary care providers to still oversee the care of their patients from a distance. Further research is needed on the sustenance of decreases in hgA1c for periods exceeding 12 months in T2DM patients managed with telehealth interventions.

Contributions of the Doctoral Project Team

The doctoral project consisted mainly of the DNP student, a doctorate-prepared second reviewer, the project chair and committee members. The second reviewer

provided increased rigor to the systematic literature review by providing valuable insight into the analysis and synthesis of the articles. The project chair provided guidance and support, ensuring that the project was completed to meet the committee's approval, and Walden University Institutional Review Board's standards.

Strength and Limitations of the Project

The strength of this project was in reviewing the first account of studies involved in the use of telehealth as an intervention of choice in the management of T2DM. Perhaps including systematic reviews of RCTs would have increased the number of articles included in this project. Nonetheless the original studies reviewed provided credibility and rigor to this systematic review. One of the limitations of this study was the limiting of hgA1c as the only principal outcome measure. Inclusion of other metrics such as blood pressure, weight and low-density lipoprotein (LDL), are also important in the management of T2DM patients. Patient satisfaction and cost effectiveness of the interventions were not reviewed by this systematic literature review.

Section 5: Dissemination Plan

Introduction

Any research study is not complete without the dissemination of the study findings through the means of professional forum presentations or publishing in a peer-reviewed journal to circulate them anywhere that the research findings can be translated into clinical practice (Curtis, Fry, Shaban & Considine, 2016). For this DNP study, plans for dissemination include submitting to ProQuest as part of the requirement for completion of the Doctor of Nursing Practice at Walden University. I also plan to reach out to various professional organizations such as Sigma Theta Tau and American Nursing Informatics Association in an effort to disseminate this project's findings. I plan to also reach out to peer-reviewed journals such as *Journal of Telehealth and Telecare and Journal of Clinical Nursing Practice,* for a broader audience. I will also reach out to the evidence-based practice team at my place of employment for assistance in disseminating the project findings because even though telehealth is practiced at the site, it is not being used at its full potential.

Analysis of Self

Completing this systematic literature review afforded me the opportunity to put into practice the methods and principles learned throughout my time at Walden University. Performing this review was very labor-intensive requiring hours of searching databases for appropriate research articles, reading the articles, extracting data, appraising, synthesizing, and developing tables and charts to keep data organized. I have come to understand and appreciate the rigor that is involved in conducting research

studies, making sure that it is appropriate for use in clinical practice. Though I faced some challenges such as permission not being granted for completion of the project at a practicum site, I persevered, understanding that there is always the possibility of challenges in every project; finding ways or having contingency plans are essential in completing projects. The valuable skills, insights, and lessons learned gained from completing this systematic literature review will assist me to perform research studies in the future to enhance evidence-based practice and in my plan to teach and mentor nursing students.

Summary

With this systematic literature review I analyzed, synthesized, and presented the current evidence regarding the impact of telehealth in the management of T2DM in the outpatient setting. This study contributes to evidence-base practice by providing important information to further educate healthcare professionals on the many benefits of integrating telehealth interventions in the management of patients with T2DM. This project also brought to light the many telehealth interventions available to healthcare professionals to apply in the effort to improve the health outcomes of patients with T2DM by reducing the hemoglobin A1c.

References

Abel, E. A., Shimada. S. L., Wang. K., Ramsey, C., Skanderson, M., Erdos, J., . . . Brandt, C. A. (2018). Dual use of a patient portal and clinical video telehealth by veterans with mental health diagnoses: Retrospective, cross-sectional analysis. *Journal of Medical Internet Research, 20*(11), e11350. doi: 10.2196/11350

Agency for Healthcare Research and Quality (2016). Telehealth: Mapping the evidence for patient outcomes from systematic reviews. Retrieved from https://effectivehealthcare.ahrq.gov/topics/telehealth/technical-brief/

Agency for Healthcare Research and Quality (2018). Care coordination. Retrieved from http://www.ahrq.gov/professionals/prevention-chronic-care/improve/coordination/index.html

American Association of Colleges of Nursing. (2006). *The essentials of doctoral education for advanced nursing practice.* Washington, DC: Author. Retrieved from http://www.aacn.nche.edu/dnp/Essentials.pdf

American Diabetes Association (2017). Statistics about diabetes. Retrieved from http://www.diabetes.org/diabetes-basics/statistics/

American Diabetes Association (2018a). Diabetes basics. Retrieved from https://www.diabetes.orgpro

American Diabetes Association (2018b). Economic costs of diabetes in the U.S. in 2017. *Diabetes Care, 41,* 917-928. doi: 10.2337/dci18-0007

American Diabetes Association (2018c). Standards of medical care in diabetes. *Diabetes Care, 41*(1), S1-S159.

