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The Effect of Using a Meal Tracking Smartphone Application in Overweight and Obese Adolescents with Prediabetes or Type 2 Diabetes to Improve BMI and HbA1c

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THE EFFECT OF USING A MEAL TRACKING SMARTPHONE APPLICATION IN OVERWEIGHT AND OBESE ADOLESCENTS WITH PREDIABETES OR TYPE 2 DIABETES TO IMPROVE BMI AND HbA1c

by

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EVIDENCE-BASED PRACTICE PROJECT REPORT

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DEDICATION

I would like to dedicate the following project to my parents who from an early age inspired me to pursue a career path in healthcare because of their lifelong devotion to making the world a better place. To my parents, thank you for always pushing me to be nothing short of excellent in this life. I owe you everything in allowing me to be where I am today. Dad, thank you for raising me to mirror your continued efforts as a tireless and compassionate leader and never allowing others to undermine who I am and what I am destined for. Mom, when others have questioned the life path I have chosen, you have continued to remind me that despite everything life has thrown at me, I am worthy of greatness. I aspire to be every bit of who you are in my future in witnessing the positive impact you have had and continue to impose on others.

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I must also acknowledge the people who have not only inspired me to chase my dreams, but have supported me wholeheartedly throughout my journey to becoming a Nurse Practitioner (NP). To my grandparents, thank you all for being my biggest cheerleaders on and off the soccer field. It means the world to me for you all to have witnessed my growth from the day I was born to now graduating as an NP. To my beloved Preston, we dove face first into our relationship at the mere start of my nursing career and graduate education and somehow you chose to stick around for the long haul. You have never failed to support me in pursuit of my occupational goals even if it meant occasional sacrifice. I thank you for your continued devotion to being my life partner and for single handedly keeping me well rested and fed despite the chaos that we have endured the past three years. You have continued to show up for me every day since the day I met you and even more so throughout the entirety of this program. With this chapter of our lives coming to an end, I cannot wait to see what lies ahead. I love and cherish you more than you will ever know. I also want to thank my classmates, Rylee and Claire, for welcoming me with open arms after transferring into the nursing program at the end of our freshman year. We have since endured this journey to becoming NPs together and I couldn't imagine experiencing it with anyone else. I'm beyond excited to take this next step in our careers together if even we continue to remain a few states apart. I also want to thank all of my professors who have been with me since my undergraduate education for their continued support and guidance in entering this next chapter of my career. Lastly, I want to acknowledge my project advisor, Dr. Davis, for her mentorship and positive support from afar throughout the entirety of my DNP project. She has inspired me to act with a certain level of patience, compassion, and drive moving forward in my future career as an NP.

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ABSTRACT

Obesity has become one of the most common chronic pediatric illnesses worldwide and is closely linked to the onset of prediabetes and subsequent Type 2 Diabetes (T2D); therefore, preventing and treating childhood obesity has become a high priority (Hampl et al., 2023). The purpose of this Evidence-Based Practice (EBP) project is to lower Glycosylated Hemoglobin A1c (HbA1C) and Body Mass Index (BMI) in overweight and obese youth with prediabetes and T2D using a meal tracking smartphone application. The Johns Hopkins Nursing Evidence-Based Practice Model (JHNEBP) was utilized to pilot this project between two pediatric endocrinology offices located in Southeast Wisconsin. Upon organizational approval of this EBP project, adolescents, aged 10 to 18, were recruited based on strict inclusion criteria including a diagnosis of prediabetes or T2D, obesity defined using the Centers for Disease Control and Prevention's (CDC) (2022c) BMI percentile calculator specific to children and prior nonuse of a meal tracking smartphone application. A total of 10 adolescents were recruited in 10–15-minute educational encounters. To achieve a reduction in both BMI and HbA1c in these participants, a smartphone application for meal tracking called Nourishly© was utilized to track dietary intake and provide individualized, diet specific education and feedback over a 12-week period. Seven educational handouts were also provided and utilized to help guide app usage as well as provide diabetes specific, dietary education to participants and their families. A paired *t* test was utilized to analyze the primary outcomes of the project including pre- and post- intervention BMI and HbA1c measures. Results for BMI showed no statistical evidence of a decrease (t =-0.655(9), p=0.264). Similar results were seen for HbA1c and there was no statistical evidence of a decrease (V=39, p=0.890). This EBP project highlights the need for further research to assess the use of dietary specific smartphone applications and their impact on HbA1c and BMI in overweight and obese youth with prediabetes and T2D in light of the digital era.

Keywords: adolescent, BMI, HbA1c, intervention, obesity, pediatric, prediabetes, smartphone application, T2D

CHAPTER 1

INTRODUCTION

Background

Historically, prediabetes and subsequent Type 2 diabetes (T2D) were labelled as adult-onset diseases as children and adolescents were rarely diagnosed. However, continual rise in the prevalence of T2D in youth dismisses previous assumptions that it is strictly an adult-onset disease process. T2D is recognized as a growing problem in young people and is highly correlated to the current obesity epidemic. According to the World Health Organization (WHO, 2021), childhood obesity has also become one of the most serious public health challenges of the 21st century. Being overweight or obese has been recognized as a leading risk factor in the development of prediabetes and T2D in all ages (Kaakinen et al., 2018; The United States Preventative Task Force (USPSTF), 2022; Wong et al., 2022); therefore, preventing and treating childhood obesity has become a high priority. WHO (2021) defines overweight and obesity as “abnormal or excessive fat accumulation that presents a risk to health”. Body Mass Index (BMI) is a standard anthropometric index of weight and height that calculates an individual's body fat as defined by the Centers for Disease Control and Prevention (CDC, 2023b). It is calculated by dividing a person’s weight (in kilograms) by the square of their height (in meters). In youth, BMI values are expressed relative to other children of the same sex and age due to developmental variability. Weight gain is a normal part of healthy development in children; however, excess amounts can place individuals at risk for the development of noncommunicable diseases such as T2D (WHO, 2020). Development of T2D in childhood and adolescence poses further risk of early-onset cardiovascular disease and renal complications; therefore, it is essential to manage both obesity and diabetes in youth to avoid premature complications including mortality. T2D is said to be largely preventable and well managed in

children and adolescents by means of weight loss. Prevention via lifestyle modifications, including improved dietary habits, specifically have been proven to help diabetic youth with underlying obesity prevent complications and improve overall glycemic control (Sivapuram et al. 2021; Wang et al., 2019).

Diabetes mellitus is a chronic health condition that affects the production of or way insulin functions to control blood sugar (CDC, 2023b). T2D specifically involves insulin resistance. Without a sufficient response to insulin in the body, blood sugar continually rises leading to the development of prediabetes. If prediabetes goes untreated, patients may develop T2D with potential complications including heart and renal disease. Weight loss and strict glycemic control in individuals with diabetes and obesity are important components of the diabetes treatment plan. These interventions in children and adolescents include lifestyle modifications such as indulging in a healthy and well-balanced diet paired with education. These are recognized as continued cornerstones of treatment for diabetes in all people and are often the first recommendations in properly managing the disease. Weight loss interventions of this nature in youth have also proven to be efficacious in overall glycemic control (American Diabetes Association (ADA), 2019; El Sayed et al., 2023). Furthermore, more substantial weight loss as a result of interventions including focused nutrition can impose greater health benefits related to glycemia and beyond with potential to even induce remission (El Sayed et al., 2023). Long term, improved nutrition can assist diabetic youth maintain a healthy weight which in turn can help provide a better quality of life.

Data Supporting Need for the Project

Global, National, Regional, and State Data

Obesity has become a commonality within the United States (US) and continues to be recognized as a major public health crisis. Not only is obesity associated with various diseases including T2D, but it is also a major contributor to premature mortality as well as economic burden. Hampl et al. (2023) states that obesity has also become one of the most common

chronic pediatric illnesses affecting up to 14.4 million children and adolescents today. To put this into perspective, it is estimated that one in every five children struggle with obesity (CDC, 2022a). In Wisconsin (WI) 27.9% of youth aged 10-18 years are overweight or obese. According to the CDC (2022a), obesity alone costs the US healthcare system nearly 173 billion dollars annually. Obesity in turn has also become an issue of national security. In recent years the CDC (2022a) states that only two of every five eligible young adults are weight eligible and therefore physically prepared for basic training in the US. Unfortunately, the persistent rise in rates of obesity in the US is due to a multitude of factors, many of which are beyond individual choices including access to healthy and affordable foods. For example, 40% of all US households do not live within one mile of healthy food retailers; subsequently, fewer than one in 10 children indulge in the recommended daily number of fruits and vegetables (CDC, 2022b). These statistics can be attributed to the distance between individual's homes and stores who sell fresh produce. According to the Milwaukee Department of City Development (2019), residents who lack access to healthy foods are at greater risk for developing obesity, diabetes, and a host of other health consequences related to diet and nutrition. More specifically, the rate of obesity in Milwaukee County was reported to be 26.4% in 2019 with an estimated diabetes rate of 10.1%, the ninth-highest rate nationwide (MDCD, 2019). This is said to be highly correlated with the presence of food deserts in this geographic location. Kenosha County officials also report that, "Low food access and security can interfere with healthy growth and development" and is "linked to higher risk of health outcomes such as obesity, diabetes, and cardiovascular disease" (Kenosha County Public Health (KCPH), 2023). In Kenosha County, the number of adults who are "food insecure" is up to 11% (Racine Kenosha Community Action Agency, 2022). It is also reported that 1 in 5 children are also food insecure (KCPH, 2022).

