DOES A TELEHEALTH EDUCATION PROGRAM IMPROVE LIFESTYLE BEHAVIORS OF INDIVIDUALS WITH PREDIABETES?

An Integrative Review

Submitted to the

Faculty of Liberty University

In partial fulfillment of

The requirements for the degree

Of Doctor of Nursing Practice

By

Loretta Richardson

Liberty University

Lynchburg, VA

June 12, 2023

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Scholarly Project Chair Approval:

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ABSTRACT

Chronic conditions are a considerable burden on the healthcare system, and one that is becoming increasingly prevalent is diabetes. Prediabetes is a condition that has become more common and diagnosed in many patients before an actual diagnosis of diabetes. Healthcare professionals strive to empower individuals to make lifestyle changes to prevent diabetes from occurring by informing individuals on how to manage prediabetes. For individuals that do not make the necessary changes to lower their hemoglobin A1c to below the standards of less than 5.6%, a diagnosis of diabetes occurs. It is estimated that five per 1000 individuals are diagnosed with prediabetes; however, research reveals that many people do not even know they have prediabetes. The number of individuals with prediabetes is consistently on the rise, ultimately increasing the number of individuals with Type 2 diabetes. Providing individuals with the necessary tools for improved lifestyle modifications will decrease the likelihood of developing Type 2 diabetes. This integrative review evaluates evidence-based, peer-reviewed, published articles on the effectiveness of increasing awareness of the necessary lifestyle behaviors for the prevention of diabetes through telehealth education. The literature supports that telehealth can improve lifestyle behaviors, including improved eating habits and increased physical activity, thus reducing hemoglobin A1c levels, body weight, or body mass index of individuals with prediabetes.

Keywords: Prediabetes, Type 2 Diabetes, DSMES, Telehealth, Diabetes Prevention, Behavioral Modifications, Continuous Glucose Monitoring, Lifestyle, Lifestyle Behaviors, Nutrition, Exercise, Mobile Applications

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List of Abbreviations

Centers for Disease Control and Prevention (CDC)

Continuous Glucose Monitoring (CGM)

Diabetes Self-Management Education and Support (DSMES)

Fasting Blood Glucose (FBG)

Fasting Plasma Glucose (FPG)

Health Care Professional (HCP)

Hemoglobin A1c (HbA1c)

Integrative Review (IR)

Lifestyle Change Program (LCP)

Lifestyle Health Coaching (LHC)

Lifestyle-Induced Weight Loss (LIWL)

Medical Nutrition Therapy (MNT)

Motivational Interviewing (MI)

National Diabetes Prevention Program (NDPP)

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

Theory of Planned Behavior (TPB)

Type 2 Diabetes Mellitus (T2DM)

Waist Circumference (WC)

Weight Loss (WL)

SECTION ONE: FORMULATING THE REVIEW QUESTION

Introduction

Diabetes is a chronic condition that affects millions of individuals worldwide, and the number of patients diagnosed is rising. This unfortunate growth requires the healthcare systems to increase awareness within the community. As the nation continues to battle this condition and the complications that can arise, it is crucial to implement educational strategies for individuals in the prediabetes stage. Prediabetes is a precursor to Type 2 diabetes (T2DM). Recent data estimates that over 33% of adults over 18 years of age have prediabetes, and 70% will be diagnosed with T2DM (Batten et al., 2022). Somerville et al. (2019) conducted research revealing that T2DM could be decreased by 58% with positive lifestyle modifications, which coincides with the national statistics of the Centers for Disease Control and Prevention (CDC). The increased healthcare costs for individuals with T2DM are roughly over $16,000 annually, which is approximately two times the medical expenses of a person without diabetes (www.cdc.gov/diabetes). On a global concern, current data estimates that in 2016, 422 million individuals had diabetes; in 2019, a rise to 463 million people, and by the year 2045, it is estimated that over 700 million people will be affected by diabetes (www.cdc.gov/diabetes,AshaRani et al., 2021). The financial burden associated with diabetes care is estimated to be $850 billion globally (Olson et al., 2022). Unfortunately, diabetes is considered the seventh leading cause of death in the United States (www.cdc.gov).

The goal is to encourage and empower individuals with prediabetes to make the necessary lifestyle modifications to prevent T2DM (Somerville et al., 2019). However, the fast-paced lifestyle of people places them at higher risk of prediabetes due to not understanding the seriousness of the condition. Unfortunately, the nation is seeing an increase in food insecurity,

and unhealthy eating habits are prevalent; fast-food access is becoming increasingly available, and individuals are increasingly becoming more sedentary, all the factors leading to prediabetes (Bakre et al., 2022). As adults continue to practice these unhealthy behaviors, they increase their risk for prediabetes. Healthcare professionals will see an increase in clinic visits and hospitalizations due to the rise in chronic conditions, thus burdening the healthcare system (Jeihooni et al., 2019). As more individuals face challenges with diabetes management leading to higher levels of blood glucose, the incidences of other comorbidities rise. Individuals with diabetes tend to have complications consisting of neuropathy, cardiovascular disease, and renal disease (Olson et al., 2022).

The data supports that positive lifestyle modifications can prevent the onset of T2DM by empowering individuals to make the necessary changes (Cannon et al.; 2022, Falguera et al.; 2020; Gosak et al., 2022). The outcomes of positive lifestyle modifications consist of a lower body mass index (BMI), decreased body weight, improved glycemic control, increased exercise, and improved dietary habits. As poor management of diabetes continues to rise, it is crucial to gain insight into how a telehealth educational program provides the necessary evidence-based tools for individuals to make the required lifestyle modifications for those with prediabetes. Telehealth research has indicated increased appointments due to ease of access and cost-effectiveness and provides the necessary resources for the underserved (Shakya et al., 2021).

National Diabetes Prevention Program and Diabetes Self-Management Education and Support

Addressing the appropriate lifestyle behaviors allows individuals to achieve improved hemoglobin A1c (HbA1c), the standard in measuring an individual's average glucose levels within three months (www.diabetes.org). The National Diabetes Prevention Program (NDPP)

and Diabetes Self-Management Education and Support (DSMES) are programs geared to increase the knowledge base of individuals (www.cdc.gov, Litchman et al., 2022). The NDPP provides the foundational framework for healthcare professionals to use to help prevent T2DM from occurring. In comparison, DSMES supports the foundation and resources for the daily management of diabetes.

Olson et al. (2022) established the framework for effective diabetes education to ensure the platform provides quality and consistency as it provides the nation with the tools to manage this chronic condition. Two outcomes are associated with positive behavior changes and education; improved clinical outcomes and reduced costs. Four indicators related to diabetes education include improved knowledge, understanding of the condition, self-management, and self-determination. A framework established and utilized nationwide in all educational services will help to achieve the desired outcome of reducing the number of individuals with T2DM.

A crucial component of addressing lifestyle behaviors in preventing diabetes is the role of telehealth as an educational platform. Our fast-paced society places a greater emphasis on technology. Telehealth has provided the healthcare system more opportunities to meet individual needs (Aberer et al., 202, Cannon et al., 2022). Telehealth has also been shown to be cost-effective, more practical for individuals, and offers broader access to the underserved. Given the tools it provides individuals with, the outcome of telehealth has proven to lower HbA1c and empower individuals to make the necessary lifestyle behaviors (Aberer et al., 202, Gosak et al., 2022). Kasturiratne et al. (2021) conducted a study supporting the importance of lifestyle modifications to help prevent the onset of T2DM, which can be achieved using technology. The study found that the platform's benefits included reducing patient visits, allowing broader access, and being cost-effective for healthcare professionals and individuals.

Telehealth Education

It is crucial to distinguish between telehealth and telemedicine within the parameters of the literature review. Telemedicine consists of a one-on-one online visit with a healthcare professional. Conversely, telehealth comprises any technology utilized to improve health (Aberer et al., 2021, Roy et al., 2022). Examples of telehealth within prediabetes and T2DM consist of mobile applications, Mhealth, continuous glucose monitor (CGM), telephone, dietary and exercise tracking programs, mobile applications, and group educational programs using technology; telediabetology is specific to diabetes management (Aberer et al., 2021 Stotz et al., 2020). A crucial component of the utilization of telehealth is the broader range of materials and independence for the individual and provider. However, it also provides the ability to reach those with limited transportation (Olson et al., 2022). Current data also indicates that individuals are more likely to keep telehealth appointments than clinic appointments (Alaslawi et al., 2022).

A necessary component of using telehealth is understanding the individuals utilizing the technology. Since Covid 19, the use of technology has tripled in providing patient care; thus, improvements are continuous. Signal et al. (2020) offer valuable insight into using technology as an intervention by addressing factors associated with technology and individuals. The related aspects must be assessed using technology: “age, motivation, personal values, digital literacy, and family support” (Signal et al. 2020, p. 2), which are essential aspects to note for the development of a program.

Defining Concepts and Variables

The purpose of this integrative review (IR) was to understand how telehealth can improve an individual's lifestyle behaviors, reducing weight and increasing PA, thus decreasing their HbA1c and reducing the risks of diagnosis of diabetes. The Toronto and Remington criteria

(2020) ensured a comprehensive review by including the process's crucial steps. T1DM is an autoimmune condition where the pancreatic beta cells no longer produce insulin, the hormone required to decrease blood glucose levels. The insulin mechanism of action attaches to the glucose molecule and transports it into the cell for energy. These individuals need lifelong insulin injections in addition to lifestyle behaviors; this condition accounts for less than 10% of the population (www.diabetes.org). Gestational diabetes occurs during pregnancy when the pancreas cannot sustain adequate amounts of insulin. T2DM is a condition that has some genetic factors but is mainly related to lifestyle. T2DM is diagnosed with a fasting blood glucose of 126 or greater and an HbA1c greater than 6.4%. Glycosylated hemoglobin A1c (HbA1c) measures the glucose amount attached to a red blood cell within three months (Sevilla-Gonzalez et al., 2022).

The standard recommended by the American Diabetes Association (ADA) for individuals without diabetes is less than 5.7% (www.diabetes.org). The concern with the increased glucose levels in the blood (hyperglycemia) can cause damage to vessels. This damage can be microvascular and macrovascular, which is irreversible. Education on diabetes can empower individuals to make the necessary lifestyle changes to limit the damage that occurs. (Olson et al., 2022). The American Diabetes Association (ADA) defines prediabetes as having an HbA1c of 5.7% to 6.4%. A diabetes diagnosis occurs with an HbA1c of 6.5% or greater. To reduce the risk of micro and macrovascular complications, the CDC and ADA recommend individuals with diabetes achieve an HbA1c of less than 7%; to achieve these levels, the time-in-range (TIR) of blood glucose range must be more than 70% (www.diabetes.org).