Bagnasco, A., Di Giacomo, P., Da Rin Della Mora, R., Catania, G., Turci, C., Rocco, G., & Sasso, L. (2014). Factors influencing self-management in patients with type 2 diabetes: a quantitative systematic review protocol. *Journal of Advanced Nursing, 70*(1), 187-200. doi: 10.1111/jan.12178

Andersson, G., & Titov, N, (2014). Advantages and limitations of internet-based interventions for common mental disorders. *World Psychiatry, 13*(1), 4-11. doi:10.1002/wps.20083

Baptista, D. R., Wiens, A., Pontarolo, R., Regis, L., Torelli Reis, W. C., & Correr, C. J. (2016). The chronic care model for type 2 diabetes: a systematic review. *Diabetology & Metabolic Syndrome, 8*(7). doi:10.1186/s13098-015-0119-z

Burchard, A. & Sadarangani, T. (2014). Telehealth as an alternative to traditional, in-person diabetes self-management support. *Journal of Clinical Outcomes Management, 21*(11). Retrieved from https://www.mdedge.com/jcomjournal/article/147027/diabetes/telehealth-alternative-traditional-person-diabetes-self

Burke, S. D., Sherr, D., & Lipman, R. D. (2014). Partnering with diabetes educators to improve patient outcomes. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*, *7*, 45-53. doi:10.2147/DMSO.S40036

Centers for Disease Control and Prevention (2016). Managing diabetes. Retrieved from https://www.cdc.gov/diabetes/home/index.html.

Cho, J. H, Kim, H. S., Yoo, S. H., Jung, C. H., Lee, W. J., Park, C. Y. . . . Yoon, K. H. (2017). An Internet-based health gateway device for interactive communication

and automatic data uploading: clinical efficacy for type 2 diabetes in a multi-centre trial. *Journal of Telemedicine and Telecare 23*:595–604. doi:10.1177/1357633X16657500

Committee on the Robert Wood Johnson Foundation Initiative on the Future of Nursing, at the Institute of Medicine (2011). *The future of nursing: Leading Change, advancing health.* Washington, DC: National Academies Press. doi:10.17226/12956

Corry, M., Smith, V., Neenan, K., & Brabyn, S. (2017). Telephone interventions, delivered by healthcare professionals, for educating and psychosocially informal caregivers of adults with diagnosed illnesses (Protocol). *Cochrane Database of Systematic Reviews, 1*. doi:10.1002/14651858.CD012533.

Coughlin, S. S. (2017). Mobile technology for self-monitoring of blood glucose among patients with type 2 diabetes mellitus. *mHealth*, *3*, 47. doi:10.21037/mhealth.2017.10.03

Crowley, M. J., Edelman, D., McAndrew, A. T., Kistler, S., Danus, S., Webb, J. A., . . . Bosworth, H. B. (2016). Practical Telemedicine for Veterans with Persistently Poor Diabetes Control: A Randomized Pilot Trial. *Telemedicine Journal And E-Health: The Official Journal of The American Telemedicine Association*, *22*(5), 376–384. doi:10.1089/tmj.2015.0145

Cund, A. (2018). The nurse's role in efficiently using telecare. *Nursing & Residential Care, 20*(10). doi:10.12968/nrec.2018.20.10.490

Curtis, K., Fry, M., Shaban, R. Z., & Considine, J. (2016). Translating research findings to clinical nursing practice. *Journal of Clinical Nursing, 26,* 862-872. doi:10.1111/jocn.13586

Fineout-Overholt, E., Melnyk, B., Stillwell, S., & Williamson, K. (2010). Evidence-based practice step by step: Critical appraisal of the evidence: Part 1: An introduction to gathering, evaluating, and recording the evidence. *American Journal of Nursing, 110*(7), 47-52./doi10.1097/01.naj.0000383935.22721.9c

Fathi, J.T., Modin, H.E., Scott, J.D. (2017). Nurses advancing telehealth services in the era of healthcare reform. *Online Journal of Issues in Nursing*, *22,* (2).

Fortmann, A. L., Gallo, L. C., Garcia, M. I., Taleb, M., Euyogue, J. A., Clark, T., . . . Philis-Tsimikas, A. (2017). Dulce digital: an mHealth SMS-based intervention improves glycemic control in Hispanics with Type 2 diabetes. *Diabetes Care 40*(10):1349–1355. doi:10.2337/dc17-0230

Gervera, K., & Graves, B. A. (2015). Integrating diabetes guidelines into a telehealth screening tool. *Perspectives in Health Information Management, 12*(Summer), 1-14. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4558483/

Godfrey, C. M. & Harrison, M. B. (2015). The Joanna Briggs Institute methodology for systematic review research quick reference guide. The Joanna Briggs Institute: Adelaide, Australia. Retrieved from http://joannabriggs.org/assets/docs/jbc/operations/can-synthesise/CAN_SYNTHSISE_Resource-V4.pdf

Grady, P. A., & Gough, L. L. (2014). Self-Management: A Comprehensive Approach to Management of Chronic Conditions. *American Journal of Public Health*, *104*(8), e25–e31.