Rates of diabetes, like that of obesity, are on the rise and continue to pose increased threats to the health of the global population. It has also imposed a great deal of economic hardship in countries like the US. In 2017, it was reported that nearly 327 billion dollars were

spent both directly and indirectly on diabetes related care for all ages (ADA, 2022). Furthermore, average medical expenditures among those formally diagnosed with diabetes were reported to be up to 2.3 times higher than those without the disease (ADA, 2022). The ADA (2022) also reported that diabetes was the seventh leading cause of death in the US in 2019. There is also an inverse relationship that now exists between the age of onset and number of persons being diagnosed. From 2001 to 2017, significant increases in the number of youths living with T2D were observed in those aged 10-14 and 15-19 years old, in both sexes and for each racial and ethnic group. The ADA (2019) reported upwards of 244,000 children and adolescents being diagnosed with diabetes in 2019. Today it is estimated that about 283,000 Americans under the age of 20 are now living with a formal diagnosis of diabetes. According to the CDC (2021) nearly 1 in 5 adolescents aged 12-18 and 1 in 4 young adults aged 19-34 in the US have also been identified as living with prediabetes, the precursor to T2D. In WI, the Department of Health Services (WDHS, 2022) reported that 5,980 youth have a current diagnosis of diabetes. It is worth noting that diabetes is known to disproportionately affect racial and ethnic minority populations of lower socioeconomic status (SES). Batcha et al. (2021) report nearly a twofold increase in prevalence of T2D in non-Hispanic Black youth as well as Hispanic youth compared to non-Hispanic White youth.

Clinical Agency Data

This Evidence-Based Practice (EBP) project piloted a meal tracking smartphone application, paired with weekly dietary feedback and education, and aimed to reduce BMI and HbA1c in adolescents with prediabetes and T2D who are overweight or obese. The project took place between two pediatric endocrinology clinics located in Greenfield and Pleasant Prairie, WI, most being recruited from the Greenfield location. Greenfield is a suburb located southwest of the greater metropolitan city of Milwaukee. Majority of patients seeking care at this clinic commute from suburban communities within the city of Milwaukee to receive care (L. Estacio, personal communication, July 2023). It is estimated that up to 50% of patients served at this

clinic have Medicaid or low-income insurance (L. Estacio, personal communication, July 2023). Pleasant Prairie is a village located centrally between Milwaukee, WI and Chicago, Illinois and is more closely associated with the city of Kenosha, WI's fourth largest city. Patients seeking care at this clinic typically reside within Kenosha County or commute from communities in Northern Illinois just over the WI state line. Like the Greenfield location, it is estimated that up to 50% of the population served at this clinic have Medicaid or low-income insurance (J. O'Neil, personal communication, August 2023).

The office is staffed with three physicians, a Nurse Practitioner (NP), two endocrinology Registered Nurses (RN), two RN/Diabetes Educator, and four medical assistants (MA). This clinic is one of over 1,000 sites overseen by Advocate Health (AH), a large healthcare organization headquartered in Charlotte, North Carolina with a combined footprint across six states – Alabama, Georgia, Illinois, North Carolina, South Carolina, and WI. AH was created out of a recent merger between two well-known institutions in their respective regions, Advocate Aurora Health (AAH) and Atrium Health, to become the third largest non-profit healthcare organization in the US. Aurora Health Care (AHC) is the primary system to manage care in the state of WI. They oversee patient care across 17 hospitals and more than 150 patient care sites.

AHC's pediatric endocrinology department was founded in July of 2020 and has since established five practices located throughout Southeast WI (L. Estacio, personal communication, July 2023). They specialize in the evaluation, management, and treatment of all types of hormonal, metabolic, and endocrine disorders in infants, children and adolescents aged three months to 22 years. Examples of specific conditions treated include prediabetes, Type 1 Diabetes (T1D), T2D, hypoglycemia, pituitary conditions, growth disorders, delayed puberty, juvenile osteoporosis, calcium and other bone conditions, and hypothyroidism. At this time, about 70% of patients being treated in this pediatric endocrine department are diagnosed with endocrinology related conditions with the remaining 30% being diabetes specific (L. Estacio, personal communication, July 2023). The physicians and NP alone see on average 8-10

patients in one day at each site with appointment durations ranging anywhere from 30 minutes to one hour. They pride themselves in using a collaborative care model alongside advanced technology and treatment techniques in accordance with the most up to date and evidence-based clinical practice guidelines (CPGs) to provide comprehensive care to their patients.

The need for this project was discussed at great length originally with an RN Diabetes Educator. It was later discussed with another RN Diabetes Educator, the NP, and a medical doctor (MD) who would help spearhead the project. The RN Diabetes Educator expressed the need for more support specifically in overweight and obese adolescents with prediabetes and T2D about meal planning and tracking (L. Estacio, personal communication, April 2023). She had noticed in practice that adolescents with diabetes lacked true comprehension of a "healthy diet" and how it subsequently affects their weight and glycemic control (L. Estacio, personal communication, April 2023). Furthermore, these patients are often required to attempt lifestyle modifications, including weight reduction and improved dietary measures, before they can trial medical or prescription weight loss interventions which the NP and MD both attested to (L. Estacio, personal communication, April 2023). Since it is known that education, and recently technology, have a large impact on nutritional habits and further diabetes management in this patient population, one MD and the NP agreed that this proposed project would be appropriate to pilot in their clinic. Additionally, it was pointed out by the student project leader that family, specifically parents and guardians, play a large role in their child's nutritional habits; therefore, the project would also provide insight on familial habits and how to better direct individual dietary education.

Purpose of the Evidence-Based Practice Project

Purpose Statement and PICOT Question

The purpose of this EBP project was to determine if implementing an evidence-based meal tracking smartphone application alongside dietary feedback and education would result in reduction of BMI and HbA1c in overweight and obese adolescents with prediabetes and T2D.

This project addresses the following PICOT question: (P) In adolescents aged 10-18 with a diagnosis of prediabetes or T2D that are overweight or obese (I) what is the effect of using a meal tracking smartphone application paired with individualized dietary feedback and education (C) compared to prior non-use of any smartphone application and usual standard of care on HbA1C and BMI (O) over a 12-week period?

EBP Project Description

Prior to their appointments, the student project leader, alongside office staff, completed chart reviews to identify patients who met the project inclusion criteria including those with a diagnosis of prediabetes or T2D. Adolescents were identified as being overweight or obese using the CDC's (2022c) BMI percentile calculator specific to children and teens by information related to their age, sex, height, and weight. Participants were offered to enroll in the project at routine follow up visits or initial consultations. One physician, the NP, two RN Diabetes Educators and all MAs were all educated on the project enrolment process; however, the student leader was the only individual to conduct the enrolment process. Each potential participant engaged in a 10–15 -minute educational session conducted by the student leader. During this session, they received information about the project and what is to be expected over the 12-week project period. Upon agreement to enroll, each participant verbally consented to participate alongside their parent and or guardian. Primary outcomes for the project were then established including BMI and HbA1c values. A pre-intervention BMI and HbA1c, defined as the most recent value, were recorded. A demographic form was also completed by each participant at this time (Appendix F). The student leader then assisted each participant in downloading the Nourishly© mobile smartphone application and becoming further acquainted with it. The student leader specifically drew attention to the messenger feature in the application that allows for communication amongst patients and providers, including the student leader for the purpose of this project. Participants were also informed that individualized feedback and dietary education would be communicated on a weekly basis over the course of the project period by the student

leader using the messenger feature. Participants were then encouraged to log as many if not every meal, snack, and drink everyday over the 12-week project period. Next, they each received a folder with seven hand outs (Appendix D) including dietary specific tips for teens and information on the app as well as a project overview form to refer to (Appendix H). Participants were recruited after having engaged in an NP or physician directed visit. Another provider directed visit would occur again in 12 weeks upon completion of the project period. In 12 weeks, the participants had their BMI recalculated and HbA1c redrawn. The project leader analyzed this data and disseminated the findings with key stakeholders, Valparaiso University, and participants of the project.

CHAPTER 2

EBP MODEL AND REVIEW OF LITERATURE

Evidence-based Practice Model

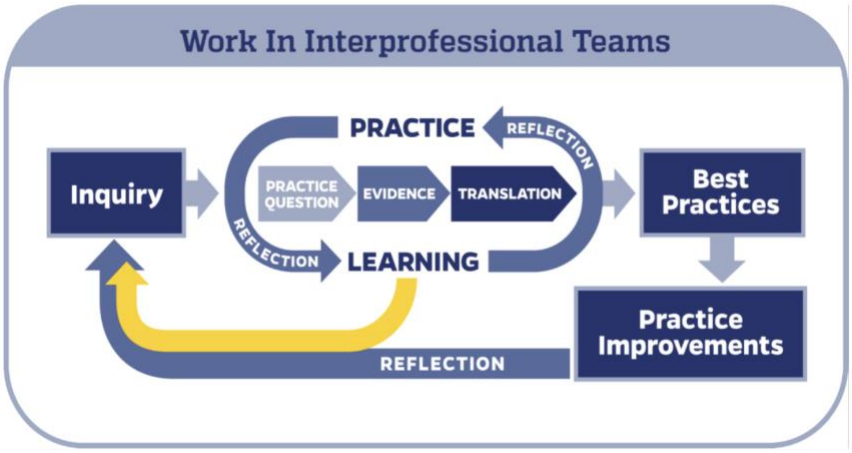
Overview of EBP Model

The Johns Hopkins Nursing Evidence-Based Practice Model (JHNEBP) was utilized to pilot this EBP project, which assists “nurses and other healthcare professionals in translating best evidence into practice to enhance patient care and improve healthcare outcomes” (Melnyck & Fineout-Overholt, 2023, p. 502). The recently updated JHNEBP model is recognized as an individual and team-oriented process that values implementation of the latest research and best practice into patient care that is user-friendly (Dang et al., 2022); each of these aspects of the model were deeply considered for the implementation of this project. The model employs a stepwise approach in three phases, also referred to as the “PET process”, which lies at the core of this model. Phase one, including the creation of a practice question and subsequent project planning, comprises steps one through seven in which clinical inquiry becomes a practice question and later involves the recruitment of an interprofessional team (1), determining responsibility for project leadership (2), scheduling team meetings (3), clarifying and describing the problem (4), developing and refining the EBP question (5), determining the need for an EBP project (6), and identifying key stakeholders (7). Phase two (evidence phase) includes the conduction of an internal and external search for evidence (8), appraisal of the level and quality of each piece of evidence (9), summarization of individual pieces of evidence (10), synthesis of findings (11), and development of practice recommendations based on the best available evidence (12). The third phase (translation phase) involves identification of practice setting-specific recommendations (13) and the creation of an action plan (14) which is deemed to be “appropriate and feasible” by the organization in which the project is to take place (Melnyck &

Fineout-Overholt, 2023). This is to ensure that the project follows the organization's QI framework, occupies their attention, and promotes adoption of the recommended intervention into real-time practice. To follow, support and resources are gathered (15) for ultimate implementation of the project (16). Upon conclusion of project implementation, outcomes are evaluated and future recommendations for practice change are determined (17). The results are then disseminated to key stakeholders (18) and next steps for implementing practice change in the future are undertaken (19). Finally, results and recommendations for practice improvements are disseminated (20). The JHNEBP model is depicted in Figure 1.1.