Additional defining variables consist of monitoring blood glucose levels to maintain target levels. Glucose meters allow individuals to monitor their glucose levels daily. This device

requires individuals to complete a finger stick to apply a drop of blood to a strip inserted into the meter. The meter analyzes the blood to determine the reading. The individual then decides the course of action to maintain the blood glucose level that will return blood glucose to the target. However, as technology has advanced in healthcare, there are numerous options for individuals with diabetes for monitoring. Continuous glucose monitoring (CGMs) has provided individuals with diabetes with the necessary tools for easier access to monitoring (Farhan et al., 2022). In addition, the technology behind CGMs offers more accessible access to treatment plan changes via methods other than face-to-face visits (Aberer et al., 2021).

Individuals must engage and understand the interventions to achieve healthier lifestyle modifications to maintain their target blood glucose level (Falguera et al., 2020, Stotz et al., 2020). Nutrition, especially carbohydrates, is critical to maintaining adequate blood glucose levels between 70-110, or target levels provided by healthcare professionals (Bakre et al., 2022). In addition, another defining variable is exercise or physical activity (PA). It is essential to understand how cells and insulin respond to movement. With exercise or physical activity (PA), cells become more sensitive to letting insulin in, thus lowering blood sugar naturally. Individuals with diabetes should achieve 150 minutes of moderate weekly activity (Batten et al., 2022). Physical activity (PA) has added benefits concerning health status; it decreases stress levels, improves sleep, decreases weight, and improves heart health (www.cdc.gov; Batten et al., 2022; Dagogo-Jack et al., 2022).

Rationale for Conducting the Review

As prediabetes continues to rise, individuals must adapt their lifestyles to prevent the diagnosis of T2DM from occurring. Individuals seek more medical care due to uncontrolled diabetes or complications arising from diabetes, which involves implementing an intensive

telehealth program that improves access to care (Olson et al., 2022). The program aims to improve HbA1c, maintain lower glycemic measures, and promote lifestyle behaviors crucial in managing diabetes. Current research has revealed that the complications of diabetes pose a serious concern to individuals' morbidity and mortality. The goal of preventing T2DM is to empower individuals, when informed they have prediabetes, to make the necessary lifestyle behavior modifications (Cannon et al., 2022).

Purpose of Review Question

The burden of diabetes complications around the globe is a vast concern, and gaining an insight into what is required to help individuals achieve a healthier lifestyle for the prevention of diabetes is crucial. Aiming to decrease individuals' prediabetes HbA1c levels to under 5.7% is necessary to prevent T2DM from occurring. Instilling adequate lifestyle modifications and behaviors through successful telehealth education to achieve optimal patient outcomes is essential. Individuals require more accessible access to information that telehealth provides. Recent studies have detailed that lifestyle modifications are necessary for preventing and managing T2DM. The results of individuals participating in a telehealth educational series on improving lifestyle behaviors have resulted in a lower HbA1c, reduced weight, and increased weekly exercise or PA, thus lowering the risk of developing T2DM (Dagogo-Jack et al., 2022).

Clinical IR Question

Does the literature support the use of telehealth education to improve the lifestyle behaviors of adults with prediabetes?

Inclusion and Exclusion Criteria of the Literature

A crucial component of the IR is defining the clinical question to be addressed to guide comprehensive literature research. Once the question was developed, formulation of the inclusion and exclusion criteria must be identified (Toronto & Remington, 2020). Inclusion criteria comprised peer-reviewed, evidenced-based articles reviewing the relationship between telehealth and lifestyle modifications for prediabetes and T2DM and the effects on lowering HbA1c. However, additional inclusion criteria included the English language between 2018-2022. The exclusion criteria included T1DM, T2DM individuals on insulin, and gestational diabetes. In addition, exclusion criteria consisted of any pediatric population with diabetes.

Consultation with diabetes care and education specialist (CDCES) within the local community provided vast knowledge on the topic. Moreover, the librarian's assistance locating substantial journal articles was crucial in implementing the IR. Disciplines associated with the search criteria included Certified Diabetes Care and Educational Specialists (CDCES), Diabetes Nurses, Physicians, Registered Dietitians, and Public Health Nurses.

Conceptual Framework

Whittemore and Knafl (2005) provided the framework and analysis method to ensure the IR's purpose was addressed and aligned appropriately. It was also crucial that the literature is accurate and organized within the IR. An extensive literature evaluation concerning various parts of the question was essential. The articles were analyzed in detail to ensure they met the necessary review components to provide in-depth knowledge of the clinical question (Toronto & Remington, 2020). This IR framework included the relationship between lifestyle behaviors and the reduction of HbA1c, weight loss, increased exercise, and the prevention of T2DM.

Theoretical Framework

The theoretical framework highly recommended for individuals with prediabetes to be used by healthcare professionals is the RE-AIM model (www.re-aim.org). This model provided a foundation for health promotion and has been used in corporations to implement new knowledge (Tschida et al., 2021). Knowledge and understanding of lifestyle modifications are essential for individuals with prediabetes. The model distinguishes how effective the interventions are for change. A factor to consider was that individuals must participate in the interventions provided by the telehealth program to achieve the desired outcome. The utilization of the model provides the resources for behavior changes (Olson et al., 2022). The interventions aim to achieve a lower HbA1C by incorporating lifestyle modifications, healthier eating habits, and increased physical activity, reducing body weight or BMI (Signal et al., 2020). Research has shown that with lifestyle modifications, there is a 58% decrease in type 2 diabetes occurring (www.cdc.gov, www.healthypeople.gov).

SECTION TWO: COMPREHENSIVE AND SYSTEMATIC SEARCH

In developing the IR, it was essential to review articles to help determine the evolution of the practice or the need to research the phenomenon further. Appendix A delineates studies on diabetes management, lifestyle management, and telehealth implications supporting evidence that a telehealth program is effective (Evans et al., 2021, Lewinski et al., 2022, Litchman et al., 2022). The literature reviewed revealed extensively that diabetes management requires lifestyle changes. Lifestyle behaviors delineated in the research included exercise, monitoring blood glucose, and maintaining a healthy balanced diet. An essential element within the literature review stated that education was crucial to the management and needed early intervention and ongoing support to be effective (Cannon et al., 2022, Celik et al., 2022, Olson et al., 2022). With

the vast improvements in technology and diabetes management, using telehealth to engage individuals provides the necessary tools for behavior modification, including improved eating habits and PA (Evans et al.; 2021, Lewinski et al.; 2022, Litchman et al.; 2022).

Search Organization and Reporting Strategies

The search strategy for this IR was obtained through five databases using a systematic approach (Toronto & Remington, 2020). CINAHL, ProQuest, PubMed, government and local websites, and American Diabetes Association (ADA). The keywords used in the search were diabetes, diabetes and technology, telehealth, telemedicine, lifestyle modifications, diabetes, National Diabetes Prevention Program (NDPP), Diabetes Self-Management Education and Support (DSMES), exercise, and nutrition. The review provided over 100 articles about answering the clinical question related to diabetes and education; however, only 45 were peer-reviewed. Approximately 29 articles were peer-reviewed due to the recently implemented telehealth uprise and NDPP. Twenty-nine articles met the inclusion criteria to be utilized in the IR.

A crucial element within this IR and the literature associated with the clinical question was the analysis of literature using Mylenke-Level Evidence (Melnyk & Fineout-Overholt, 2018). Developing the IR requires detailed research of the studies conducted to understand the clinical question relationship, quality, and validity of the addressed concern.

Terminology

For this IR, the search included the term *database,* the electronic collection of materials from the Jerry Falwell Library at Liberty University (Toronto & Remington, 2020). The

investigation also involved databases that correlated statistics, including government, local, and international sites.

SECTION THREE: MANAGING THE COLLECTED DATA

An essential process of developing the IR was the review and analysis of the literature review. Melnyk and Fineout-Overholt, (2018) outlined the process for the literature matrix; Appendix A delineates the evidence-based peer-reviewed articles used for this IR. Articles were carefully screened based on wording and topic, including Diabetes Prevention, NDPP, DSMES, prediabetes, T2DM, behavioral modifications, telehealth, lifestyle modifications, nutrition, and exercise. In addition, the articles were analyzed to ensure consistency in data to formulate the knowledge for the clinical question to be addressed.

SECTION FOUR: QUALITY APPRAISAL

Sources of Bias

An essential aspect of a literature review was identifying potential sources of bias. Bias within research can inhibit the validity or trustworthiness of the research data (Toronto & Remington, 2020). However, reviewing the literature was completed by a single researcher using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 (PRISMA) checklist; all criteria were analyzed (Page et al., 2021). Studies must be designed and analyzed that minimize bias. If there is any form of discrimination within a study, it loses its trustworthiness. Articles written in the English language were the only articles reviewed. However, the articles reviewed were global.

Potential sources of bias within this research consisted of demographics and measurements of weight. Providing the nature of this IR was examining lifestyles on the effects

of preventing T2DM from occurring for individuals with prediabetes; it was essential to ensure lifestyle behaviors were outlined within each of the studies analyzed to ensure accuracy.

Internal Validity

It was essential to ensure scientific methods were utilized to analyze studies for internal validity (Toronto & Remington, 2020). External validity can be compromised if internal validity is skewed or not established. To answer the IR clinical question, the research articles needed to demonstrate internal validity (Melnyk & Fineout-Overholt, 2018). Upon analysis of the literature, internal validity was established by indicating that lifestyle behaviors, such as exercise and eating habits were indicators that affect individuals with prediabetes.

Appraisal Tools (Literature Matrix)

An essential part of conducting a study to answer the clinical question was to analyze the research appropriately according to the type of literature being reviewed (Toronto & Remington, 2020). Considering there is no best way to appraise a study accurately, the researcher conducting the IR must be aware of and ensure the same appraisal tool is used for all studies analyzed. There are over 100 appraisal tools, nine of which are highly utilized within the healthcare profession. The appraisal tool used for this IR was the Melnyk and Fineout-Overholt Level of Evidence (Melnyk & Fineout-Overholt, 2018).

The initial step within the review consisted of gathering data and ensuring the clinical question's relevance. The nature of this IR examined prediabetes or prevention of T2DM, telehealth, and education, and then the research was separated into categories to ensure relevant topics were addressed. The types of evidence ranged from a systematic review or meta-analysis (Level 1) to Expert Opinion (Level VII), outlined in Appendix A (Melnyk & Fineout-Overholt,

2018). In addition, Appendix C summarizes the categories of research annotated to answer the clinical question.