Greenwood, D. A., Blozis, S. A., Young, H. M., Nesbitt, T. S., & Quinn, C. C. (2015). Overcoming clinical inertia: A randomized clinical trial of a telehealth remote monitoring intervention using paired glucose testing in adults with type 2 diabetes. *Journal of Medical Internet Research*, *17*(7), e178–e178. doi:10.2196/jmir.4112

Healthy People 2020 (2018). Diabetes. Retrieved from https://www.healthypeople.gov/2020/topics-objectives/topic/diabetes

Health Resources and Services Administration (2015). Federal office of rural health policy. Retrieved from https://www.hrsa.gov/ruralhealth/telehealth.

Heron, M. (2018). Deaths: leading causes for 2016. *National Vital Statistics Report, 67*(6), 1-77.

Holly, C., Salmond, S., & Saimbert, M. (2017). *Comprehensive systematic review for advanced practice nursing.* New York, NY: Springer Publishing Company.

Istepanian, R. S. H., Mousa, A., Haddad, N., Sungoor, A., Hammadan, T., Soran, H., & Al Anzi, T. (2014). The potential of m-health systems for diabetes management in post conflict regions a case study from Iraq. *36th Annual Conference of the IEEE Engineering in Medicine and Biology Society,* 3650–3653. doi:10.1109/EMBC.2014.6944414

Joanna Briggs Institute (2018). The JBI approach. Retrieved from http://joannabriggs.org/jbi-approach.html

Kalankesh, L. R., Pourasghar, F., Nicholson, L., Ahmadi, S., & Hosseini, M. (2016). Effect of Telehealth Interventions on Hospitalization Indicators: A Systematic Review. *Perspectives in Health Information Management*, *13*(Fall), 1h.

Kempf, K., Altpeter, B., Berger, J., Reuss, O., Fuchs, M., Schneider, M., Gartner, B., Niedermeier, K., & Martin, S. (2017). Efficacy of the Telemedical Lifestyle Intervention Program TeLiPro in advanced stages of type 2 diabetes: A randomized controlled trial. *Diabetes Care 40*, 863–871. doi:10.2337/dc17-0303

Kim, H. S., Sun. C., Yang. S. J., Sun, L., Li, F., Choi, I. Y., . . . Yoon, K. H. (2016). Randomized, open-label, parallel group study to evaluate the effect of internet-based glucose management system on subjects with diabetes in China. *Telemedine and e-Health 22*: 666–674. doi:10.1089/tmj.2015.0170

Koivunen, M. & Saranto, K. (2018). Nursing professionals' experiences of the facilitators and barriers to the use of telehealth applications: a systematic review of qualitative studies. *Scandinavian Journal of Caring Sciences, 32*, 24-44. doi:101111/scs.12445

Kruse, C. S., Karem, P., Shifflett, K., Vegi, L., Ravi, K., & Brooks, M. (2016). Evaluating barriers to adopting telemedicine worldwide: A systematic review. *Journal of Telemedicine and Telecare, 24*(1), 4-12. doi:10.1177/1357633x16674087

Lee, S., Chan, C., Chua, S. & Chaiyakunapruk, N. (2017). Comparative effectiveness of telemedicine strategies on type 2 diabetes management: A systematic review and network met-analysis. *Scientific Reports, 7,* 12680. doi:10.1038/s41598-01712987-z

Lee, P. A., Greenfield, G., & Pappas, Y. (2018). The impact of telehealth remote patient Monitoring on glycemic control in type 2 diabetes: a systematic review and meta-analysis of systematic reviews of randomized controlled trials. *BMC Health services Research, 18*(1), 495. doi:10.1186/s12913-018-3274-8

Lim, S., Kang, S. M., Kim, K. M., Moon, J. H., Choi, S. H., Hwang, H., . . . Jang, H. C. (2016). Multifactorial intervention in diabetes care using real-time monitoring and tailored feedback in type 2 diabetes. *Acta Diabetol, 53*(2):189–198. doi:10.1007/s00592-015-0754-8

Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009) Preferred reporting items for systematic reviews and meta-analyses: The PRISMA Statement. *Annuals of Internal Medicine, 151*(4), 264-270.

Nicolucci, A., Cercone, S., Chiriatti, A., Muscas, F., & Gensini, G. (2015). A Randomized Trial on Home Telemonitoring for the Management of Metabolic and Cardiovascular Risk in Patients with Type 2 Diabetes. *Diabetes Technology & Therapeutics*, *17*(8), 563–570.