Figure 1.1

JHNEBP Model



Note: Permission was obtained to use the JHNEBP model and can be viewed in Appendix A.

Practice Question

Consistent with the first phase of the JHNEBP model, a site for the EBP project was identified and an interprofessional team was recruited. The team consisted of a RN/Diabetes Educator, Family Nurse Practitioner (FNP), and MD. It was determined that the doctoral student would take on the leadership role for the EBP project. The student project leader first initiated communication amongst project team members during which the clinical problem was clarified and further described. The RN/Diabetes Educator, FNP, and MD, provided care within the clinic

setting and reported that more research is needed to better support overweight and obese adolescents with prediabetes and T2D related to nutritional habits; therefore, the providers decided that a meal tracking smartphone intervention could be utilized to improve patients' dietary habits and weight while also providing a unique way in which to provide dietary specific feedback and education. It thought that a combination of these interventions would help overweight or obese adolescents with prediabetes and T2 improve overall management of their condition. The following members of the care team were then identified as key stakeholders: three RN Diabetes Educators, one NP, one MD, clinic management, and a department specific Registered Dietician (RD). All key stakeholders were identified to have valuable insight and skills which would promote overall success of this EBP project. A PICOT question was then developed and later refined by the doctoral student to ensure that the scheme would align with the organizational and further departmental priorities.

Evidence

An internal and external search for evidence was conducted consistent with phase two of the JHNEBP model. The literature search focused specifically on best practice for diabetes care in adolescents, including that of nutritional and weight management practices, as well as subsequent interventions successful in lowering Hemoglobin A1c (HbA1c) and BMI, including those that are digital in nature. The pieces of evidence selected for the final literature review were then rated by the Melnyk & Fineout-Overholt's (2023) hierarchy of evidence rating system. Each piece of evidence was then appraised using either The Research Evidence Appraisal Tool from the JHNEBP model or the Appraisal of Guidelines for Research and Evaluation (AGREE II). Lastly, a final synthesis of literature was then drafted revealing best practice recommendations for overweight and obese adolescents with prediabetes and T2D including promotion of lifestyle modifications, such as improved dietary practices, using mobile phone application, and dietary specific education to reduce BMI and improve glycemic control.

Translation

Consistent with phase three, practice setting-specific recommendations were entwined with the best available evidence in determining the practicality of the EBP project for the target population. Furthermore, the project was constructed in a way to promote ease of participation by the student leader in conjunction with key stakeholders. Adjustments to the project were also made to accommodate recommendations made by the organization to be deemed both appropriate and feasible. The project was then set to commence in August of 2023.

Literature Search

Sources Examined for Relevant Evidence

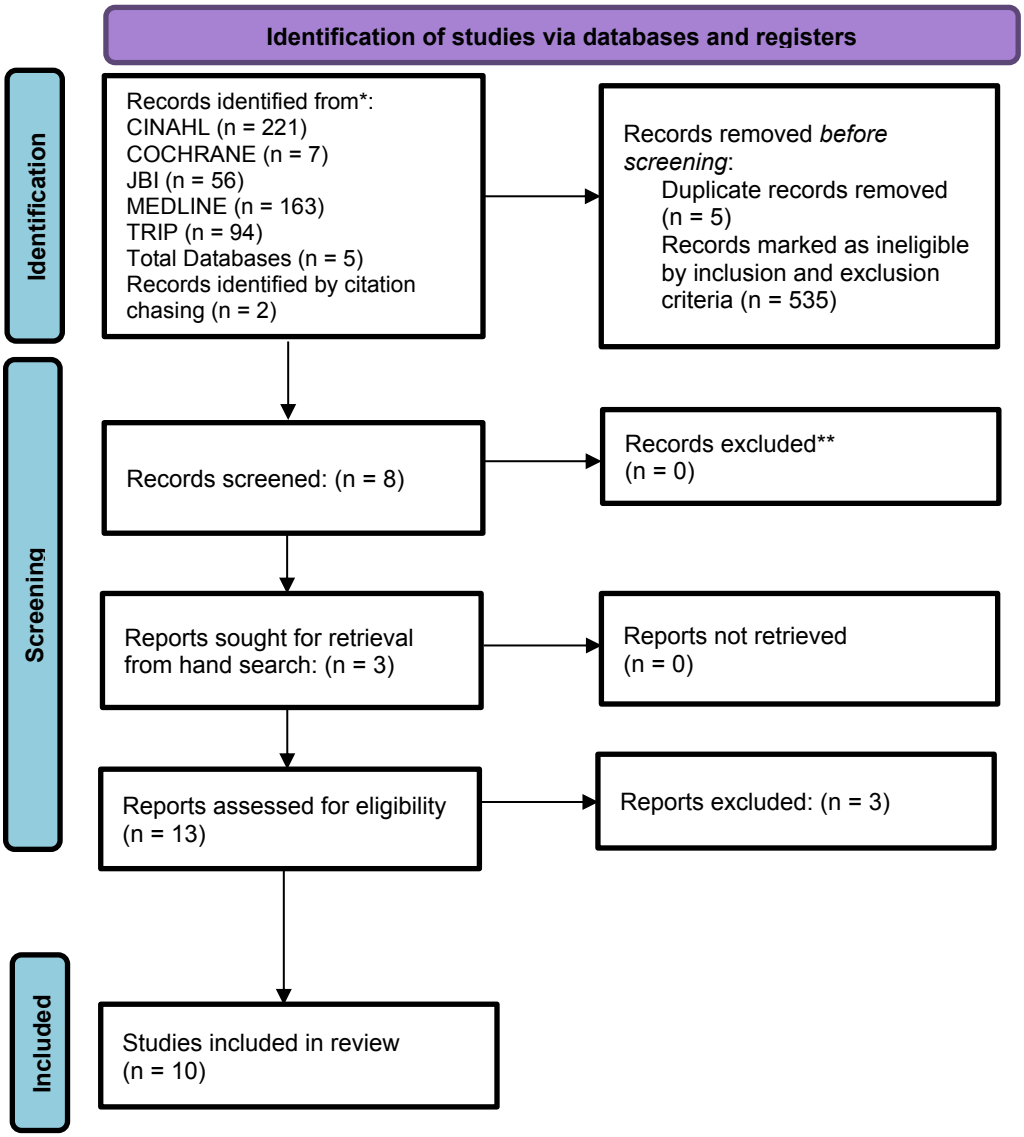
In fulfilling the second phase of the JHNEBP model, or the evidence phase, an exhaustive search for evidence was conducted by the student leader in multiple trusted nursing and healthcare specific databases (See Appendix B). The search was conducted after an in-depth consultation with the Health and Research Services Librarian at Valparaiso University to refine search terms and employ appropriate search strategies. The following databases were utilized: Cochrane, Joanna Briggs Institute (JBI), Turning Research into Practice (TRIP), Cumulative Index to Nursing and Allied Health Literature (CINAHL), and MEDLINE with full text via EBSCO. Citation chasing was also employed as well as a hand search within the journals of *JMIR mHealth and uHealth* and *Frontiers in Endocrinology* obtained from the Christopher Center online library. Similar keywords and phrases were employed in several different combinations within each database and online journal with assistance from the Health and Research Services Librarian until the most relevant literature was found. The final search extracted words within the PICOT question and other relevant search terms including variations of the following: “diabetes”, “adolescent”, “weight”, “BMI”, and “treat”. Each article was screened for relevance based on the title and deemed appropriate based on the information included within the abstract as well the explicit inclusion criteria. Inclusion criteria consisted of a recent publication date range between 2018 to 2023, written in the English language, scholarly peer reviewed, inclusive to the age range between 10 and 18, contained information on prediabetes

and or T2D, and clinical guidelines, if applicable. Articles were excluded if focusing solely on pharmacologic interventions, pregnant women and gestational diabetes, T1D, and adult diabetic conditions and management.

In the end, five duplicate articles as well as 535 other pieces were omitted following the application of the inclusion and exclusion criteria. In total, 13 articles were screened for relevance by the student leader for applicability, three of which were ultimately excluded due to being of low level and or poor strength. The final literature synthesis yielded 10 articles retrieved from various databases, hand searching and citation chasing for this EBP project literature review. The literature search process is outlined in a PRISMA flow chart found in Figure 1.2 below.