The review comprised 29 articles on prediabetes, prevention of T2DM, telehealth and prediabetes or T2DM, and lifestyle modifications. Of the 29 articles reviewed, five were Level I; eight were Level II, four were Level III, three were Level IV, four were Level V, and five were Level VI. Even though Level VI is lower within the Hierarchy of Evidence, they provided valuable insight into the topic. All levels were included in the review to meet the rigors of research (Melnyk & Fineout-Overholt, 2018, Toronto & Remington, 2020). The lifestyle modifications achieve a desired lower HbA1c, FBS, FPG, weight, or BMI.

Applicability of Results

Current research supports that education is critical for individuals with prediabetes to prevent T2DM. Educational requirements include addressing lifestyle modifications to incorporate healthy eating habits, increasing or engaging in PA, decreasing stress, and decreasing weight or BMI.

Reporting Guidelines

A crucial step within an IR is the data acquired to answer the clinical question. However, the PRISMA guideline is the preferred method for systematic reviews (Toronto & Remington, 2020). Page et al. (2021) provided detailed procedures for conducting the IR to ensure each article met the requirements. Each article reviewed was evaluated to ensure it was applicable in addressing the clinical question regarding telehealth, education, prediabetes/diabetes prevention, and DSMES. Appendix B, the PRISMA flow diagram, outlines the data collection.

SECTION FIVE: DATA ANALYSIS AND SYNTHESIS

Data Analysis Methods

A crucial step within the IR was to have a vast understanding of the topic's primary purpose and the IR's goal. Within this IR, evaluating the literature to increase knowledge of the categories crucial to answering the clinical question was essential (Toronto & Remington, 2020). This IR aims to provide insight into the benefits of telehealth education to improve the lifestyle behaviors of adults with prediabetes. The literature examined included various elements of lifestyle behaviors, including knowledge of individuals and healthcare professionals on diabetes, nutrition, and exercise. In addition, articles addressed face-to-face or telehealth education to understand its role in individuals with prediabetes or T2DM.

Article Theme Discussion

The literature was categorized into four main themes to address the clinical question: readiness and knowledge, National Diabetes Prevention Program, lifestyle, and telehealth. Each theme represents crucial information for healthcare professionals to understand to empower individuals with prediabetes to make those lifestyle modifications. The following section will discuss each of the article themes in detail.

Readiness and Knowledge

Among the articles reviewed, six emphasized knowledge, readiness, and behavior as crucial elements for success in individuals with prediabetes to make the necessary lifestyle modifications. A common theme noted within four of the studies consisted of individuals who are not ready for behavioral change will not be open to making the necessary lifestyle modifications (Annie Kao et al., 2021; Davis-Ajami et al., 2021; MohammadniaMotlagh et al., 2022; Teoh et al. 2023). In addition, Teoh et al. 2023, Davis-Ajami et al. 2021, and Speaker et al.

2021 studies recognized the importance of healthcare professionals' knowledge of prediabetes and informing patients to make those essential lifestyle recommendations. In addition, Somerville et al. and Speaker et al. research reported that healthcare professionals recognize lifestyle modifications of physical activity and improved nutritional habits could reduce the progression to T2DM by 58%. Nutrition, a cornerstone of prediabetes management, is not being referred by HCPs for individuals to increase their knowledge of nutrition (Somerville et al., 2019; Speaker et al., 2021). Eleven percent (1881) of individuals within Speaker et al.'s study received Medical Nutrition Therapy (MNT) referrals, and Somerville et al.'s study had 21% of individuals receive a referral. However, Speaker et al. (2021) reported only 7.4% (140) had at least one visit, and 1% of people with prediabetes saw a nutritionist. However, the studies identified that for lifestyle modifications to occur, they must begin with an internal behavior change (Annie Kao et al., 2021; Davis-Ajami et al., 2021; MohammadniaMotlagh et al., 2022; Teoh et al., 2023). One key element noted within the research completed by MohammadniaMotlagh et al. was that education based upon theory shows positive effects; however, there was a significant increase in physical activity compared to an improvement within the intervention group. Given minimal diet improvements, fasting blood sugar (FBS) improved from 106 to 99.70 after education. In addition, the research revealed that after education or advice for lifestyle modifications was adhered to, individuals who increased or started an exercise program reduced their BMI. The results provided evidence that self-management, self-efficacy, and knowledge are critical components to reducing the prevalence of T2DM.

National Diabetes Prevention Program

The development of NDPP is a CDC-recognized program established to prevent T2DM (https://www.cdc.gov/diabetes/prevention). The Azzi et al. (2020), Cannon et al. (2022), and Kirley & Sachdev (2018) studies recognized the relevance of the program for individuals with prediabetes. Azzi et al.'s finding aligned with Cannon et al., indicating that these programs motivate behavior change by providing the necessary tools. However, Kirley & Sachdev's study reduced the risk of T2DM by 27% with the lifestyle change program (LCP), including a weight reduction of 4.7%, and Azzi et al.'s study showed an 85% increase in knowledge in nutrition and a 74% increase in physical activity through the NDPP.

Lifestyle Interventions

Six articles reviewed focused on lifestyle interventions to prevent T2DM (Azzi et al., 2020, Celik et al.; 2022, Dagogo-Jack et al., 2022; Ghisi et al., 2021, Mash et al., 2022, Salmon et al.; 2021). Dagogo-Jack et al. findings revealed that with lifestyle modification, people with prediabetes could reduce their risk of T2DM between 30-60%, comparable to the CDC standard of 58% reduced risk of T2DM with lifestyle interventions implemented early upon diagnosis of prediabetes (https://www.cdc.gov/diabetes/prevention). Mash et al. showed an increase in physical activity by 53% and nutrition knowledge and positive diet changes by 76%.

The Celik et al. (2022), Idris et al. (2022), Litchman et al. (2022), Mash et al. (2022), and Leong et al. (2022) studies recommend Diabetes Self-Management Education and Support (DSMES) for lifestyle behaviors in order to manage diabetes. Diabetes is a chronic condition that requires healthy eating and exercise to maintain target blood glucose. Ghisi et al. study viewed the phases to establish an educational program, and the study reported that DSMES is a powerful tool for behavior change in individuals with prediabetes. The guidelines established for T2DM

management can apply to prediabetes, given that prediabetes is the precursor to T2DM. Celik et al. (2022) study showed that 78.5% of patients received instruction from the educator within the year, whereas 46.7% received one time, 27.7% received education twice, and 25% of individuals received education more than three times; Leong et al. (2022) study evaluated education through the social media platform. Those individuals who received instruction three or more times had decreased their HbA1c by 1% (Celik et al. 2022) and increased their diabetes knowledge from 68.3% to 76% (Leong et al. 2022).

Yin et al. (2022), Salmon et al. (2022), Sevilla-Gonzalez et al. (2022), and Zimmermann et al. (2022) studies reported similar results in changes in HbA1c, BMI, FBG, or FPG. Yin et al.'s study revealed HbA1c percentage of 8.56 at baseline decreased by a mean of 1.63 percent after a 6-month follow-up lifestyle telehealth intervention, and Sevilla-Gonzalez et al.'s study showed a significant change in HbA1c from 5.9 to 5.8, after the 3-month intervention.

Yin et al.'s study had effective WL; BMI averaged 29.25 at baseline to 25.49 after the 6-month intervention follow-up. Zimmerman et al.'s study had approximately 12% WL between the four quarters. However, after the 5-year follow-up, WL maintained a 3.7% drop. In contrast, Sevilla-Gonzalez et al.'s study revealed a WL of 3.4 Kg and a waist circumference (WC) decrease of 3.9 inches after the intervention.

Yin et al.'s (2022) and Salmon et al.'s (2022) studies revealed a change in FBG with intervention. Yin et al.'s baseline average FBG of 8.45 mmol/L after a 6-month telehealth lifestyle intervention; FBG decreased to 5.58 mmol/L; Salmon et al. study viewed FBG categorized upon BMI; mean 5.8-5.9 mmol/L between BMI 18.5 - >30 Kg reduced by 0.4 within BMI 18.5-24.9 kg group, 0.3 decreases within BMI 25.0-29.0 kg group, and a decrease of 0.3 kg

within the BMI >30 kg group. Sevilla-Gonzalez et al. (2022) and Zimmerman et al. (2022) studies showed a reduction in FPG, averaging a three-point drop (Sevilla-Gonzalez et al. 2022); 5.8 in quarter one to 5.6 in quarter four (Zimmerman et al. 2022).

Telehealth

Articles focused on telehealth as a platform were critical to answering the IR clinical question. Alaslawi et al. (2022), Idris et al. (2022), and Lewinski et al. (2022) provided the foundational instrument for understanding telehealth and what future research needs to occur, as well as the role telehealth plays in empowering individuals. The systematic review completed by Lewinski et al. examined over 8,000 articles on telehealth and chronic disease, 80% of which focused on T2DM. One of the studies showed a decrease in HbA1C from 9.5 to 8.6. However, Alaslawi et al. and Idris et al. revealed that the younger population is more consistent with interactive technology. Technology provides the opportunity to increase communication with providers. Given that the prevalence of prediabetes is more prevalent in younger individuals, mobile applications are suitable means of education for this generation.

Ahn et al. (2023) studied dietary coaching in addition to the use of CGM and compared it to a control group that received formal education on diet and exercise. CGM is a telehealth platform that is effective in reducing HbA1c and improving dietary habits. The studies completed by Annie Kao et al. (2021) and Zimmermann et al. (2022) utilized telephone and weekly feedback as the telehealth platform intervention. Both of these studies revealed that self-efficacy was crucial for behavior modifications. Weight loss (WL) occurred in the six-week nurse-led intervention (Annie Kao et al. 2021), but no significant change occurred in HbA1c; understandable six-week is a short duration to see a difference in HbA1c. Over the five-year study (Zimmermann et al., 2022), there was substantial WL within the first two months. This is

crucial information regarding weight as a factor for prediabetes, as noted within the following studies Annie Kao et al., 2021; Salmon et al., 2021; Zimmermann et al., 2022. WL within the Annie Kao et al. (2021) study was accompanied by a decrease in blood pressure, indicating cardiac health improvement. Salmon et al., 2021 provided counseling on nutrition and exercise through a telehealth platform to decrease individuals' FPG; thus, 45% of individuals returned to normalized FBG over six months and increased physical activity from 65 minutes to 122 minutes for individuals with BMI >30.