Niemczewski, J., Polivka, & Clark, P. (2016). Evaluating an outpatient diabetes program telephone follow-up process on glycosylated hemoglobin levels. *Journal of Doctoral Nursing Practice*, *9*(2), 199–216. doi:10.1891/2380-9418Th2.199

Nundy, S., Dick, J. J., Chou, C. H., Nocon, R. S., Chin, M. H., & Peek, M. E. (2014). Mobile phone diabetes project led to improved glycemic control and net savings for Chicago plan participants. *Health Affairs, 33*(2), 265 – 272. doi:10.1377/hlthaff.2013.0589

Odnoletkova, I., Goderis, G, Nobels, F., Fieuws, S., Aertgeerts, B., Annemans, L. & Ramaekers, D. (2016). Optimizing diabetes control in people with Type diabetes through nurse-led telecoaching. *Diabetic Medicine*, *33*(6), 777–785. doi:10.1111/dme.13092

Olson, D. E, Zhu, M., Long, Q., Barb, D., Haw, J. S., Rhee, M. K., . . . Phillips, L. S. (2015). Increased cardiovascular disease, resource use, and costs before the clinical diagnosis of diabetes on veterans in the southeastern U.S. *Journal of General Internal Medicine, 30*(6), 749-757. doi:10.1007/s11606-014-3075-7

Orsama, A. L., Lähteenmäki, J., Harno, K., Kulju, M., Wintergerst, E., Schachner, H., . . . Fisher, W. A. (2013). Active assistance technology reduces glycosylated hemoglobin and weight in individuals with type 2 diabetes: Results of a theory-based randomized trial. *Diabetes Technology &Therapeutics,15*(8), 662–669. doi:10.1089/ dia.2013.0056.

Parker, S., Prince, A., Thomas, L., Song, H., Milosevic, D., & Harris, M. F. (2018). Electronic, mobile and telehealth tools for vulnerable patients with chronic disease: A systematic review and realist synthesis. *BMJ open*, *8*(8), e019192. doi:10.1136/bmjopen-2017-019192

Peters, M. D., Godfrey, C.M., Khalil, H., McInerney, P., Parker. D., & Soares, C. B. (2015). Guidance for conducting systematic scoping reviews. *International Journal of Evidence-Based Healthcare. 13*(3):141–6.

Rasmussen, O. W., Lauszus, F. F., & Loekke, M. (2016). Telemedicine compared withstandard care in type 2 diabetes mellitus: A randomized trial in an outpatient clinic. *Journal of Telemedicine and Telecare*, *22*(6), 363–368. doi:10.1177/1357633X15608984

Salisbury, C., Thomas, C., O'Cathain, A., Rogers, A., Pope, C., Yardley, L., . . . Montgomery, A. (2015). TElehealth in CHronic disease: Mixed-methods study to develop the TECH conceptual model for intervention design and evaluation. *BMJ Open, 5*, e006448. doi:10.1136/bmjopen-2014-006448

So, C. F., & Chung, J. W. (2017). Telehealth for diabetic self-management in primary healthcare: A systematic review and meta-analysis. *Journal of Telemedicine and Telecare, 24*(5), 356-364. doi:10.1177/1357633x17700552

Stellefson, M., Dipnarine, K., & Stopka, C. (2013). The chronic care model and diabetes management in US primary care settings: A systematic review. *Preventing Chronic Disease, 10*, 120180. doi:10.5888/pcd10.120180

Steventon, A., Bardsley, M., Doll, H., Tuckey, E., & Newman, S. P. (2014). Effect of telehealth on glycaemic control: analysis of patients with type 2 diabetes in the whole systems demonstrator cluster randomized trial. *BioMed Central Health Services Research, 14*(334). doi:10.1186/1472-6963-14-334

Tang, P. C., Overhage, J. M., Chan, A. S., Brown, N. L., Aghighi, B., Entwistle, M. P., . . . Young, C. Y. (2013). Online disease management of diabetes: engaging and motivating patients online with enhanced resources-diabetes (EMPOWER-D), a randomized controlled trial. *Journal of the American Medical Informatics Association*, *20*(3), 526–534. doi:10.1136/amiajnl-2012-001263

Taylor, J. & Coates, L. (2015). Caring from a distance: the role of telehealth. *Nursing Times, 111*(28/29), 18-20.