Figure 1.2

Prisma Flow Chart



Levels of Evidence

The Melnyk and Fineout-Overholt (2023) hierarchy of evidence was utilized to categorize the evidence found within this literature review by rating level. When employed appropriately, this tool provides reliable answers to specific clinical questions. The levels of evidence range from Level I (highest level of evidence), including systematic reviews and CPGs, to Level VII (lowest level of evidence) which consists of expert opinions. The higher the rank of a given

methodology, the more likely the results represent authenticity and the more confidence health care providers can have that the intervention of interest will produce the same outcomes in patients they treat. A low ranking within this hierarchy represents less generalizable results with an increasing risk of bias. In an attempt to produce high quality evidence that is generalizable to the target population, majority of pieces selected for this literature review are high level consisting of four-Level 1 CPGs (El Sayed et al., 2022; Shah et al., 2022; Smart et al., 2018; Wong et al., 2022), three evidence summaries (Magge et al., 2020; Sivapuram et al., 2021; USPSTF, 2022), and one systematic review using RCTs only (Qui et al., 2022). There are also two Level III systematic reviews (Kaakinen et al., 2018; Wang et al., 2019) including a mixture of RCTs and other quantitative research designs (See Appendix C, Table 2.2).

Analysis and Appraisal of Relevant Evidence

Step seven of the JHNEBP model includes summarizing the evidence which was conducted utilizing two different evidence appraisal tools. The Research Evidence Appraisal Tool was retrieved from the JHNEBP model and was used to appraise seven of the 10 total studies included in this review while the AGREE II was utilized specifically to appraise the three CPGs. The included studies were appraised as either good or high-quality evidence by the student leader (see Table 1.1). The Research Evidence Appraisal Tool was utilized as it derives from the JHNEBP model which is the basis for this EBP project, its ease of use, and the student leader's previous experience with the tool. The instrument involves a meticulous yet efficient review focusing on the validity, reliability, and applicability of evidence all of which come together to conduct a final appraisal. The new internationally recognized AGREE II tool was also exercised during the appraisal process as it specifically evaluates CPGs while the Research Evidence Appraisal Tool does not. This instrument contains 23 items within six domains which focus on unique dimensions of guideline quality to assist providers and their patients in making appropriate clinical decisions (Brouwers et al., 2013). The AGREE II tool is methodical yet user-friendly to determine if appropriate information and criteria are present to make for a valid CPG.

The following tools were beneficial not only in identifying quality evidence for the purpose of this literature review, but also to note individual strengths and weaknesses of each piece.

Table 1.1

Summary of Evidence

Author/Year	Database	Level/Type	Quality/Tool
El Sayed et al., 2022	TRIP	Level 1/SR	High/AGREE II
Kaakinen et al., 2018	Hand search	Level 3/SR	High/Johns Hopkins
Magge et al., 2020	Medline	Level 1/Summary	High/Johns Hopkins
Qui et al., 2022	Hand search	Level 1/SR	High/Johns Hopkins
Shah et al., 2022	CINAHL	Level 1/CPG	High/AGREE II
Smart et al., 2018	CINAHL	Level 1/CPG	High/AGREE II
Sivapuram, 2021	JBI	Level 1/Summary	High/Johns Hopkins
USPSTF, 2022	TRIP	Level 1/Summary	Good/Johns Hopkins
Wang et al., 2019	Citation chase	Level 3/SR	Good/Johns Hopkins
Wong et al., 2022	TRIP	Level 1/CPG	High/Johns Hopkins

Construction of Evidence-based Practice

Synthesis of Critically Appraised Literature

A review of the literature was performed to fulfill steps ten (summarizing the evidence) and eleven (synthesis of the findings) of the JHNEBP model to determine the best practice for lowering BMI and HbA1c levels in adolescents with prediabetes and T2D. Since the number of youths aged 10-18 living with prediabetes and T2D continues to surge along with those identified as overweight or obese, the literature is saturated in guidelines and interventions to

appropriately manage diabetes through healthy eating habits and weight management to prevent future complications. The following is a synthesized summary of 10 articles chosen for review based on the interventions of interest for this EBP project (See Appendix C, Table 1.2). The evidence has been separated into the following themes: (A) diagnosing diabetes in youth, (B) lifestyle modifications, and (C) digital technologies.

Diagnosing Diabetes in Youth

Magge et al. (2020), The Pediatric Endocrine Society, European Society of Endocrinology, and the ADA endorse screening for prediabetes and T2D in high-risk youth which includes pubertal individuals or those greater than or equal to 10 years of age whom meet specific criteria including those with a BMI ≥85th percentile for age and sex based on the CDC's standardized growth charts, weight for height >85th percentile, or weight >120% of ideal (50th percentile) for height. On behalf of the ADA, El Sayed et al. (2022) also endorse these guidelines with an emphasis on those who are classified as overweight or obese. Furthermore, the USPSTF (2022) states that diagnosing diabetes in children and adolescents occurs in the same manner as it does for adults. That is that a, "fasting plasma glucose level of 100 to 125 mg/dL (5.6-6.9 mmol/L), a hemoglobin A1c (HbA1c) level of 5.7% to 6.4%, or a 2-hour post load glucose level of 140 to 199 mg/dL (7.8-11.0 mmol/L) are consistent with prediabetes". A fasting plasma glucose level of 126 mg/dL (7.0 mmol/L) or greater, an HbA1c level of 6.5% or greater, or a 2-hour post load glucose level of 200 mg/dL (11.1 mmol/L) or greater are consistent with the diagnosis of type 2 diabetes". This is consistent with the recommendations from the ADA (Magge et al., 2020). Additionally, a broader HbA1c range of 5.7-6.4%, formally identifying a state of prediabetes, allows for interventions to be implemented earlier, preventing future development of T2D and other complications. Magge et al. (2020) and El Sayed et al. (2022) also promote the use of HcA1c testing as an accurate measure of detecting, diagnosing, and managing pediatric diabetes. As a screening measure and formal diagnostic tool, HbA1c levels can be obtained via a singular finger stick as a point-of-care draw without having to fast, which

is a major advantage in children and adolescents (Magge et al., 2020). It is also known to be a less expensive and time efficient method for all involved (Magge et al., 2020).

Lifestyle Modifications

Weight.

According to Shah et al. (2022) the cause of excess adiposity in youth is complex given it is a monumental time in a person's development. However, Kaakinen et al. (2018), the USPSTF (2022), and Wong et al. (2022) state that obesity and the presence of excess adipose tissue are the most important risk factors for developing T2D in young persons. Shah et al. (2022) also explicitly identify obesity as a risk factor for the development of youth onset-set T2D which may further contribute to insulin resistance. Given this information, Qui et al. (2022), Smart et al. (2018) and the USPSTF (2022) have identified weight management as a key strategy of care in diabetic youth which involves preventing, achieving, and maintaining a healthy weight. Smart et al. (2018) also state that specific aims of nutritional management in this population should focus on achieving and maintaining appropriate BMI as well as waist circumference. Plotting growth over time including measurements of both BMI and waist circumference every three months is also recommended to maintain a healthy body weight in this population (Smart et al., 2018). The following interventions to reduce and maintain a healthy weight have been shown in previous research to improve HbA1c in diabetic youth and are therefore promoted as a standard of care (Wang et al., 2019).

Diet.

According to Shah et al. (2022), dietary factors are important to consider in the setting of youth onset diabetes. Given the lifelong necessity for healthy eating it is important to encourage healthy habits at a young age, especially in youth who are at high risk of developing diabetes or have already developed such conditions. Furthermore, Wong et al. (2022) emphasize the maintenance of a healthy relationship with food early on as a paramount to diabetes management and treatment.

Nutrition for youth with prediabetes and T2D, like that of all children and adolescents, should focus on healthy eating patterns that emphasize the consumption of nutrient-dense, high-quality foods and decreased consumption of calorie-dense, nutrient-poor foods, particularly sugar-added beverages (El Sayed et al., 2022; Wong et al., 2022). Avoidance of restrictive diets are specifically recommended in this population in hopes of avoiding poor growth and development, nutritional deficiencies and increased psychosocial burden (Smart et al., 2018). General guidelines to healthy dietary practices in diabetic youth incorporate intake of three meals a day paired with snacks consisting of a variety of nutritious foods including fruits, vegetables, whole grains, and low-fat dairy products to maintain glycemic control (Smart et al., 2018; Wong et al., 2022).

The consumption of energy-dense foods and sugar sweetened beverages, often with high fructose corn syrup, are commonly seen in youth with T2D (Shah et al., 2022). Evidence has been found linking the consumption of sucrose sweetened beverages and excess weight gain therefore increasing a child's risk of developing T2D (Smart et al., 2018; Shah et al., 2022). Considering this, diet, or light drinks for children with diabetes instead of sugary drinks on special occasions are recommended, otherwise water should be encouraged daily with every meal (Smart et al., 2018). Complete elimination of sugar sweetened beverages and soft drinks with substitution of water and other calorie-free beverages has been found to result in substantial weight loss potentially preventing the onset of diabetes in youth (Shah et al., 2022).

According to Qui et al. (2022) familial influence plays a particularly large role in shaping a child's health related habits; therefore, individual patient education on nutritional management in youth diabetes is equally as important in family members. Furthermore, if parents are motivated to assist their children in maintaining healthy dietary habits, appropriate weight management is likely to ensue (Kaakinen et al., 2018). Given this information, El Sayed et al. (2022) fully support a family-centered approach to children with T2D as a means of lifestyle modification. Modelling healthy eating habits in this manner may involve a regular familial

mealtime schedule, decreasing portion sizes, and avoidance of an overly restrictive diet for all (Shah et al., 2022). Smart et al. (2018) have also concurred that regularity in mealtimes amongst families not only promotes healthy food choices and closer monitoring of portion sizes but has been shown to improve glycemic outcomes in diabetic youth. To add, a subgroup analysis by Qui et al. (2022) found that parental involvement in digital interventions related to lifestyle modification in overweight and obese adolescents revealed a significant difference in BMI (WMD = −0.66, 95% CI: −0.98 to −0.34) and no statistically significant difference in trials without parental involvement.