The Alaslawi et al. (2022), Alshehri and Alshaikh (2021), Batten et al. (2022), Cannon et al. (2022), Kasturiratne et al. (2021), Kirley & Sachdev (2018), Salmon et al. (2021), Sevilla-Gonzalez et al., (2022), and Signal et al., (2020) studies concluded that the use of mobile applications and delivery of education via a telehealth platform was a successful tool for self-management of individuals with prediabetes. Specifically, Batten et al., Cannon et al., and Kirley and Sachdev's studies focused on NDPP implemented digitally. Cannon et al. study viewed NDPP programs through various methods, including face-to-face, digital, distance, and hybrid, from 2012 to 2019, with 455,954 individuals enrolled. The breakdown consists of approximately 166,000 in-person, 260,000 online, 4756 for distance learning, and over 15,000 for hybrid or a combination. Highlights of the demographics include in-person had the lowest number of men enrolled, 19.4%. In comparison, men had a higher enrollment number in the online platform, approximately 27.1%. Other demographics were reasonably distributed across each ethnicity. The in-person average age was about 65 years, whereas the online enrollment had 41.5% of 18-44 years old registered. Statistically speaking, the number of telehealth-registered individuals provides a framework that telehealth is suitable for delivering education.

Alshehri and Alshaikh (2021) conducted a cross-sectional study using self-administered questionnaires administered in phases to gather data on the telehealth program's introduction, adoption, and employment phases. The goal was to collect data from healthcare professionals, including physicians, dieticians, and health educators, on telehealth applications in diabetes prevention. The findings revealed that healthcare professionals believed mHealth is beneficial for individuals with prediabetes to improve their lifestyles. Besides healthcare professionals, the study also examined patients' perceptions of telehealth. Over 75% of individuals with prediabetes were open to telehealth; the other 25% stated they may be open to it. Studies that examined the implementation of lifestyle behavior modification for preventing diabetes through telehealth research were completed by Alshehri and Alshaikh (2021) and Signal et al. (2020). Specifically, these studies analyzed the elements of implementing a telehealth education program. Signal et al.'s (2020) study included 429 individuals in a telehealth program called the betaMe/Melon program, which included a Random Control Trial, with 214 participants in the control group and 215 in the intervention group. Signal et al.'s (2020) findings revealed improved knowledge that leads to better management, which decreased HbA1c and WL through the health coaching app. Alshehri and Alshaikh's (2021) findings showed a decrease of 5% in body weight with a mobile application. Moyaka et al. (2022) analyzed 12 articles that revealed the intervention group had an HbA1c change between 0.10 to 2.83 decrease and FBG from 173 to 131 compared to the control group.

A crucial step for determining a telehealth program's effectiveness is evaluation. Both Batten et al. and Sevilla-Gonzalez et al.'s research provide insight into the assessment of delivering a web-based platform educational program. Sevilla-Gonzalez et al. examined the effects after a three-month intervention; results showed improvement in FBG, body fat

percentage, and waist circumference (WC). A concern noted within the study was the user interface with technology, and the researchers recommended that individuals have a solid understanding of the technology used before implementation. Batten et al. evaluated post-12-month intervention with over 1000 individuals at the start of the study, a nine-month analysis of 1,095 individuals, and a 12-month examination of 945 individuals. Results of the study at nine months revealed 13-pound WL when exercise increased from 66 minutes to 116 minutes. The 12-month results showed a 10-pound WL; however, exercise decreased from 116 minutes to 91 minutes. Both studies suggest that telehealth plays a role in weight and exercise improvements.

Descriptive Results

This IR aimed to analyze articles focusing on telehealth, prediabetes, and T2DM to improve education to prevent the incidence of T2DM within the community. The IR examined 29 peer-reviewed articles to include various criteria to address the clinical question; Does the literature support telehealth education to improve the lifestyles of adults with prediabetes? It was imperative to review articles on diabetes education, NDPP, DSMES, prediabetes, lifestyle behaviors, readiness, nutrition, exercise, and mobile applications to accurately provide insight into the clinical question. However, the articles reviewed also included those components in addition to telehealth. The time frame of the literature review was between 2018 and 2023; excluded were articles for 2023 that did not have research results published. Appendices A-C provided a detailed presentation of the literature search categories and their Level of Evidence Hierarchy (Melnyk & Fineout-Overholt, 2018).

The knowledge gained within the literature strengthens the perspective that telehealth is a platform to enhance an individual's proficiency with lifestyle modifications to reduce T2DM. The information obtained from the literature implies a strong correlation between education and

positive lifestyle behaviors (Somerville et al., 2019). To decrease the incidence of T2DM, individuals can make lifestyle changes with the reversible prediabetes diagnosis. Given this instance, the literature obtained in the IR related to T2DM, education, and telehealth applies to individuals with prediabetes.

Synthesis

The IR presented within the 29 articles provides an increased knowledge of telehealth education to improve lifestyle behaviors to prevent T2DM from occurring (Ahn et al., 2023, Alaslawi et al., 2022, AshaRani et al., 2021; Batten et al., 2022). The data gathered provided the information required to answer the clinical question (Toronto & Remington, 2020). Appendix C correlates the topic and author as a visual presentation. However, some articles utilized in the IR did not have results completed, but showed the importance of the issue at hand (Kasturiratne et al., 2021, Sarfati et al., 2018, Shakya et al., 2021).

Ethical Considerations

The project consisted of an IR in which the researcher had no contact with human subjects. In addition, no patient data were identified within the literature. Providing the information that ethical concerns did not apply to this IR, the Liberty University IRB approved the research (See Appendix E).

Timeline

A vital component of an IR is establishing a timeline to ensure accuracy and that all individuals reviewing the project are aware of the process. The timeline associated with the IR is annotated in Appendix D.

SECTION SIX: DISCUSSION

Implications for Practice

The prevalence of prediabetes is rising; lifestyle modifications must be implemented to prevent T2DM from occurring in individuals with prediabetes. However, in the fast-paced, technology-driven world, it is crucial to utilize this platform to engage people with prediabetes (Alshehri & Alshaikh, 2021; Batten et al., 2022, Cannon et al., 2022; Kasturiratne et al., 2021; Kirley & Sachdev, 2018, Salmon et al., 2021, Sevilla-Gonzalez et al., 2022, and Signal et al., 2020). This IR aimed to establish a foundational framework to provide healthcare professionals with the resources necessary to develop and implement a telehealth educational program for individuals with prediabetes that will improve lifestyle behaviors. Implementing these lifestyle behaviors will decrease HbA1c, weight, or BMI, and increase physical activity, thus reducing the risk of T2DM. In addition, providing education through telehealth gives the underserved access to valuable information and resources to prevent T2DM. In addition, those with limited transportation or who cannot travel and the underserved can access educational material through telehealth platforms (Aberer et al., 2021).

The study also provides an excellent foundation for telehealth and how to implement programs. Synthesizing the literature and allocating it into the different compartments specific to answering the clinical question increased the effectiveness of the IR.

Limitations of the IR consist of the literature on prediabetes compared to T2DM and telehealth with lifestyle modifications. Although a limitation to the study, knowledge obtained and implemented for T2DM can be utilized for prediabetes. Another limitation of the study is the

English language search strategy. Besides language limitations, the search for prediabetes and telehealth could have missed relevant literature.

The study's primary strength includes the wide variety of literature that determined telehealth was a positive intervention in diabetes management. The focus of the literature review was broad and included telehealth, prediabetes, lifestyle modifications, T2DM prevention, and T2DM education. All the knowledge combined reveals how a telehealth education program can improve the lifestyle behaviors of adults with prediabetes. A secondary strength of the IR included annotating behavioral processes and the knowledge of the healthcare professionals as a critical component before any favorable lifestyle modification can occur.

Dissemination

The literature review provided an in-depth analysis to develop new perspectives on the need to utilize telehealth to educate individuals with prediabetes (Cannon et al., 2022). The literature synthesis also increases the foundational knowledge for healthcare professionals on the importance of positive lifestyle behaviors, eating healthy, and exercising to improve overall health outcomes. However, understanding the limitations and barriers associated with technology, it is still crucial to understand the benefits of motivating healthcare professionals to utilize this platform to change the lifestyle behaviors of individuals with prediabetes. This IR will be submitted to Scholars Crossing for publication to increase healthcare professionals' knowledge of telehealth and its position with individuals with prediabetes. A follow-up to the IR would be conducting an evidence-based research project within the community to enhance the literature on prediabetes and telehealth.

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Zimmermann, S., Vogel, M., Mathew, A., Ebert, T., Rana, R., Jiang, S., Isermann, B., & Biemann, R. (2022). The extent of lifestyle-induced weight loss determines the risk of prediabetes and metabolic syndrome recurrence during a 5-year follow-up. *Nutrients*, *14*(15), 3060, 1-14. https://doi.org/10.3390/nu14153060

Appendix A

ARTICLE SYNTHESIS MATRIX

NAME: LORETTA RICHARDSON

CLINICAL QUESTION: Does the Literature Support the Use of Telehealth Education to Improve the Lifestyles of Adults with Prediabetes?

Article Title, Author, etc. (Current APA Format)	Study Purpose	Sample (Characteristics of the Sample: Demographics, etc.)	Methods	Study Results	Level of Evidence (Use Melnyk Framework)	Study Limitations	Would Use as Evidence to Support a Change? (Yes or No) Provide Rationale.
Ahn, Y.-C., Kim, Y. S., Kim, B., Ryu, J. M., Kim, M. S., Kang, M., & Park, J. (2023). Effectiveness of non-contact dietary coaching in adults with diabetes or prediabetes using a continuous glucose monitoring device: A randomized controlled trial. *Healthcare, 11*(2), 1-14. https://doi.org/10.3390/healthcare11020252	To understand if using a CGM with the addition of coaching for individuals with prediabetes/ diabetes improves behavioral skills and health outcomes.	Forty-five individuals between 18-45 of age with prediabetes/diabetes	Four-week Randomized Control trial	The additional coaching provided improved health outcomes	Level II: Randomized Study	Limitations of the study consisted of four weeks, and minimal biochemical variables were analyzed in participants.	Yes: The study explains that CGM with coaching improves health outcomes.