The Joanna Briggs Institute (2014). The Joanna Briggs Institute Levels of Evidence and Grades of Recommendation Working Party. Supporting Document for the Joanna Briggs Institute Levels of Evidence and Grades of Recommendation. Retrieved from http://joannabriggs.org/assets/docs/approach/Levels-of-Evidence SupportingDocuments-v2.pdf

Threatt, T. B., & Ward, E. D. (2017). Telehealth for diabetes self-management education and support in an underserved, free clinic population: A pilot study. *Journal of the American Pharmacists Association*, *57*(3), 402–406. doi:10.1016/j.japh.2017.01.019

Tuckson, R. V., Edmunds, M., & Hodgkins, M. L. (2017). Telehealth. *New England Journal of Medicine, 377*(16), 1585-1592. doi:10.1056/NEJMsr1503323

Van Dyk, L. (2014). A review of telehealth service implementation frameworks. *International Journal of Environmental Research and Public Health, 11,* 1279-1298. doi:10.3390/ijerph110201279

Vegesna, A., Tran, M., Angelaccio, M., & Arcona, S. (2017). Remote patient monitoring via non-invasive digital technologies: A systematic review. *Telemedicine and e-Health*, *23*(1), 3-17. doi:10.1089/tmj.2016.0051

Wagner, E. H. (1998). Chronic disease management: what will it take to improve care for chronic illness? *Effective Clinical Practice, 1*(1), 2-4.

Wang, G., Zhang, Z., Feng, Y., Sun, L., Xiao, X., Wang, G., . . . Sun, C. (2017). Telemedicine in the Management of Type 2 Diabetes Mellitus. *American Journal of the Medical Sciences*, *353*(1), 1–5. doi:10.1016/j.amjms.2016.10.008

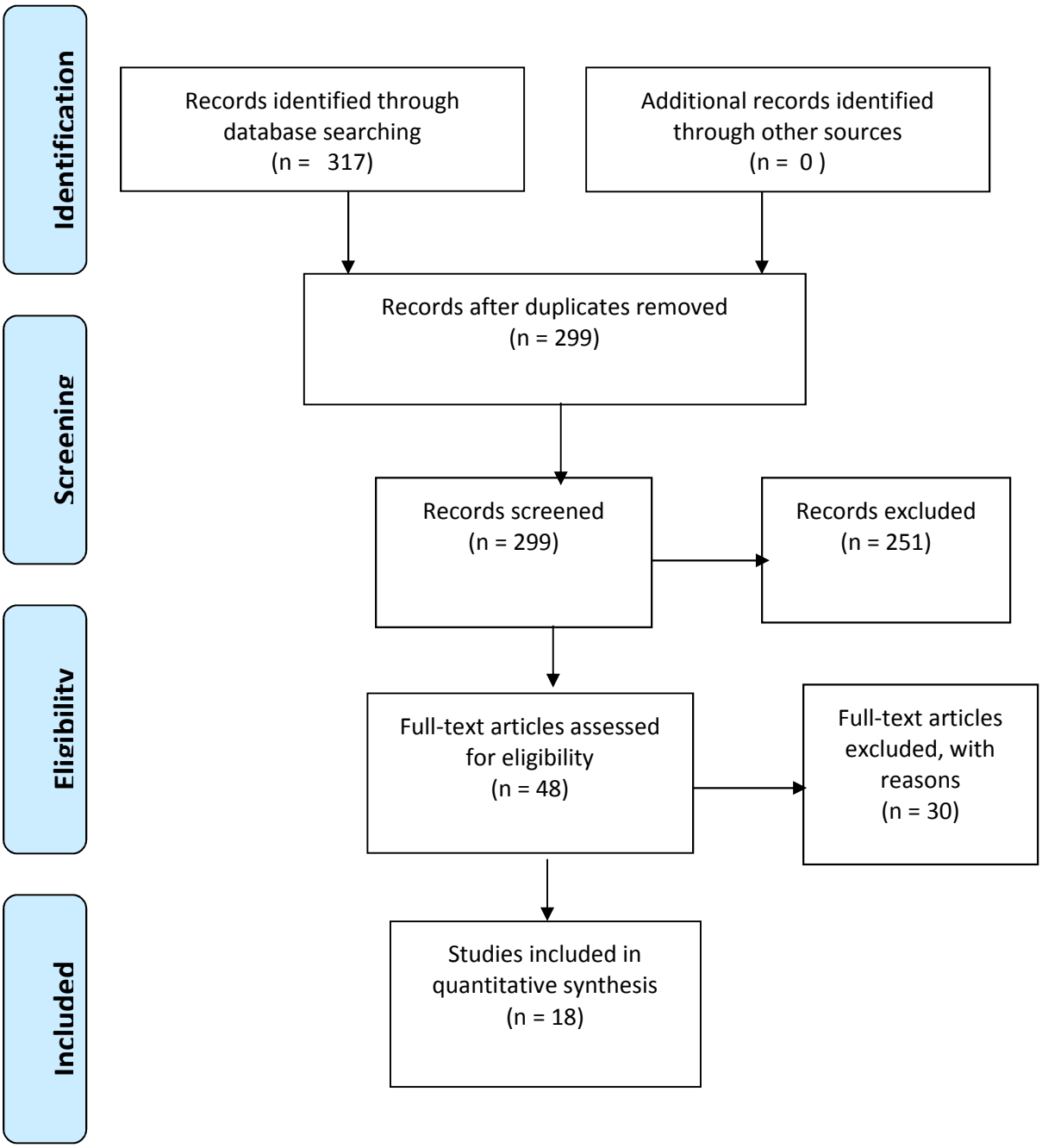
Warren, R., Carlisle, K., Mihala, G., & Scuffham, P. A. (2018). Effects of telemonitoring on glycaemic control and healthcare costs in type 2 diabetes: A randomised controlled trial. *Journal Of Telemedicine And Telecare*, *24*(9), 586–595. doi:10.1177/1357633X17723943