Digital Technologies in Diabetes Care

In both developed and undeveloped countries mobile technology has become a cornerstone of everyday life including healthcare. Some advantages of mobile technology in the healthcare setting include practicality, reliability, and easy access to health-related information as well as direct communication to providers which allows for efficient health management. It can also provide patients and their families with better access to services in areas or populations who may require more support socioeconomically. Wang et al. (2019) describe mobile technologies as an opportunity for patients to improve their treatment adherence and communication with providers while also inducing necessary behavioral changes in the setting of conditions such as diabetes. Furthermore, studies have shown that the use of the internet and mobile applications have become a major resource to obtain health related information (Qui et al., 2022). Research also demonstrates that interventions involving the use of digital technologies have been associated with improved treatment adherence, monitoring, patient satisfaction, and overall clinical benefits in the setting of youth onset diabetes (Sivapuram et al., 2021). In adolescents, diabetes specific education by means of interactive mobile apps can be of great benefit for condition management while also increasing knowledge of and compliance with care (Sivapuram et al., 2021; Wong et al., 2022).

A meta-analysis by Qui et al. (2022) revealed that the use of a single intervention self-monitoring eHealth-delivered lifestyle intervention showed more clinical effect compared with the control group, with a statistically significant weighted mean difference of −0.32 (95% CI: −0.50 to −0.13) in the setting of overweight and obese in children and adolescents.

In a systematic review by Wang et al. (2019), which evaluated the effectiveness of mobile health interventions on diabetes and obesity treatment and management, large improvements in BMI were found in several of the reviews. One of the meta-analyses indicated a significant reduction in HbA1c from 0.25% (95% CI −0.41 to −0.09) to 0.48% (95% CI −0.78 to −0.19). Differences between the mobile health intervention group and the control group were significant for patients with HbA1c <8% at baseline by −0.33% (−3.61 mmol/mol; I^2= 70%), whereas it was not significant in the patients with HbA1c ≥8% (*P*=.33). Furthermore, larger reductions in HbA1c were noticed after app use among patients with T2D compared to patients with T1D. Another meta-analysis of RCTs found that app usage was associated with significant improvements in body weight and BMI from −1.04 kg (95% CI −1.75 to −0.34) to −2.35 kg (95% CI −2.84 to −1.87) and from −0.43 kg/m^2 (95% CI −0.74 to −0.13) to −0.77 kg/m^2 (95% CI −1.01 to −0.52) than the control group, respectively. In conclusion, change in HbA1c pre- and post-intervention was statistically significant in seven out of the 10 reviews compared to standard diabetes care. From this review, Wang et al. (2019) determined that patient centered self-monitoring with personalized feedback via mobile health interventions are important to induce behavioral changes in diabetic patients considering their age, sex, type of diabetes and geographical location.

In another systematic review by Kaakinen et al. (2018) focused on technology-based counselling in the management of weight and lifestyle interventions in the setting of obese or overweight children and adolescents, it was concluded that such interventions, when tailored to individual needs, can promote significant clinical benefits and the promotion of a healthier lifestyle. Four studies reported a significantly lower BMI in the intervention group than in the

control group ($p < 0.001$) (Kaakinen et al., 2018). One study noted that the intervention group exhibited significantly higher self-efficacy scores for eating fruits and vegetables than the control group ($p < 0.001$). It is important to note that many of the study outcomes were self-reported, but measures such as BMI were collected by the researchers in addition to self-reported measures. In the care of overweight and obese adolescents, Kaakinen et al. (2018) concluded that technology-based interventions can be successful in encouraging healthy lifestyle interventions when catering to individual needs.

Recommendation for Best Practice

Based on the synthesis of literature, best practice recommendations to reduce adiposity, clinically measured by means of BMI, concurrently with HbA1c in adolescents with prediabetes and or T2D involves interventions that specifically focus on weight reduction by means of improved dietary practices with education and the assistance of digital technologies. Identification of adolescents with prediabetes and T2 should occur by means of validated clinical guidelines (Magge et al., 2020; USPSTF, 2022). Identifying adolescents as overweight or obese should then occur by accurately calculating BMI using the CDC's (2022c) standardized age-appropriate calculators. To achieve a reduction in both BMI and HbA1c in these patients, a smartphone application for meal tracking will be utilized to provide individualized, diet specific feedback and education. The use of digital technologies, including mobile-phone applications, that focus on lifestyle modifications such as improved dietary practices have been shown to effectively reduce BMI and improve glycemic control which have been identified as key outcomes for this EBP project (Kaakinen et al., 2018; Qui et al., 2022; Wang et al., 2019). Multifaceted nutrition specific education will be provided by the student leader during the enrolment phase of the project and at weekly intervals during the implementation phase via the chosen smartphone application over the course of a 12-week project period. This proves to be an effective strategy in facilitating reduction in BMI and ultimate fall of elevated HbA1c levels in children and adolescents (Sivapuram et al., 2021; Wang et al., 2019). Reduction and

maintenance of a healthy BMI and target HbA1c level in adolescence and young adulthood can prevent the onset of prediabetes and T2D as well as other diabetes specific complications later in life while improving both psychosocial and behavioral health (Sivapuram et al. 2021; Wang et al., 2019).

CHAPTER 3

IMPLEMENTATION OF PRACTICE CHANGE

Due to the nature of adolescence, consuming a healthy diet and/or monitoring weight may not always take priority over the ease of readily available unhealthy foods. Conversations about weight and dietary choices can also become sensitive in this patient population since the body is undergoing significant changes both physically, mentally, and psychosocially. Furthermore, restrictions on the length of patient appointments can affect how disease specific education related to nutritional habits and weight management may be delivered. The clinical question was discussed at great length with the RN Diabetes Educator and NP. The project was ultimately implemented by the student leader and the NP and aimed to decrease BMI and HbA1c in overweight and obese adolescents with prediabetes and T2D by use of a meal tracking smartphone application paired with individualized feedback and dietary specific education.

Participants and Setting

Several key stakeholders were involved in the conduction of this EBP project including three RN Diabetes Educators, an RD, two MAs one NP, one MD, AAH IT staff, and a statistician, Greg Gilbert. The primary NP involved in this project had two years of NP experience in the pediatric endocrinology office at AAH and over 26 years of pediatric nursing experience. The physician completed her pediatric residency and fellowship in pediatric endocrinology becoming board-certified in 2008 where she began her professional career at the Medical College of WI. In 2020, she transferred to AAH and assisted in jumpstarting the pediatric endocrinology department treating patients and their families in the greater Southeast WI market. The student leader briefed each of the providers individually on the purpose and subsequent details of the project including participant eligibility, the recruitment process, and intervention to be employed. The endocrinology clinic nurses and MAs were tasked with

obtaining eligible participants' baseline weight and height to calculate an accurate BMI. In line with typical clinic operations the participants as patients were responsible for obtaining HbA1c levels at a laboratory prior to their consultation with the NP and MD. If not obtained prior to their visit, a point of care HbA1c measure was obtained by the clinic nurses and MAs on the day of their visit.

Participants eligible for the project must have had a diagnosis of prediabetes or T2D, between the ages of 10-18 years old, and a BMI identified as being overweight or obese using the CDC's (2022c) BMI percentile calculator specific to children and teens. Pregnant females, patients with T1D, those without access to a device compatible with the mobile application, and patients currently on medications specifically for weight loss were ineligible for this project. The project sites are both newly established clinics located in Greenfield, WI and Pleasant Prairie, WI. The sites are part of a large multi-state healthcare system, recognized as the 3rd largest non-profit organization in the US, with over 150,000 employees. AAH is widely recognized for its culture of care excellence as well as its academic and clinical research that continues to advance modern healthcare worldwide.

Pre-intervention Group Characteristics

The participants recruited were adolescents aged 10-18 years, with a diagnosis of prediabetes or T2D, and a BMI identified as overweight or obese by the CDC's (2022c) BMI percentile calculator. Participants were screened for eligibility via chart review upon arrival to the clinic with assistance from the IT department and office staff. BMI is calculated in the target population like adults but is interpreted differently due to changes and weight that occur with physical development; therefore, participant BMI levels were interpreted and expressed relative to children and adolescents of the same sex and age. Baseline HbA1c were obtained prior to or on the day of their provider lead visit at the time of recruitment. It was anticipated by the student leader and key stakeholders that HbA1c levels would read anywhere from 5.7% to 6.5% and beyond based on the diagnostic criteria for prediabetes and T2D endorsed by the USPSTF

(2022) and ADA (Magge et al., 2020). Race and ethnicity of patients at this site treated for prediabetes and T2D varied. This is consistent with current research that states diabetes disproportionately affects racial and ethnic minority populations of lower socioeconomic status (SES).

Intervention

Prior to implementation, the student leader underwent a multifaceted process to identify the overarching clinical question and subsequent details to form an intervention for the project. The foundation for this project and mobile phone intervention lay upon an extensive literature search for evidence related to prediabetes, T2D, body weight, and appropriate dietary management in youth. The literature did not support one specific approach to decrease BMI and HbA1c; therefore, key stakeholders, including three RN Diabetes Educators and an RD were consulted. A specific intervention was suggested by project team members and later refined by the student leader as the basis for this EBP project. The student leader, alongside key stakeholders, agreed upon a start date of August 24th for the implementation phase of the project to wrap up Kids Eat Right Month hosted by the Academy of Nutrition and Dietetics Foundation (2023).