Alaslawi, H., Berrou, I., Al Hamid , A., Alhuwail, D., & Aslanpour, Z. (2022). Diabetes self-management apps: Systematic Review of Adoption Determinants and Future Research Agenda. *Journal Medical Internet Research Diabetes*, *7*(3), 1-20. https://doi.org/10.2196/28153	Gain insight into diabetes self-management apps and HCP recommendations; future research is needed.	A literature search from PubMed, Scopus, CINAHL, ACM digital library, IEEE Xplore digital library, and Cochrane utilization of the words mobile Apps, mHealth, smartphones, digital technology, and diabetes	Systematic review	Findings revealed individuals and HCP with more technical information were more likely to recommend using an app, and tech-savvy individuals would utilize apps.	Level I: Systematic review	It was the first systematic review of DSM apps and HCP recommendations. Some studies were not concluded or were poor.	Yes: it indicates with proper knowledge and education, Mhealth can play a role in diabetes management.
Alshehri, F., & Alshaikh, F. (2021). Exploring the constituent elements of a successful mobile health intervention for prediabetic patients in King Saud University Medical City	To understand successful mhealth interventions for	Questionnaires sent to Participants consisted	Cross-Sectional	Twenty healthcare professionals, ten physicians, six	Level VI: Qualitative Study	Limitations consist of the study being cross-	Yes, it provides insight into mHealth for prediabetes interventions

Hospitals in Saudi Arabia: Cross-sectional study. *Journal Medical Internet Research Formative Research*, *5*(7), 1-22. https://doi.org/10.2196/22968	individuals with prediabetes	of thirty-eight healthcare providers and 281 individuals with prediabetes ages 20-65 in Saudia Arabia.		dieticians, and four health educators return questionnaires. The impactful intervention was medicine, a healthy diet, and physical activity; 85% believed mHealth apps would benefit individuals with prediabetes. Individuals with prediabetes were willing to utilize mHealth		sectional and the sample size	

Annie Kao, T.-S., Born, A. L., & Ling, J. (2021). Ameliorating prediabetes with healthy lifestyles: A stage-tailored motivational interviewing pilot. *The Journal for Nurse Practitioners*, *17*(7), 860–864. https://doi.org/10.1016/j.nurpra.2021.04.003	To assess the effectiveness of MI in modifying lifestyle	Twenty-three African American females from 200 were invited based on inclusion criteria of BMI greater than 25 and A1c 5.7-6.4. completed a pilot program. A six-week nurse program that required face-to-face two times and then received two 20–30-minute phone	Controlled trial without randomization	The study's results improved eating; individuals didn't even know they had prediabetes. MI allowed for deeper communication to learn about food insecurities. Consumption of sweets and fatty foods was significantly decreased	Level III: Controlled intervention: Pilot Program	Limitations include small sample sizes, self-reported measures, and preliminary long-term evaluations.	Yes, using telephone MI is a form of telehealth that can assist in preventing T2DM.

		calls that were two weeks apart					
Azzi, J. L., Azzi, S., Lavigne-Robichaud, M., Vermeer, A., Barresi, T., Blaine, S., & Giroux, I. (2020). Participant evaluation of a prediabetes intervention program designed for rural adults. *Canadian Journal of Dietetic Practice and Research*, *81*(2), 80–85. https://doi.org/10.3148/cjdpr-2019-033	Evaluate the effectiveness of a prediabetes educational program	Forty-nine adults with prediabetes in Ontario attended a monthly group program addressing nutrition, knowledge of diabetes, activity, and lifestyle modifications	Descriptive Study	Results revealed that participants made lifestyle modifications from the education received during the program.	Level VI: Descriptive	Limitations of the study consist of the individuals who completed the focus groups discussion were motivated, compared to those that did not attend	Yes, the study provided the resources that an educational program is beneficial in preventing T2DM.
Batten, R., Alwashmi, M. F., Mugford, G., Nuccio, M., Besner, A., & Gao, Z. (2022). A 12-month follow-up of the effects of a digital diabetes prevention program (VP transform for Prediabetes) on weight and physical activity	Examine the digital National Diabetes Prevention Program (NDPP) through a	The study consisted of 1095 individuals with prediabetes who completed	Retrospective longitudinal cohort secondary data analysis	Findings revealed that those who completed at least nine months of	Level III: Controlled study with no control group	Limitations of the study include mainly females, no control	Yes: the study provided valuable insight into how digital NDPP with virtual coaches and

among adults with prediabetes: Secondary Analysis. *Journal Medical Internet Research Diabetes*, *7*(1), 1-12. https://doi.org/10.2196/23243	12-month weight and physical activity study.	at least nine months of the 12-month program. 741 were women average age of 53		the program lost an average of 11.4 lbs and 5.5% weight loss, and increased physical activity went from 66 minutes per week to 154 minutes per week.		group, and the intensity of exercise was not measured.	classes can help individuals with prediabetes.
Cannon, M. J., Ng, B. P., Lloyd, K., Reynolds, J., & Ely, E. K. (2022). Delivering the National Diabetes Prevention Program: Assessment of enrollment in in-person and virtual organizations. *Journal of Diabetes Research*, *2022*, 1–9. https://doi.org/10.1155/2022/2942918	To analyze the number of prediabetes individuals enrolled by the delivery method in the CDC National DPP from Jan 2012 to Dec 2019	Total enrollment was 455,954 ages 18 or older with prediabetes BMI greater than 25. Person - 166,691 online - 269,004, distance-	Analyze and describe the cumulative enrollment to gain insight into the different delivery modes.	The study's results provided valuable information on the lifestyle changes that can prevent or delay T2DM for individuals with	Level VI: Descriptive study	Limitations of the study consist of the different state number enrollments, technology availability of some	Yes: the study provides the implications and knowledge of various delivery methods of NDPP and insight into the demographics of the different delivery

		learning-4,786, and combination 15,473 There were various ethnic and cultural individuals in each group; the majority were female between 45-64 years.		prediabetes.		areas, and 18% of organizations disenrolled in the program.	methods. In addition, NDPP can prevent or delay T2DM.
Celik, S., Olgun, N., Yilmaz, F. T., Anataca, G., Ozsoy, I., Ciftci, N., Aykiz, E. F., Yasa, S., Karakiraz, E., Ulker, Y., Demirhan, Y. E., Celik, S. Y., Arpaci, I., Gunduz, F., Temel, D., Dincturk, C., Sefer, B. E., Bagdemir, E., Erdem, E., … Cetin, N. (2022b). Assessment of the effect of diabetes education on self-care behaviors and glycemic control in the Turkey Nursing Diabetes Education Evaluating Project	To gain insight into if education improves self-care and glycemic control	Seven-month study in Turkey of 1492 individuals with T2DM avg age of 59 males and females,	Descriptive Cross-Sectional	Results revealed that those provided with education have better self-care and improved glycemic control, improved HgbA1c over 1%	Level: VI Descriptive	Limitations of the study include the location of 28 different hospitals in Turkey, various demographics, and the	Yes: The study provides insight into education is crucial to improved self-care in diabetes management.

(TURNUDEP): A multi-center study. *BioMedical Central Nursing*, *21*(1), 1-9. https://doi.org/10.1186/s12912-022-01001-1						education provided, the diabetes nurse educator selected sample,	
Dagogo-Jack, S., Umekwe, N., Brewer, A. A., Owei, I., Mupparaju, V., Rosenthal, R., & Wan, J. (2022). The outcome of lifestyle intervention concerning the duration of prediabetes: The pathobiology and reversibility of Prediabetes in a biracial cohort (prop-ABC) study. *British Medical Journal Open Diabetes Research & Care*, *10*(2), 1-9. https://doi.org/10.1136/bmjdrc-2021-002748	The study was to evaluate lifestyle intervention in individuals with a family history of T2DM	222 participants, African American and European American adults with normoglycemic values, followed for 5.5 years with no (POP-ABC) interventions, enrolled every six months	Observational study to a randomized control study 72 individuals remained normoglycemic in the control group	The study revealed with close observation in individuals with a family history of T2DM, catching prediabetes early and initiating lifestyle modifications can reduce or prevent T2DM by approximately 93%	Level IV: Observational	The limitation of the study is that enrollment was based on a family history of T2DM. In addition, adherence to lifestyle modifications was not measured; only 70% attended the schedule	Yes: It provides value to the early detection of prediabetes and encourages healthcare professionals to screen early and encourage lifestyle modifications.

						d sessions, and the material was mailed, but unsure of the status of the material once it reached the individual.	
Davis-Ajami, M. L., Lu, Z. K., & Wu, J. (2021). Delivery of healthcare provider's lifestyle advice and lifestyle behavioural change in adults who were overweight or obese in prediabetes management in the USA: NHANES (2013–2018). *Family Medicine and Community Health*, *9*(4), 1-7. https://doi.org/10.1136/fmch-2021-001139	The object of the study is to understand how healthcare professionals provide information and advice to individuals with prediabetes/ overweight for lifestyle	1039 Adults with prediabetes, overweight, impaired fasting glucose, and elevated BMI. Seven hundred ninety-eight of	Retrospective-cross-sectional	Over seventy percent of those 798 who received advice made the necessary lifestyle recommendations to reduce T2DM from occurring.	Level IV: Case-Control Study	Limitations of the study include individuals who self-reported the diagnosis of prediabetes. The healthcare professionals'	The study provides insight into the importance of healthcare professionals encouraging patients to make lifestyle modifications to prevent T2DM.

	modifications	those received advice from healthcare professionals. Two hundred and forty-one did not receive advice.				specialty was unknown to verify what advice was given.	
Ghisi, G. L., Seixas, M. B., Pereira, D. S., Cisneros, L. L., Ezequiel, D. G., Aultman, C., Sandison, N., Oh, P., & da Silva, L. P. (2021a). Patient education program for Brazilians living with diabetes and prediabetes: Findings from a development study. *BioMedical Central Public Health*, *21*(1), 1-16. https://doi.org/10.1186/s12889-021-11300-y	To gain insight into a structured education program for individuals with diabetes and prediabetes who live in Brazil	The study reviewed the literature on developing diabetes education to	Literature review that occurred over two years on needs analysis, best practices to obtain a program from Brazil	The results of the study revealed 18 educational sessions	Level: V Systematic review	Limitations of the study include the method of analysis of the literature. Information needs were based upon experts, not individuals.	Yes, the study indicates a process for an educational plan.