World Health Organization (1998). A health telematics policy in support of WHO's health-for-all strategy for global health development: report of the WHO group consultation on health telematics 11–16 December, Geneva, 1997.

Xiang, R., Li, L., & Liu, S. (2013). Meta-analysis and meta-regression of telehealth programmes for patients with chronic heart failure. *Journal of Telemedicine and Telecare, 19*(5), 249-259. doi:10.1177/1357633x13495490

Zhou, P., Xu, L., Liu, X., Huang, J., Xn, & Wanping, X. (2014). Web-based telemedicine for management of type 2 diabetes through glucose uploads: A randomized controlled trial. *International Journal of Clinical and Experimental Pathology, 7*: 8848–8854.

Appendix A: A Preferred Reporting Items for Systematic Reviews and Meta-Analyses Flow Diagram



Appendix B: Joanna Briggs Institute Data Extraction Form for Experimental/Observational Studies

JBI Data Extraction Form for Experimental / Observational Studies

Reviewer _____ Date _____

Author _____ Year _____

Journal _____ Record Number _____

Study Method

RCT	☐	Quasi-RCT	☐	Longitudinal	☐
Retrospective	☐	Observational	☐	Other	☐

Participants

Setting _____

Population _____

Sample size

Group A _____ Group B _____

Interventions

Intervention A _____

_____

Intervention B _____

_____

Authors Conclusions:

_____

_____

_____

Reviewers Conclusions:

_____

_____

_____

Appendix C: Joanna Briggs Institute Critical Appraisal Checklist for Randomized Controlled Trials

JBI Critical Appraisal Checklist for Randomized Controlled Trials

Reviewer_____Date_____

Author _____Year_____Record Number_____

		Yes	No	Unclear	NA
1.	Was true randomization used for assignment of participants to treatment groups?	☐	☐	☐	☐
2.	Was allocation to treatment groups concealed?	☐	☐	☐	☐
3.	Were treatment groups similar at the baseline?	☐	☐	☐	☐
4.	Were participants blind to treatment assignment?	☐	☐	☐	☐
5.	Were those delivering treatment blind to treatment assignment?	☐	☐	☐	☐
6.	Were outcomes assessors blind to treatment assignment?	☐	☐	☐	☐
7.	Were treatment groups treated identically other than the intervention of interest?	☐	☐	☐	☐
8.	Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	☐	☐	☐	☐
9.	Were participants analyzed in the groups to which they were randomized?	☐	☐	☐	☐
10.	Were outcomes measured in the same way for treatment groups?	☐	☐	☐	☐
11.	Were outcomes measured in a reliable way?	☐	☐	☐	☐
12.	Was appropriate statistical analysis used?	☐	☐	☐	☐
13.	Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

_____

_____

_____

Appendix D: Joanna Briggs Institute Critical Appraisal Checklist for Quasi-Experimental Studies

JBI Critical Appraisal Checklist for Quasi-Experimental Studies (non-randomized experimental studies)

Reviewer_____Date_____

Author _____Year_____Record Number_____

	Yes	No	Unclear	Not applicable
14. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	☐	☐	☐	☐
15. Were the participants included in any comparisons similar?	☐	☐	☐	☐
16. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	☐	☐	☐	☐
17. Was there a control group?	☐	☐	☐	☐
18. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	☐	☐	☐	☐
19. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	☐	☐	☐	☐
20. Were the outcomes of participants included in any comparisons measured in the same way?	☐	☐	☐	☐
21. Were outcomes measured in a reliable way?	☐	☐	☐	☐
22. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

_____

Appendix E: Joanna Briggs Institute Critical Appraisal Checklist for Case Control Studies