Eligible participants were first identified by chart review utilizing established inclusion and exclusion criteria with the help of one of the RN Diabetes Educators and the AAH IT department prior to the onset of the implementation phase. This was completed in a way that personalized health information (PHI) was de-identified to comply with AAH's student project policies. Come August 24th, eligible participants were recruited in a 10–15-minute educational encounter upon completion of their visit with the NP or MD. In this session, the student leader informed the participant and their family about the project with the help of the project overview form (Appendix H). Additionally, the student assisted the participants in downloading the free smartphone application, Nourishly©, by referencing an additional handout (Appendix E). Participants were able to then connect to the student's clinician version of the application via a

link code provided by the student. They were also provided a folder with seven educational handouts (Appendix D), a project overview form, as well as a guide for creating meal, snack, and drink logs (Appendix E) for the purpose of the project. Through Nourishly©, participants were kindly asked to log as many, if not every, snack, meal and drink consumed for the next 12 weeks or the length of the project period. Before completion of this session, the participant also completed a demographic form to identify their age, gender, race/ethnicity, current diagnosis of prediabetes or T2D, and primary caregiver (Appendix F). The student leader from this point on provided a combination of diet specific feedback and education to participants via the secure messenger feature in Nourishly© on a weekly basis. Education was provided in reference to the seven handouts participants received upon recruitment in the clinic. Additional educational information was provided to patients that the student leader had personally researched in the months preparing for the project as well as information obtained via shadow experiences with the RD to ensure each participant was contacted via the Nourishly© secure messenger platform consistently on a weekly basis, an excel spreadsheet was created to document progress by the student leader. In 12 weeks, participants followed up with their designated provider and an updated BMI and HbA1c were obtained via chart review by the student with assistance from office staff to ensure PHI was de-identified.

Comparison

Best practice for decreasing BMI and HbA1c in the selected population was completed by means of a meal tracking smartphone application paired with individualized and dietary specific feedback and education for this project. A total of 10 articles with good and high levels of evidence were selected in driving this practice change and were separated into the following themes: (A) diagnosing diabetes in youth (El Sayed et al., 2022; Magge et al., 2020), (B) lifestyle modifications (El Sayed et al., 2022; Kaakinen et al., 2018; Qui et al., 2022; Shah et al., 2022; Smart et al., 2018; USPSTF, 2022; Wong et al., 2022), and (C) digital technologies (Kaakinen et al., 2018; Qui et al., 2022; Sivapuram et al., 2021; Wang et al., 2019; Wong et al.,

2018). Diagnosing diabetes in youth includes identification of risk factors for the disease such as age and being overweight or obese by means of trusted CPGs and evidence summaries written by experts in the field. Specific diagnosis of prediabetes and T2D also involves obtaining a HbA1c level. Lifestyle modifications include weight control and further maintenance by means of improved dietary intake. High-level CPGs demonstrate necessary dietary modifications for weight and HbA1c reduction and further management. Research also demonstrated that parental involvement related to lifestyle modifications, such as improved dietary intake and weight reduction, in overweight and obese adolescents are clinically significant. Digital technologies to successfully achieve improved BMI and HbA1c in youth include interactive mobile phone applications. Research demonstrates clinically significant decreases in weight reduction and HbA1c as well as subsequent success in the promotion of a healthy lifestyle with the use of mobile technology in the setting of overweight and or obese children.

Outcomes

The primary outcomes measured for the purpose of this project included pre- and post-intervention BMI and HbA1c. The literature review revealed that BMI measurements are appropriate in identifying overweight and obese youth and can also be utilized to monitor subsequent progress over time (El Sayed et al., 2022; Magge et al., 2020; Smart et al., 2018). HbA1c was also determined to be an appropriate lab value to identify and further manage glycemic control in youth with a diagnosis of prediabetes and T2D (El Sayed et al., 2022; Magge et al., 2020; USPSTF, 2022; Wang et al., 2019). Secondary outcomes include information obtained via the demographic form and will be described as mean or percentage.

Time

The project began on August 24th, coinciding with the beginning of Valparaiso University's fall semester, with participants being enrolled on a weekly basis through October 13th. Fixed enrollment was necessary as HbA1c was monitored over a three-month or 12-week interval in youth with prediabetes and T2D at the project site. Prior to piloting this intervention,

the student leader conducted over 140 clinical hours developing the project, researching dietary education for youth, researching, and developing patient handouts, creating the demographic questionnaire, shadowing different providers, and determining appropriate statistical testing measures alongside key stakeholders. Once participants were recruited and the Nourishly© app was downloaded and linked to the student leader's account, this commenced the 12-week project period, which varied depending on when the patients were seen in the office by their designated provider. Contact was made between the participants and the student leader weekly during this time via Nourishly©, the meal tracking smartphone application. The implementation phase was completed by October 13th. The official timeline for implementation of this project utilizing the PET process as part of the JHNEBP model is outlined in Table 1.3.

Table 1.3

PET Process Guide

PICOT question: (P) In adolescents aged 10-18 with a diagnosis of prediabetes or T2D that are overweight or obese (I) what is the effect of using a meal tracking smartphone application paired with individualized dietary feedback and education (C) compared to prior non-use of any smartphone application and usual standard of care on HbA1C and BMI (O) over a 3-month period?

EBP Team Leader: Lauren Torhorst BSN, RN

EBP Team Members: Dr. Kacy Davis and Ms. Amy Stuhlmaker MSN, FNP-BC

Goal completion date: April 2024

PET Process	Steps	Month											
		1	2	3	4	5	6	7	8	9	10	11	12	13
Practice Question & Project Planning	1. Recruit interprofessional team	5/17/23												
	2. Determine responsibility for project leadership	5/17/23												
	3. Schedule team meetings	5/17/23, 7/31/23												
	4. Clarify & describe problem	5/17/23												
	5. Develop & refine EBP questions	5/20/23												
	6. Determine need for EBP project	5/17/23												
	7. ID key stakeholders	5/17/23	6/23/23											
Evidence	8. Conduct search for evidence		6/13/23-6/25/23											
	9. Appraise level and quality of evidence		6/27/23-6/28/23											
	10. Summarize evidence		6/27/23- 6/28/23	7/4/23-7/7/23										
	11. Synthesize findings			7/4/23-7/7/23										
Translation	12. Develop best evidence recommendations			7/4/23-7/7/23										
	13. ID practice setting specific recommendations			7/19/23-7/30/23										
	14. Create action plan			7/19/23-7/30/23										
	15. Secure support & resources to implement plan			7/19/23-7/30/23										
	16. Implement action plan				8/31/23-2/6/245									
	17. Evaluate outcomes to determine if improvements have been made										2/17/24			
	18. Report results to stakeholders											3/13/24		
	19. ID next steps											3/18/24		
	20. Disseminate findings													5/9/24

Protection of Human Subjects

Protecting human subjects involved in this project was a main priority. The student leader completed research ethics training through the Collaborative Institutional Training Initiative (CITI) program on March 23rd, 2023 (Appendix H). Additionally, an application for

Institutional Review Board (IRB) approval was submitted through the IRB board at Valparaiso University on July 14th, 2023, with an official response of “IRB approval not required.” Details of the project were discussed at large with Karen Ganey, the AAH Nursing Professional Development Specialist and Primary Academic Liaison. In accordance with AAH’s student project policies, an IRB application was also submitted to IRBNet on July 7th, 2023, to determine if the project involves the conduction of human subject research. An official decision letter was received by the student on July 19th, 2023, deeming the project exempt from formal IRB review and oversight, confirming approval for implementation of the EBP project by Karen Ganey (Appendix I). Details of the project were shared with all key stakeholders involved in this project as well as the clinic operations manager in charge of the project site. The following steps were completed in the development phase of the project, prior to the implementation of the intervention, to comply with ethical guidelines and to promote patient safety.

Since the intervention for this project involved an EBP change, informed consent was not needed from participants. This was confirmed with the student leader’s submission to IRBNet through AAH. Verbal consent was obtained by the NP and MD whose patients would be recruited and involved in the project before implementation. Chart reviews were conducted in accordance with AAH’s student policies which involved the de-identified of PHI with assistance from the AAH IT department. Any participant information for the purpose of the project was collected, kept confidential and stored with the student or on the student leader’s password protected laptop. Outcome data remained de-identifiable for later analysis.

CHAPTER 4

FINDINGS

This smartphone application focused project was developed to provide an evidence-based approach, tailored to individual and age-related dietary needs to reduce BMI and HbA1c in overweight and obese adolescents with prediabetes and T2D over a 12-week period. Based on the synthesis of literature, best practice recommendations to reduce adiposity, clinically measured by means of BMI, concurrently with HbA1c in adolescents with prediabetes and or T2D involves interventions that specifically focus on weight reduction by means of improved dietary practices with education and the assistance of digital technologies. To complete step 14 of the JHNEBP model, evaluating the outcomes, the following data analyses detailed project outcomes and the effects of using a meal tracking smartphone application, Nourishly©, on patient health outcomes. Demographic information for the participants and key project findings are presented and compared using pre- and post- intervention statistics below.

Participants

A total of 10 adolescents were recruited from August 24th, 2023, to October 5th, 2023, between two pediatric endocrinology offices located Southeast WI. This project had a 47% attrition rate. There were 19 eligible participants, nine of which failed to follow through with the intended intervention. Demographic characteristic of the participants are listed within Table 1.5 below. There was one provider who elected not to participate in this project due to being newly hired at the time of project planning without a sufficient patient population to provide meaningful data. Due to the project's small sample size, it is not representative of the nation-wide population of adolescents with prediabetes and T2D. However, data analyzed from the prediabetics studied within his project are consistent with trends from the National Health and Nutrition Examination Survey (NHANES) from 1999-2000 through 2017-2018 on youths aged 12 to 19 years who completed the survey's interview and examination. NHANES, between the

2018-2018, found that the incidence of prediabetes was highest in those who identified as black and of male gender (Liu et al., 2022). Furthermore, incidence was highest among those who were found to fall within the obese BMI category. The following data from the NHANES survey respondents is comparable to this EBP project's demographic data outlined below outside of gender as the project studied a 100% female prediabetic population (Table 1.5). There were also two T2D participants within this EBP project. Perng et al. (2023) states that incidence of T2D in adolescents increases with age and is highest among females and those of ethnic minority. This project studied two males with T2D and one female all of which were over the age of 15 and were identified to be of ethnic minority.