Idris, M. Y., Alema-Mensah, E., Olorundare, E., Mohammad, M., Brown, M., Ofili, E., & Pemu, P. (2022). Exploring the discursive emphasis on patients and coaches who participated in technology-assisted diabetes self-management education: Clinical Implementation Study of health360x. *Journal of Medical Internet Research*, *24*(3),1-21. https://doi.org/10.2196/23535	Identify results that occur from communications between patients and coaches on self-management of diabetes.	The study comprised 80 adults with diabetes and a high risk for complications: tobacco use, high BMI, depression, HTN, HgbA1C >7, recent hospitalizations for hypoglycemia, and renal and cardiac issues. The study went over five years.	Implementation study Longitudinal data and transcripts analyzed	Results of the study revealed that changes were made when coaches received good feedback. The study also revealed that when coaches dominated the conversation, a slight improvement in diabetes management was made.	Level VI: Qualitative	Limitations consisted of several topic models utilized that were less than available. Transcription was outsourced, and transcription errors could have occurred. A subjective analysis could occur. The sample size was small. Another limitation was the training	Yes: overall, the information is valuable to help to be aware of a practice change; communication techniques are essential with Telehealth

						of coaches.	
Kirley, K., & Sachdev, N. (2018). Digital Health–supported lifestyle change programs to prevent type 2 diabetes. *Diabetes Spectrum*, *31*(4), 303–309. https://doi.org/10.2337/ds18-0019	Describe how digital LCP can help prevent T2DM and to identify gaps	Articles reviewed from PubMed from 2000-2018 on the effectiveness of digital health-supported LCPs. efficacy was based on weight loss	Systematic Review	The study revealed gaps in patient experience on digital LCPs, and healthcare professionals need to understand the various modalities of digital health and what best suits the patient. Digital options can assist in reducing costs and offer availability to patients who cannot	Level V: Systematic review or literature	Limitations of the study consist of research conducted from 2000-2018, in which digital LCP has expanded.	The study provides insight into digital LCP in the prevention of T2DM.

				attend in person.			
Kirwan, M., Chiu, C. L., Laing, T., Chowdhury, N., & Gwynne, K. (2022). A web-delivered, clinician-led group exercise intervention for older adults with type 2 diabetes: Single-arm pre-post intervention. *Journal of Medical Internet Research*, *24*(9), 1-12. https://doi.org/10.2196/39800	To gain insight into an online educational program benefits for T2DM and exercise compared to the in-person program	The sample included individuals with T2DM, 171 adults over 60 completed a web-based health and fitness assessment.	Cohort Study	Results revealed that the online program was just as effective as the in-person program.	Level IV**:** Cohort	Pre and post-evaluation but did not have a control group; only short-term results were evaluated, not long-term outcomes.	Yes, the study reveals that Telehealth via Zoom is another option for Diabetes Education.
Leong, C. M., Lee, T.-I., Chien, Y.-M., Kuo, L.-N., Kuo, Y.-F., & Chen, H.-Y. (2022). Social Media–delivered patient education to enhance self-management and attitudes of patients with type 2 diabetes during the COVID-19 pandemic: Randomized Controlled Trial. *Journal of Medical Internet Research*, *24*(3), 1-15. https://doi.org/10.2196/31449	The study aimed to evaluate the use of social media platforms and the management of diabetes.	Ninety-one individuals were in the intervention group and 90 in the control group. Criteria consisted of being	Open-level randomized control	Results revealed no significant change between groups in HbA1c, but the intervention group increased knowledge and	Level II: Randomized control trial	Limitations consisted of videos being clicked on but unsure of the actual individual watching and economic	Yes: utilization of social media/technology and diabetes education will enhance the project by incorporating technology and education

		over age 20, having Hb A1C more significant than 6%, and having a smartphone.		attitude toward diabetes.		s involved in social media was not thoroughly conducted. Time was only 12 weeks, another limitation; it was a single-center study with limited demographics.	
Lewinski, A. A., Walsh, C., Rushton, S., Soliman, D., Carlson, S. M., Luedke, M. W., Halpern, D. J., Crowley, M. J., Shaw, R. J., Sharpe, J. A., Alexopoulos, A.-S., Tabriz, A. A., Dietch, J. R., Uthappa, D. M., Hwang, S., Ball Ricks, K. A., Cantrell, S., Kosinski, A. S., Ear, B., … Goldstein, K. M. (2022).	To identify if Telehealth use is equivalent to in-person care	8662 studies reviewed, 129 full texts of CHF, COPD, and T2DM, four met inclusions	Systematic review: MEDLINE and Embase	Results revealed that with the Telehealth groups compared to standard care, there	Level I: Systematic review	Studies only included EPOC criteria, reviewed three chronic conditions, and studied	The studies revealed that Telehealth in conjunction with in-person could significantly improve T2DM.

Telehealth for the longitudinal management of chronic conditions: Systematic review. *Journal of Medical Internet Research*, *24*(8), 1-19. https://doi.org/10.2196/37100		for diabetes		was a drop in HbA1c.		only in OECD countries.	
Litchman, M. L., Kwan, B. M., Zittleman, L., Simonetti, J., Iacob, E., Curcija, K., Neuberger, J., Latendress, G., & Oser, T. K. (2022). A telehealth diabetes intervention for rural populations: Protocol for a randomized controlled trial. *Journal Medical Internet Research Research Protocols*, *11*(6), 1-9. https://doi.org/10.2196/34255	Implement diabetes education in a rural area and compare it to standard care.	Type 1 and type 2 individuals with diabetes, English, and Spanish speaking, 64 participants and 16 care partners.	Randomized control	The first study to evaluate telehealth diabetes education in rural areas	Level II: randomized control trial	Limitations consist of the number of individuals who participated	The results of the study would indicate the effectiveness of telehealth diabetes education, which could be used to construct a change
Mash, R., Schouw, D., & Fischer, A. E. (2022). Evaluating the implementation of the great4diabetes WhatsApp Chatbot to educate people with type 2 diabetes during the COVID-19 pandemic: Convergent mixed methods	The study aimed to evaluate a Chatbot, a mobile app for diabetes education.	Sixteen three-four minutes videos were sent out to 4577 individual	Mixed method	The study's results indicate that those who listened made	Level III: Control trial without randomization	Limitations of the study consist of data collection, Chatbot not being	Yes: study indicates that mobile applications provide insight into lifestyle changes.

study. *Journal Medical Internet Research Diabetes*, *7*(2), 1-16. https://doi.org/10.2196/37882		s who listened to the messages.		changes and even passed messages to other individuals.		made for research data, and not interviewing patients to get additional data.	
MohammadniaMotlagh, K., Shamsi, M., Roozbahani, N., Karimi, M., & Moradzadeh, R. (2022). Effect of theory-based education on promoting a healthy lifestyle in prediabetic women: RCT. *BioMedical Central Women's Health*, *22*(1), 1-9. https://doi.org/10.1186/s12905-022-01608-1	To gain insight into using a theory of planned behavior educational tool to assist individuals in making lifestyle changes	Arak, Iran health centers with seventy-one women, 30-60, average 46 years old, with prediabetes. 36 in the intervention, 35 in the control group, and pretest and post-test	Randomized controlled trial	Results of the study showed that education using this theory provides individuals with the resources and knowledge to make lifestyle changes.	Level II: randomized Control Study	Limitations of the study include self-reported items, and follow-up was during Covid-19. The sample size included only women.	The study provides valuable insight when implementing an education program for prediabetes to assist people in making lifestyle modifications.

Mokaya, M., Kyallo, F., Vangoitsenhoven, R., & Matthys, C. (2022). Clinical and patient-centered implementation outcomes of health interventions for type 2 diabetes in low-and-middle-income countries: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *19*(1), 1-21. https://doi.org/10.1186/s12966-021-01238-0	To gain a better insight into the use of mHealth interventions for individuals with diabetes	Of 1116 articles reviewed, only 30 met the criteria	A systematic review and Meta-analysis	Results found that there was an improvement in HbA1c with mhealth interventions.	Level I: Systematic review	The limitation of the study was it did not indicate actual HbA1c levels, grey literature was not included within the search, and only articles in English.	Yes: it demonstrates that mhealth does improve diabetes knowledge and management.
Olson, J. L., White, B., Mitchell, H., Halliday, J., Skinner, T., Schofield, D., Sweeting, J., & Watson, N. (2022). The design of an evaluation framework for diabetes self-management education and support programs delivered nationally. *BioMedical Central Health Services Research*, *22*(1), 1-11. https://doi.org/10.1186/s12913-021-07374-4	To develop a framework to standardize group education and ensure consistent program quality	Team approach from diabetes experts, dieticians, and other health care professionals that provide diabetes care	A systematic review of diabetes education to develop the framework utilized by a participatory approach.	Results developed key outcomes, indicators, and tools to ensure quality diabetes education is conducted.	Level V: Systematic review of outcome	Limitations consisted of not receiving a vast amount of input from the community; the framework needs to	Yes: it provides the framework to help develop the criteria/framework for prediabetes education.

						consider resources. Standards for general people with diabetes	
Salmon, M. K., Gordon, N. F., Constantinou, D., Reid, K. S., Wright, B. S., Kridl, T. L., & Faircloth, G. C. (2021). Comparative effectiveness of lifestyle intervention on fasting plasma glucose in normal weight versus overweight and obese adults with Prediabetes. *American Journal of Lifestyle Medicine*, *16*(3), 334–341. https://doi.org/10.1177/15598276211019012	To gain insight into lifestyle intervention through technology for prediabetes and obesity on fasting plasma glucose	The study consisted of 1358 US adults, avg age 51, that completed an assessment and follow-up at six months of a technology LHC program.	Controlled trial without randomization	Results include decreased FPG, decreased weight, a change in BMI, and improved blood pressure and cholesterol.	Level II: Randomized controlled study	The limitation of the study is the short follow-up of the control group. Activity intensity and calorie consumption were not evaluated.	The study provides insight that technology programs can help achieve lifestyle modifications.
Sevilla-Gonzalez, M. D., Bourguet-Ramirez, B., Lazaro-Carrera, L. S., Martagon-Rosado, A. J., Gomez-Velasco, D. V., & Viveros-Ruiz, T. L. (2022). Evaluation of a web platform	To explore barriers, feasibility, and usability of Vida Sana	Mexican males and females between 18-65 with	Three-month Prospective Interventional Study of lifestyle modification	The findings of the study showed that the	Level III: Controlled trial without randomization	The limitation of the study is that COVID-	Yes: data proves that the web platform, Telehealth is beneficial in

to record lifestyle habits in subjects at risk of developing type 2 diabetes in a middle-income population: Prospective Interventional Study. *Journal Medical Internet Research Diabetes*, *7*(1), 1-12. https://doi.org/10.2196/25105	(Web platform) for recording lifestyle habits of individuals with prediabetes or individuals at risk of T2DM	prediabetes and a BMI of 24-40 kg/m² from the public hospital were invited through phone and physical. advertising 231 screened, 77 completed the study: 33 used the platform, 44 did not	s and lifestyle modifications plus metformin	web platform lowered fasting glucose levels, 2 hours postprandial, and body fat percentage		19 interrupted the study, limiting the sample size.	individuals with prediabetes.
Signal, V., McLeod, M., Stanley, J., Stairmand, J., Sukumaran, N., Thompson, D.-M., Henderson, K., Davies, C., Krebs, J., Dowell, A., Grainger, R., & Sarfati, D. (2020). A mobile- and web-based health intervention program for diabetes and	To gain insight and evaluate BetaMe/Melon (digital intervention platform) and what users found	429 Individuals ages 18-75 with an HbA1c of 41-70 mmol/mol enrolled in	Sixteen-week Randomized Controlled Trial 215 intervention arms	Findings revealed the participants liked the program, but individuals dropped	Level II: Randomized control study	Limitations included information released by the web platform,	Yes: although helpful information does support the perspective from a user view of the