JBI Critical Appraisal Checklist for Case Control Studies

Reviewer_____Date_____

Author _____Year_____Record Number_____

	Yes	No	Unclear	Not applicable
23. Were the groups comparable other than the presence of disease in cases or the absence of disease in controls?	☐	☐	☐	☐
24. Were cases and controls matched appropriately?	☐	☐	☐	☐
25. Were the same criteria used for identification of cases and controls?	☐	☐	☐	☐
26. Was exposure measured in a standard, valid and reliable way?	☐	☐	☐	☐
27. Was exposure measured in the same way for cases and controls?	☐	☐	☐	☐
28. Were confounding factors identified?	☐	☐	☐	☐
29. Were strategies to deal with confounding factors stated?	☐	☐	☐	☐
30. Were outcomes assessed in a standard, valid and reliable way for cases and controls?	☐	☐	☐	☐
31. Was the exposure period of interest long enough to be meaningful?	☐	☐	☐	☐
32. Was appropriate statistical analysis used?	☐	☐	☐	☐

Overall appraisal: Include ☐ Exclude ☐ Seek further info ☐

Comments (Including reason for exclusion)

_____

_____

_____

Appendix F: Copyright Permission for Chronic Care Model

Step 3: Order Confirmation

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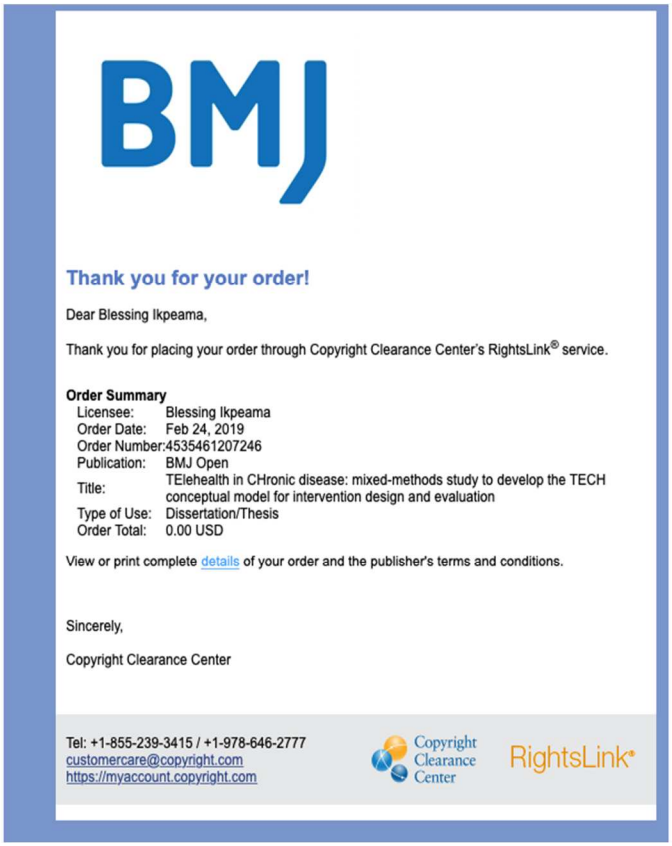
Appendix G: Copyright Permission for the TElehealth in CHronic Disease Model



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Appendix H: Copyright Permission for Joanna Briggs Institute Tools

Dear Blessing,

Thanks for your email and interest in our tools and levels of evidence.

Yes, you are able to use the JBI critical appraisal & data extraction tools for your capstone project. We simply ask that you cite them accordingly.

Each critical appraisal tool has information on how to cite it within the guidance in each tool download at http://joannabriggs.org/research/critical-appraisal-tools.html

The data extraction form as available through JBI SUMARI (https://www.jbisumari.org/) – our online software that can be used for conducting reviews. I am unsure if your organization has access to the software. Please let me know if you don't and I can send you the word document of the form.

The JBI Levels of Evidence are available at http://joannabriggs.org/jbi-approach.html#tabbed-nav=Levels-of-Evidence however we usually uses Grades of Recommendations in regards to systematic reviews. More information can be found at http://joannabriggs.org/assets/docs/approach/Levels-of-Evidence-SupportingDocuments-v2.pdf

Kind regards
Cindy

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Appendix I: Literature Matrix of Included Literature

Authors/Year	Aim/Study Objectives	Methodology	Telehealth Interventions/ Modalities	Analysis & Results	Level of Evidence
Nicolucci, A., Cercone, S., Chiratti, A., Muscas, F., & Gensini, G. (2015).	Using of a remote educational telehealth system in improving glycemic control and cardiovascular risk profile in patients with T2DM	Randomized control trial	Home telehealth using remote monitoring equipment and Telephone	Over a period of 12 months, the use of this intervention method was associated with significant reduction in the average hgA1c levels compared to the control group.	1c
Orsama et al. (2013)	Evaluation of a mobile telephone-based remote patient monitoring system	Randomized control trial	Smart phone/ Application	Intervention group achieved greater decline in hgA1c compared to control group (adjusted mean hgA1c of -0.40 vs. -0.036).	1c
Cho et al. (2016).	Improve glycemic control and evaluate the efficacy of an internet-based integrated health care system	Randomized control trial with participants from 3 different health centers	Internet-based modality	HgA1c was significantly reduced at 6 months in the intervention group. Patients with baseline A1c <8.0% showed significant reduction in A1c at 6 months while the control group showed an increased tendency.	1c
Fortmann et al. (2017).	Glycemic benefit and acceptance of a culturally tailored,	Randomized control trial	Smart phone/ Application	At months 3 and 6 the intervention group showed	1c