Changes in Outcomes

This project addressed the following PICOT question: (P) In adolescents aged 10-18 with a diagnosis of prediabetes or T2D that are overweight or obese (I) what is the effect of using a meal tracking smartphone application paired with individualized dietary feedback and education (C) compared to prior non-use of any smartphone application and usual standard of care on HbA1C and BMI (O) over a 12-week period? The primary outcomes of focus included pre and post intervention HbA1c and BMI (Table 1.4). Secondary outcomes included age, gender, race/ethnicity, current diagnosis of prediabetes or T2D, and primary caregiver (Table 2.6). The pre- and post-intervention data for these outcomes were analyzed utilizing a Wilcoxon Sign Rank test and McNemar test.

Statistical Testing and Significance

Statistical Package for Social Sciences (SPSS) 25 was the program used to complete data analysis. Data was tested for normality using the Shapiro-Wilk test and a normal probability (Q-Q) plot (Shapiro & Wilk, 1965). BMI was judged to be distributed normally (W=0.941, p=0.566) while HBA1c was judged to not be normally distributed (W=0.756, p=0.004). Based on the distribution of data, a Wilcoxon Sign Rank and McNemar test were utilized for analysis. Results of the testing for BMI showed no statistical evidence of a decrease (t =-0.655(9),

p=0.264). Similar results were seen for HbA1c. There was no statistical evidence of a decrease (*V*=39, *p*=0.890).

Findings

Primary Outcomes

BMI. Post-intervention BMIs increased slightly from pre-intervention values (37.2 vs. 37.7) as did median values (36.51 vs. 39.56). Results of the paired *t* test for BMI showed no statistical evidence of a decrease (*t* =-0.655(9), *p*=0.264). The Common Language Effect Size (CLES) was calculated to give an idea of clinical significance (McGraw & Wong, 1992). For BMIs this can be interpreted as if a random sample were taken of participants during the post-intervention phase as 47% of the sample would have shown a decrease in BMI – a very weak clinical effect.

HbA1c. Mean post-intervention HBA1c values decreased from 5.9 to 4.8. Median HbA1c values also decreased in the post-intervention period to 5.75 from 5.85. Although there was statistical significance between pre-intervention and post-intervention HbA1c values, there was also a weak clinical effect. If a random sample of participants in the post-intervention were taken, we could only expect 59% (or six out of ten) to have an HbA1c that decreased. Of note, a total of three participants' HbA1c level dropped below the prediabetic range of 5.7%.

Table 1.4

Participant Data for Primary Outcomes

Participant	Pre- intervention BMI	Post- intervention BMI	Pre- intervention HbA1c	Post-intervention HbA1c
1	42.11	41	5.8	5.8
2	32.05	29.8	5.8	5.2
3	40.07	39.34	5.9	5.3
4	35.24	38.54	5.9	6
5	37.43	40.07	5.8	8.1
6	35.59	39.78	5.9	5.7
7	44.52	45.02	5.7	5.8
8	31.14	31.7	6.2	5.8
9	32.19	29.7	5.7	5.5
10	41.88	41.99	5.9	6.3

Note. BMI = Body Mass Index, HbA1c = Glycolate Hemoglobin A1c

Secondary Outcomes

Age. The average age of participants was 15 (SD=3.1). The median age was slightly older at 15.5 (IQR=5.5). Ages ranged from 10 to 18 with an official range of 8.

Gender. Ten participants were enrolled in this Evidence-Based Practice project, eight women (80%) and two men (20%). 100% of the prediabetic participants were female. More than half of the T2D participants were male.

Race/Ethnicity. Six individuals who identified as African American (60%) participated, three individuals (30%) who identified as Hispanic participated, and one individual who identified as White participated (10%). Nearly 60% of prediabetic participants were African American with up to 29% identified as Hispanic. 67% of the T2D participants were African American with the remaining 33% identified as Hispanic.

Current diagnosis. Seventy percent (*n*=7) of the individuals had been diagnosed with prediabetes and three individuals (30%) had been diagnosed with T2D.

Primary caregiver. Four participants (40%) reported their father as the primary caregiver, three participants (30%) reported their mother as the primary caregiver, and three participants (30%) reported both their father and mother as their primary caregivers.

Table 1.5

Demographic characteristics of 10 adolescent participants

Characteristic		*Value*
Age (years) [M (SD)]		*14.6 (3.1)*
Age (years) [Mdn (IQR)]		*15.5 (5.5)*
Female [n (%)]		*8 (80)*
Ethnicity [n (%)]	*Black/African American*	*6 (60)*
	Hispanic	*3 (30)*
	White/Caucasian	*1 (10)*
Caregiver [n (%)]	*Father*	*4 (40)*
	Mother	*3 (30)*
	Mother & Father	*3 (30)*
Diagnosis [n (%)]	*Prediabetes*	*7 (70)*
	Male *Female*	*0 (0)* *7 (100)*
	Type 2 Diabetes	*3 (30)*
	Male *Female*	*2 (67)* *1 (34)*

*Abbreviations: M=mean; SD=standard deviation; Mdn=median; IQR=interquartile range; n=numbe**r***

CHAPTER 5

DISCUSSION

The purpose of this EBP project was to determine if implementing an evidence-based meal tracking smartphone application, Nourishly©, alongside dietary feedback and education would result in reduction of BMI and HbA1c in overweight and obese adolescents with prediabetes and T2D. The intervention was initially suggested by key stakeholders as members of the clinical staff as a way to engage adolescent patients in lifestyle modifications which was later refined in conjunction with the student project leader to promote successful implementation. Patient tailored interventions that focus specifically on lifestyle modifications, including dietary intake, are needed in the pediatric endocrinology setting to continue in preventative efforts against the development of diabetes in the adolescent population. For those diagnosed with prediabetes and T2D, digital technologies provide ease of access to lifestyle modification tools to improve well-being while also providing a certain level of personalization. Following the recommended first-line approach to pediatric diabetes by means of lifestyle modification in conjunction with digital technology is necessary to decrease rates of morbidity and subsequent premature mortality. Although the outcomes of this project were not statistically significant, it contributes to a growing body of literature surrounding interventions to best support adolescents with prediabetes and T2D. The JHNEBP model was used as a guide to implement this project and the remainder of the steps will be discussed in this chapter, including: (15) reporting the outcomes to stakeholders, (16) identifying the next steps needed, and (17) dissemination of all the findings.

Explanation of the Findings

A thorough review of literature prior to implementation of this project supported use of digital technologies, including mobile phone applications, targeting lifestyle modification techniques such as improved dietary practice alongside dietary specific education to promote

reduction in adiposity concurrently with disease specific measures in adolescents with prediabetes and T2D. This project specifically involved the utilization of a smartphone application, Nourishly©, which involved dietary tracking alongside diet specific feedback and education. An additional literature search was conducted post-intervention to ensure no changes to the recommendations were made during the implementation period, and none were identified. Thus, the following outcomes were in line with EBP and support the recommendations for current practice.

Primary Outcomes

Based on the distribution of data, a Wilcoxon Sign Rank and McNemar test were utilized to analyze changes in BMI and HbA1c from the start of implementation to the end of the 12-week project period.

BMI.

Upon completion of the implementation phase at the end of 12 weeks, a post-intervention BMI was calculated for each participant. Post-intervention BMIs increased slightly from pre-intervention values (37.2 vs. 37.7) as did median values (36.51 vs. 39.56). Only four of the ten participants showed an overall decrease in their BMI from project start to finish. Of note, nine out of the ten participants were still identified as having severe obesity post-intervention with a BMI at or above the 99th percentile for their age according to CDC's (2023a) BMI categories for children and teens. The remaining participant was still identified as obese with a BMI between the 95th and 99th percentile for their age. Results of the paired *t* test for BMI showed no statistical evidence of a decrease (t =-0.655(9), p=0.264). The Common Language Effect Size (CLES) was calculated to give an idea of clinical significance (McGraw & Wong, 1992). In 1992 McGraw and Wong introduced this measure of effect size to help nonstatisticians make sense of effect size. For BMIs this can be interpreted as if a random sample were taken of participants during the post-intervention phase as 47% of the sample would have shown a decrease in BMI – a very weak clinical effect. It was determined that there was insufficient

evidence to support that the intervention had a significant impact on reducing the participants' BMI levels.

HbA1c.

Five out of ten or 50% of participants obtained a decrease in their pre- intervention HbA1c level. Of note, a total of three participants' HbA1c level dropped below the prediabetic range of 5.7%. Mean post-intervention HBA1c values decreased from 5.9 to 4.8 a decrease in the overall mean HbA1c levels which supports implementation of the intervention. Median HbA1c values also decreased in the post-intervention period to 5.75 from 5.85. Although there was statistical significance between pre-intervention and post-intervention HbA1c values, there was a weak clinical effect. If a random sample of participants in the post-intervention were taken, we could only expect 59% (or six out of ten) to have an HbA1c that decreased. It was determined, despite a statistically significant decrease in HbA1c levels from start to finish, that there was insufficient evidence to support that the intervention had a significant impact on HbA1c levels.