Prediabetes Self-management (became/melon): Process evaluation following a randomized controlled trial. *Journal of Medical Internet Research*, *22*(12), 1-13. https://doi.org/10.2196/19150	helpful and to identify potential barriers.	BetaMe/ Melon receiving primary care	214 control arms	off over the sixteen weeks.		data from coaching not being fully disclosed, and not all individuals answering the online questionnaire.	digital platforms
Somerville, M., Ball, L., Chua, D., Johnson, T., Williams, S., & Williams, L. T. (2021). How do healthcare providers support people with Prediabetes to eat well? An in-depth, mixed-methods case study of provider practices. *Australian Journal of General Practice*, *50*(7), 497–504. https://doi.org/10.31128/ajgp-08-20-5597	To explore HCP practices on nutrition care for individuals with prediabetes	May 2019- Jan 2020 in Australia to include 47 patients who agreed and met the criteria to have their chart reviewed and who visited the facility at least three	Retrospective chart review	Results of the review indicated that HCP understands the need for nutrition consults with individuals with prediabetes, but referrals and what individuals receive	Level: V Systematic review	Limitations of the study include a small sample size	Yes, the study provides insight into the importance of nutrition for individuals with prediabetes

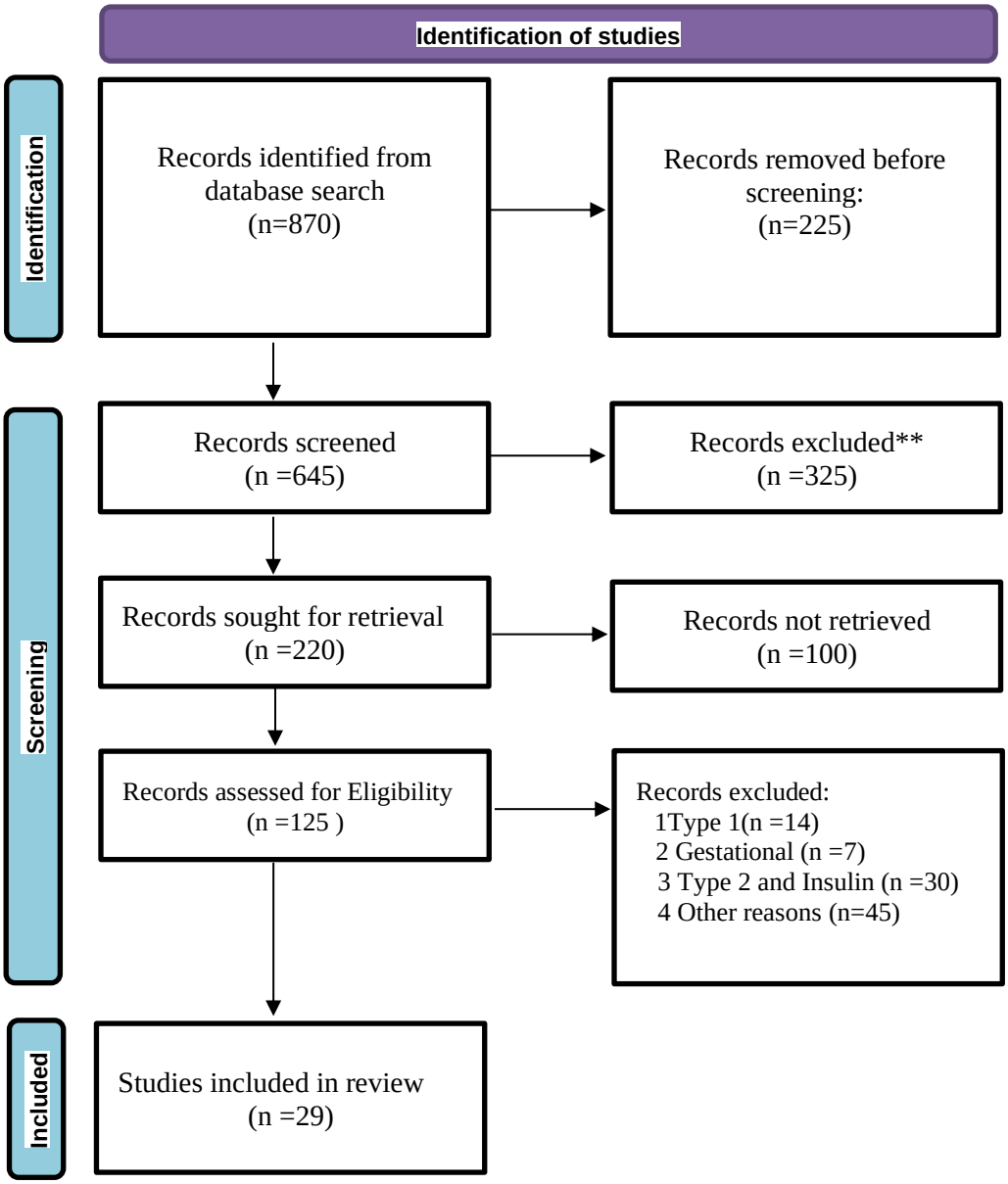
		times within the year, were over 18, and had prediabetes.		are limited.			
Somerville, M., Ball, L., Sierra-Silvestre, E., & Williams, L. T. (2019). Understanding the knowledge, attitudes, and practices of providing and receiving nutrition care for Prediabetes: An integrative review. *Australian Journal of Primary Health*, *25*(4), 289-302. https://doi.org/10.1071/py19082	To understand how healthcare professionals and patients understand the relationship between nutrition and prediabetes	Literature review of CINAHL, MEDLINE< Embase, PsychINFO, Scopus, and ProQuest, 12,851 reviewed, 26 met criteria of focus on nutrition	Systematic Review	Results revealed a discrepancy in care experienced by patients compared to the care reported. Healthcare professionals face barriers when providing nutritional care.	Level I: Systematic Literature Review	Limitations of the study included the time range and the many articles reviewed; some could have been overlooked.	The study indicates the gap in nutrition care among healthcare professionals and patients; nutrition is vital to prediabetes education.
Teoh, K. W., Ng, C. M., Chong, C. W., Bell, J. S., Cheong, W. L., & Lee, S. W. (2023b). Knowledge, attitude, and practice toward pre-diabetes among the public, patients with pre-diabetes and healthcare professionals: A	To gain an in-depth knowledge of evidence to improve diabetes prevention	Analysis of over 4600 relevant articles to include over 8800 participan	A systematic review to include reports from CINAHL, PsyciINFO, PubMed, Embase,	Results viewed knowledge of prediabetes from the patient's view;	Level I: Systematic Review	The limitation of the viewed quantitative and not qualitativ	Understanding KAP is essential to developing and implementing a telehealth

systematic review. *British Medical Journal Open Diabetes Research & Care*, *11*(1), 1-10. https://doi.org/10.1136/bmjdrc-2022-003203		ts within the studies, 2007 had prediabetes, with a mean age of 45	CNKI, and LILIACS	93.7% of individuals were unfamiliar with prediabetes and related terms and had mixed perceptions. Healthcare providers agree that lifestyle modifications are crucial		e KAP, participants were from middle-income countries	program for prediabetes.
Yin, W., Liu, Y., Hu, H., Sun, J., Liu, Y., & Wang, Z. (2022). Telemedicine management of type 2 diabetes mellitus in obese and overweight young and middle-aged patients during COVID-19 outbreak: A single-center, prospective, Randomized Control Study. *PLOS ONE*, *17*(9), 1-13. https://doi.org/10.1371/journal.pone.0275251	To understand the effects of Telehealth for individuals with type 2 DM during COVID	One hundred and twenty individuals with type 2 DM, ages 18-55, 60 in each group	Single-center, prospective randomized study using a random number sequence by the SPSS software	Results of the study revealed that the intervention group significantly improved BMI, HbA1c, FBG, and PBG.	Level II: Randomized study	Limitations consist of a single study; only individuals who could use mobile phones and had internet	Yes: as technology and health care advance, learning how Telehealth can assist with improved patient outcomes provides the rationale used within the IR.

						were in the study.	
Zimmermann, S., Vogel, M., Mathew, A., Ebert, T., Rana, R., Jiang, S., Isermann, B., & Biemann, R. (2022). The extent of lifestyle-induced weight loss determines the risk of prediabetes and metabolic syndrome recurrence during a 5-year follow-up. *Nutrients*, *14*(15), 1-14. https://doi.org/10.3390/nu14153060	The study aimed to determine if a higher increase in weight loss reduced T2DM in individuals with obesity/risk for prediabetes using a technology LIWL.	Seventy-four individuals met the criteria for the six-month program. Thirty in control, thirty-three in the intervention	Randomized Controlled	Results of the study revealed that weight loss achieved within the first two months revealed consistent with maintaining that weight loss; 30% dropped out during the five-year follow-up.	Level II: Randomized study	Limitations of the study included only Caucasian males, the sample size, and the dropout percentage.	The study is helpful with using telehealth in a WL education program. Telemonitoring and weekly letters resources to be utilized