	SMS-based DSME and support in underserved Hispanics with poor control.			significant decrease in mean hgA1c than control group.	
Warren, Carlisle, Mihala, & Scuffham (2017).	Effect of tailored telemonitoring intervention on glycemic control and utilization of health services.	Prospective randomized control trial	Remote monitoring equipment	Significant decrease in A1c. Intervention was effective in lowering A1c levels, helping T2DM patients move towards good control from poor control.	1c
Kempf et al. (2017).	To test the hypothesis that participation in the TeLipro would be associated with improved A1c.	Randomized control trial	Internet-based modality	A significant reduction in hgA1c was noted in the intervention group, at 12 weeks.	1c
Niemczewski, Polivka, & Clark (2016).	Can follow up telephone calls after DSME class lead to reduction in A1c	Quasi-experimental	Telephone Intervention	Both groups achieved reduction in A1c. Follow up calls were effective in helping patients stay on track with goals.	2c
Lim et al. (2016).	Investigated use of individualized multidisciplinary u-healthcare service in older adults with T2DM	Randomized control trial	Internet-based modality	Statistically significant reduction in HgA1c and number of hypoglycemic events	1c

Tang et al. (2013).	Evaluated the Engaging and Motivating Patients Online for Diabetes (EMPOWER-D) that supports patients with T2DM	Randomized control trial	Internet-based modality	Achieved and maintained a reduction in hgA1c at 6 months and 12 months	1c
Odnoletkova, Goderis, Nobels, Fieuws, Annermans, & Ramaekers. (2016).	Effect of the COACH programme on hgA1c and other modifiable risks factors in patients with T2DM	Randomized control trial	Telephone intervention	At 6 months significant decrease is noted in the hgA1c of the intervention while In the control group no change in hgA1c was noted.	1c
Greenwood, Blozis, Young, Nesbitt, & Quinn. (2015).	Evaluate the effectiveness of a telehealth remote monitoring modality with paired glucose testing in adults with T2DM and non-insulin dependent.	Randomized control trial	Remote monitoring intervention	The intervention group showed significant decrease in hgA1c at 6 months though both groups showed decrease in A1c, the control group at 6 months were no longer improving.	1c
Crowley et al. (2016).	Feasibility and effectiveness of delivering Advanced Comprehensive Diabetes Care (ACDC) for persistent poorly	Randomized control trial	Telephone and remote monitoring interventions	Significant improvement in mean hgA1c at 3 months and 6 months. The study concluded that this methodology improved hgA1c by 1.0% which if sustained can reduce microvascular complications by 37%.	1c

	controlled diabetes mellitus (PPDM)				
Kim et al. (2016).	Evaluated the efficacy of the IBGMS in controlling blood sugar in the Chinese population.	Randomized control trial	Internet-based modality	Significant decrease in hgA1c was noted at 3 and 6 months. This system allows users to upload their glucose readings during their day-to-day lives.	1c
Threatt & Ward. (2017)	To note any changes in hgA1c from baseline in a free clinic population participating in telehealth DSME/S services.	Exploratory study design	Clinical video telehealth (CVT) intervention	Significant decrease in hgA1c was noted. Education was provided one on one via clinical video.	3c
Rasmussen, Lauszus, & Loekke (2016).	Tested home treatment of T2DM by video consultation versus standard care in a randomized trial.	Randomized control trial	Clinical video telehealth (CVT) intervention	A treatment algorithm was used and proven to be effective because both groups achieved individually planned goals.	1c
Wang et al. (2017).	Evaluated the effectiveness and practicality of a model of internet-based integrated management of diabetes.	RCT	Internet-based intervention	At 3 months and 6 months mean hgA1c was significantly improved from baseline in both groups. Study noted feedback was very essential in reaching significant reduction in A1c.	1c
Istepanian et al. (2014).	Feasibility study on using mobile phone technologies for type	Case study	Internet-based and Smart phone/app	At the end of the intervention period, significant difference was noted in the mean hgA1c.	4d

	2 diabetes patients in Iraq.				
Zhou, Xu, Liu, Huang, Xu, &Chen (2014).	Feasibility and effectiveness of an internet-based telemedicine system managing T2DM patients in China	RCT	Internet-based modality	At 3 months there was significant change in the mean hgA1c of the intervention group compared to the control group.	1c