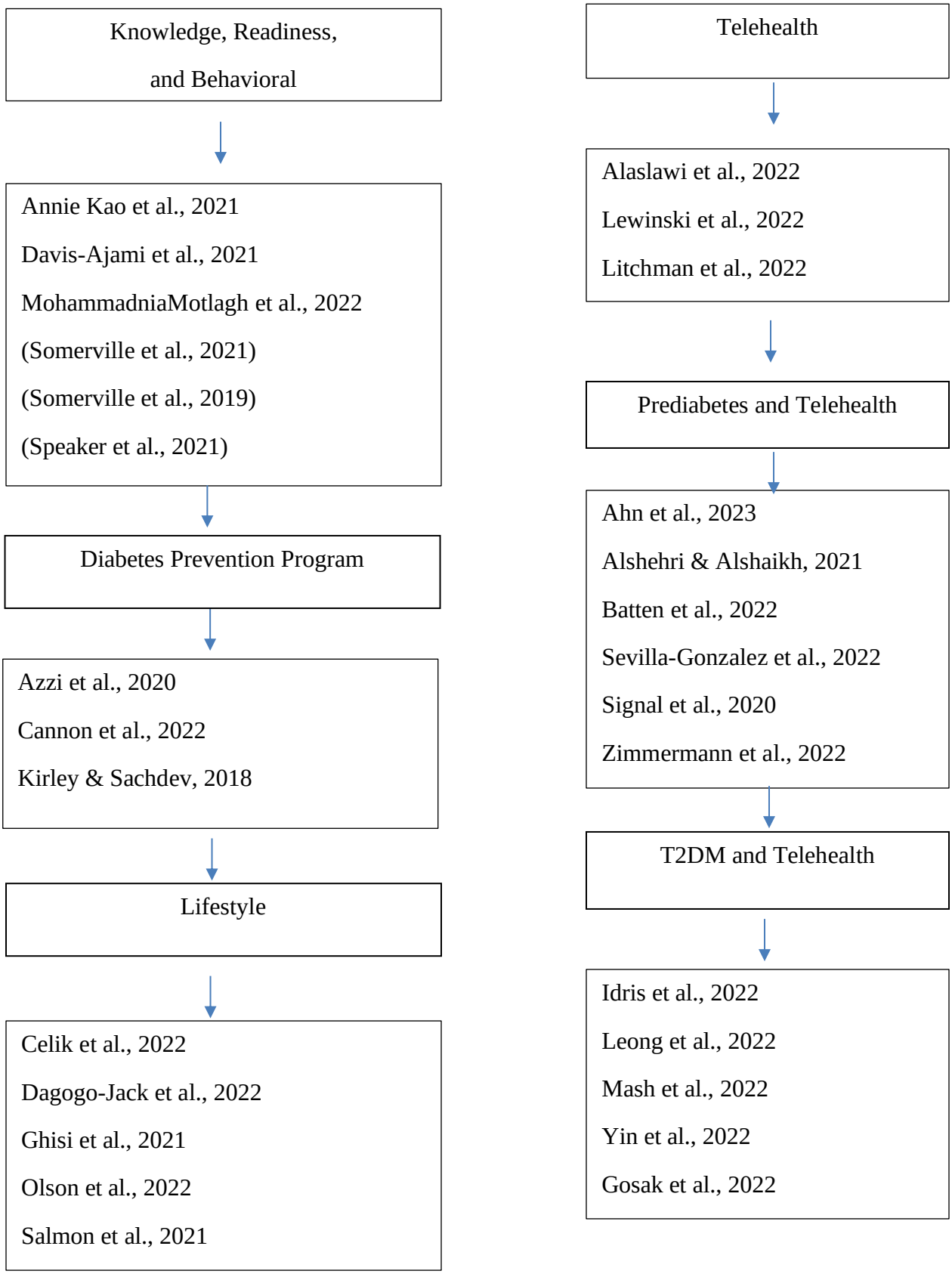
Appendix B

PRISMA 2020 Flow Diagram



From: Prisma. (n.d.). Retrieved April 27, 2023, from http://www.prisma-statement.org/PRISMAStatement/FlowDiagram

Appendix C

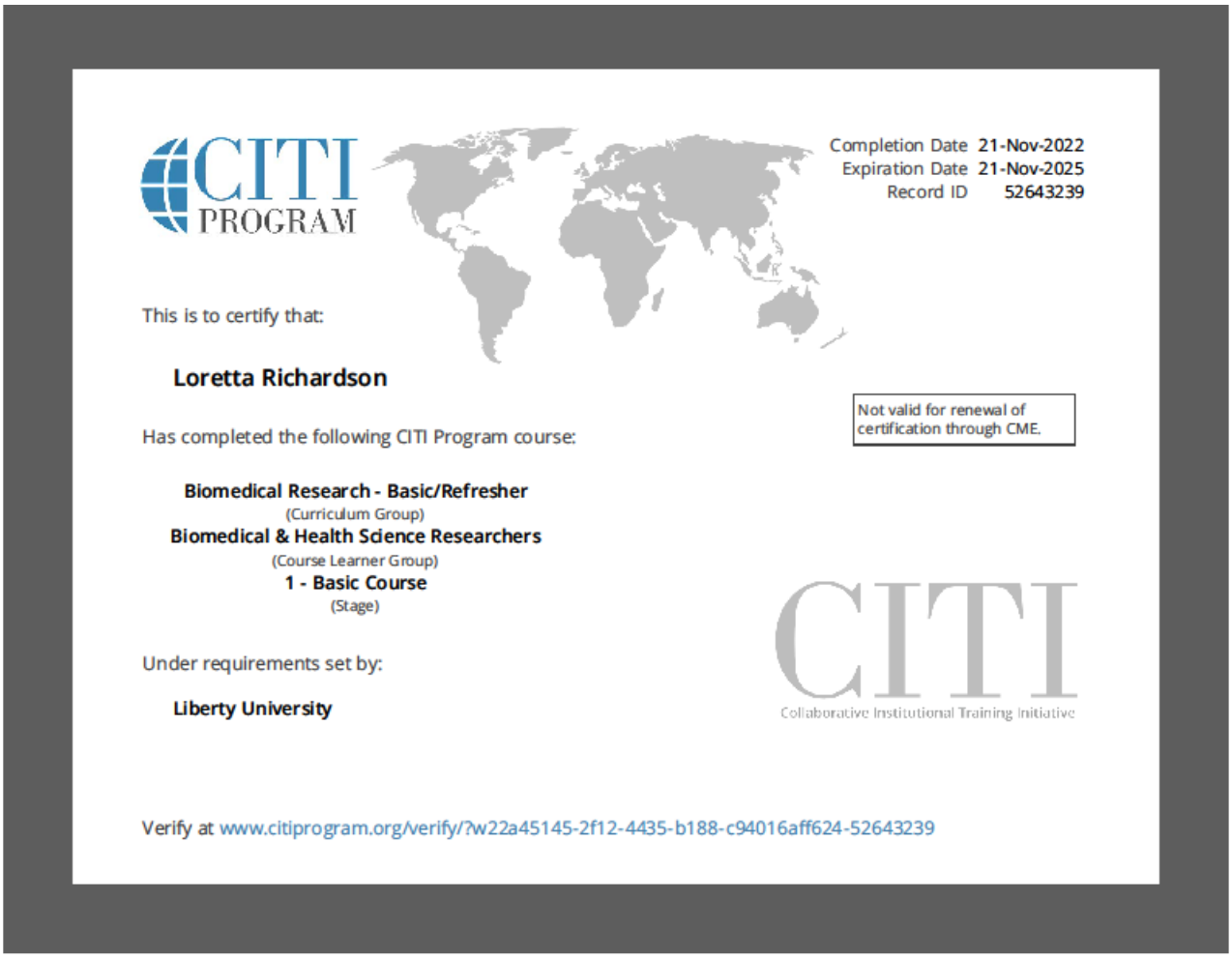

Knowledge, Readiness, and Behavioral
Annie Kao et al., 2021
Davis-Ajami et al., 2021
MohammadniaMotlagh et al., 2022
(Somerville et al., 2021)
(Somerville et al., 2019)
(Speaker et al., 2021)
Diabetes Prevention Program
Azzi et al., 2020
Cannon et al., 2022
Kirley & Sachdev, 2018
Lifestyle
Celik et al., 2022
Dagogo-Jack et al., 2022
Ghisi et al., 2021
Olson et al., 2022
Salmon et al., 2021
Telehealth
Alaslawi et al., 2022
Lewinski et al., 2022
Litchman et al., 2022
Prediabetes and Telehealth
Ahn et al., 2023
Alshehri & Alshaikh, 2021
Batten et al., 2022
Sevilla-Gonzalez et al., 2022
Signal et al., 2020
Zimmermann et al., 2022
T2DM and Telehealth
Idris et al., 2022
Leong et al., 2022
Mash et al., 2022
Yin et al., 2022
Gosak et al., 2022

Appendix D

Timeline: Telehealth and Prediabetes Education

Milestone	Deliverable	Description	Estimated Completion Date
CITI Training	Student	CITI training for IRB knowledge	Dec2022
Project outline	Student/mentor	First draft Outline of Scholarly project	Dec 2022
Project Presentation	Student/mentor	Update presentation for defense	Feb 2023
Project update	Project	A second draft of the project/presentation with notes	Feb 2023
Facility approval	Preceptor/Facility	Approval to begin practicum hours	Feb 2023
Approval	Facility/preceptor	Receive support for the project at the facility	Feb 2023
IRB	Student	IRB application	Mar 2023
CDCES Exam	Student	Certified Diabetes Care and Education Specialist	Mar 2023
Project Part 4	Student/Mentor	The first draft of Part 4 Submitted	Apr 2023
Project research analysis	Student	In-depth review of the literature	Apr 2023
Presentation updated	Student/Mentor	Update presentation to include	Apr 2023
Project update	Project	The second draft of the project/presentation to include Sections 4 & 5	Apr 2023
Project Completion	Chair	Review of the Final manuscript	May 2023
Editor review	Editor	Review by Editor	May 2023
Project Defend	Student/Chair	Final Defense of Project	Jun 12, 2023
Submission to Scholars Crossing	Student	Submission to Scholars Crossing at Liberty University Library	Jun 12, 2023

Appendix E



CITI PROGRAM

Completion Date 21-Nov-2022
Expiration Date 21-Nov-2025
Record ID 52643239

This is to certify that:

Loretta Richardson

Not valid for renewal of certification through CME.

Has completed the following CITI Program course:

Biomedical Research - Basic/Refresher
(Curriculum Group)
Biomedical & Health Science Researchers
(Course Learner Group)
1 - Basic Course
(Stage)

Under requirements set by:

Liberty University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w22a45145-2f12-4435-b188-c94016aff624-52643239

Appendix F

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

March 31, 2023

Loretta Richardson

Debra Maddox

Re: IRB Application - IRB-FY22-23-1306 Does A Telehealth Education Program

Improve Lifestyle Behaviors of Individuals with Prediabetes? An Integrative Review

Dear Loretta Richardson and Debra Maddox,

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds that your study does not meet the definition of human subjects research. This means you may begin your project with the data safeguarding methods mentioned in your IRB application.

Decision: No Human Subjects Research

Explanation: Your study is not considered human subjects research because it will not involve the collection of identifiable, private information from or about living individuals (45 CFR 46.102).

Please note that this decision only applies to your current application. Any modifications to your protocol must be reported to the Liberty University IRB for verification of continued non-human subjects research status. You may report these changes by completing a modification submission through your Cayuse IRB account.

If you have any questions about this determination or need assistance in determining whether possible modifications to your protocol would change your application's status, please email us at irb@liberty.edu.

Sincerely,

G. Michele Baker, MA, CIP

Administrative Chair of Institutional Research

Research Ethics Office