Strengths and Limitations of the DNP Project

Strengths

There were several notable strengths of this EBP project which led to successful implementation. First, evidence-based literature was found and reviewed by the student project leader alongside several faculty members at Valparaiso University. Ten pieces of evidence, majority of which were recognized as high level pieces of evidence, were utilized to develop this project. Second, key stakeholders involved in the project exhibited a high level of receptiveness to the student project leader's presence in their clinics throughout the project period. This was key in having lost a significant key stakeholder near the start of project implementation. Ancillary clinic staff were also more than willing to assist with various aspects of the project as needed to ensure a high level of quality and ultimate completion. It is important to address the efforts put forth by the clinic RNs and diabetes educators in helping to identify appropriate patients for the

project. Favorable reception from the entire healthcare team created a conducive environment for smooth and effective implementation without interruption in their day-to-day clinic operations and allowed for mutual collaboration with the clinic providers. Additionally, statistician Greg Gilbert is recognized for his meaningful efforts in analyzing and interpreting the project data. Third, the project took place at two pediatric endocrinology clinics, newly established as of 2020, located at state-of-the-art healthcare facilities overseen by AHC. The clinics provided ease of access to computers with clinic schedules and patient health information necessary for implementation of the project. These clinics had access to associated clinical laboratories (ACL) within the same building allowing patients to readily obtain necessary lab work at the time of their appointments. If patients failed to obtain needed lab work, point of care HbA1c levels are able to be obtained at the time of their appointment which was a large advantage for the purpose of obtaining pre- and post- intervention data for the student project leader. Most importantly, the pediatric endocrinology offices provided access to the specific population of patients targeted for this EBP project. Fourth, although the number of times participants tracked their dietary intake was decided not to be tracked, every participant endured this intervention for the full 12 weeks. It was recognized early on that this would be difficult for most participants to complete based on the history of the prediabetic patient population at this clinic specifically. However, each of the ten participants completed the intervention in its entirety to varying degrees. Participants who inputted more data into Nourishly©, followed up with the student via the chat feature of the application as needed, and actually read the handouts (Appendix D) given to them at the time of recruitment coincidentally showed decreases in their BMI and HbA1c. The patient handouts guided weekly dietary specific and individualize education in line with up-to-date CPGs. Educational topics within the handouts included water, fruit, vegetable, and protein intake as well as avoidance of foods and drinks high in fat and added sugars. It was evident that participants whose caregivers and families who were additionally as invested, enthusiastic, and motivated to decrease their BMI and HbA1c levels also displayed more

significant results. These combined familial efforts lead to three participants' HbA1c levels dropping below the prediabetic range of 5.7%. Lastly, strength can also be seen by the future reproducibility of the project intervention in the future. The medical providers and supporting diabetes educators work very closely to make individualized treatment plans appropriate to each patient. The medical providers are the first to introduce meaningful lifestyle modifications to assist in appropriate diabetes management. The diabetes educators and even dietary staff from other departments, take the information provided by the medical provider and further delve into interventions and lifestyle modifications to assist in meeting their health-related goals. This team-based approach helps to provide more effective and efficient delivery of high-quality care. Additionally, the pediatric endocrinology appointments, unlike other specialty clinics, allow for extended appointment times with both the medical provider and the diabetes educators. This displays exceptional support for patient-centered care that relies heavily on contact time with patients. This clinic model supports the following project intervention which relies heavily upon patient education surrounding the implementation of appropriate lifestyle interventions, including improved dietary habits, by means of digital technologies.

Limitations

Despite having mentioned the many strengths of this EBP project, there are also several limitations to make note of. Several limitations were identified during the planning and implementation phases of the project. In the planning phase, there was a considerable delay in obtaining approval at the project site location because the IRB approval process specifically was unclear and complicated. The student project leader was not allowed at the project site up until a few weeks prior to implementation causing interruptions in communication with key stakeholders and lack of ability to chart review to identify potential participants causing a lot of unnecessary anxiety for the student. The student was unable to chart review unless physically on site. By the time the student leader was able to start chart reviewing, it was identified that there was a significant lack in the number of available patients to enlist during the designated

recruitment phase with prediabetes and T2D. Just days before implementation, it was decided that an additional project site would be pursued in hopes of increasing the total number of project participants. Additionally, one of the main key stakeholders announced her resignation just weeks prior to implementation. Ideas surrounding the project stemmed from communication between the student project leader and this key stakeholder specifically throughout the entirety of the planning phase. Loss of this member of the project team was substantial and almost led to ultimate failure to implement this EBP project. It is also important to recognize that the sample size could have been larger if the recommended project timeline allowed for a longer time for recruitment. Participants were recruited for just under two months' time, which limited the number of diabetes specific patients that were eligible for the project. Furthermore, during the planning phase, there were specific days of the week designated specifically to diabetes specific visits. The student project leader had made changes to her personal work schedule and concurrent clinical schedule to accommodate this. Just weeks before implementation of the project, diabetes patients were being dispersed throughout the week instead of being scheduled on previously designated diabetes clinic days. This further contributed to the small sample size as the student project leader was unable to attend all eligible patient's visit due to scheduling conflicts. Furthermore, it was made clear very early on in the planning phase that the prediabetes population of patients specifically has up to a 50% no show rate. This also greatly contributed to the final sample size obtained for the project. The following limitations posed significant challenges early on in the implementation of the project potentially affecting the project's overall success.

There are also a few limitations to make note of that occurred throughout the implementation phase. The technology component of the project posed another significant challenge, particularly access to wireless fidelity (Wi-Fi). This issue only occurred at one of two project sites; however this clinic was considered to be the main project site. Issues were encountered during participant recruitment with Wi-Fi connection specifically while in patient

rooms. The Wi-Fi connection to mobile devices failed when located in patient rooms, but worked seamlessly in the front lobby. This was problematic as the foundation of the invention relied on use of the Nourishly©, a mobile phone application, which needed to be downloaded by the patient on their mobile device at the time of recruitment. Many of the first few participants who were eligible for the project were lost to this limitation, which may have contributed to the high level of attrition. Adjustments needed to be made due to this issue, such as disconnecting from the publicly available Wi-Fi, as to how some participants were recruited. Some participants also encountered difficulties downloading and utilizing the application despite detailed instruction from the student project leader. These technological limitations hindered the smooth execution of the project and likely contributed to the high level of attrition. Additional on-site planning and support was needed from key stakeholders to overcome these unforeseen obstacles. The post-intervention results may have also been affected due to the implementation period spanning over two American holidays, Thanksgiving and Christmas, which tend to promote the overindulgence of unhealthy food. This was endorsed by verbal feedback obtained from participants and their families at the time of their post- intervention follow-up making it hard to engage in healthy dietary choices during this time. Additionally, many of the participants suffered from additional comorbidities atop their diabetes. It is worth noting that polycystic ovarian syndrome (PCOS) and suspected hypothyroidism specifically may have contributed to specific participants' ability to decrease their BMI throughout project implementation.

The project's high rate of attrition alongside the above limitations, likely contributed to the project's sample size. Although the small sample was relatively homogenous, a larger sample could have allowed for more transformative results and better population representation as the sample was determined to be atypical of the nation-wide population of adolescents with prediabetes and T2D.

Sustainability

The sites in which this EBP project was completed were specific to patients with pediatric endocrinology related diseases and conditions. The providers who manage the patients seen at these clinics are supported by a team of RN Diabetes Educators who have earned specialty certification demonstrating diabetic specific knowledge and skills to distinguish themselves from others. The healthcare team between each of the two project sites as a whole expressed and displayed commitment to supporting research that leads to new and improved ways of providing high quality care to their patients. Despite working with experts in adolescent diabetes, the student project leader continually provided the medical providers, diabetes educators, dietary staff and other ancillary staff members involved in the project with the most up to date research related to this EBP project and its proposed intervention. Although the use of the Nourishly© application was brought forth originally by a key stakeholder. This key stakeholder left the organization prior to the implementation phase and was not able to see the project through. Other key stakeholders were not familiar with this application, but were open to having their difficult prediabetic and T2D adolescents be recipients of its proposed positive effects on dietary intake. Key stakeholders assisted in providing additional educational materials to the student project leader that later served as part of the intervention. The project leader continually emphasized the importance of keeping providers involved in the project, encouraging them to enroll participants and help establish long-term goals alongside their family while exploring the effectiveness of Nourishly© application. There was no evidence of existing use of the Nourishly© application previously within the pediatric endocrinology and the diabetic education departments as a whole; therefore, the goal was to help implement the use of the Nourishly© application as part of the consultation protocol using information from the project to serve as a valuable resource for future care.

Additionally, to promote the sustainability of this project, extra copies of the handout (Appendix E) created by the student project leader were provided to the clinic staff. Handouts (Appendices D & E) were also disseminated by the student project leader as a poster presenter

at the 2023 Diabetes Care and Education conference to a variety of diabetes specific clinical care staff for further use in their patient care settings. Results of the project were disseminated to the key stakeholders electronically upon completion of the final data analysis in which recommendations for future implementation were also relayed. Recommendations for the future use and sustainability of this project would be to implement use of the Nourishly© application specifically for new prediabetic and T2D patients at the time of consultation before exploring pharmaceutical options for both diabetic control and weight loss when appropriate. It was discussed that restrictions on the length of patient appointments can affect how disease specific education related to nutritional habits and weight management may be delivered; however, it was recommended that these topics not be neglected in the targeted population as lifestyle modifications continue to be recommended as first-line treatment for adolescent prediabetes and T2D.

As mentioned, the goal of this EBP project closely aligned with the organization's mission, goals, and standards of care making it a natural fit within the existing department structure. By targeting the patients the clinic historically struggles to connect with the most, the project addressed key areas of focus moving forward in utilizing known tools for improved and individualized lifestyle modification interventions. This also facilitated buy-in from providers and staff, who were already invested in promoting these goals, but are continually seeking new and improved technological solutions. Overall, the project's strong alignment with the organization's mission and department specific goals made it a valuable effort to improve adolescent health and outcomes.

Relevance for EBP Model

The JHNEBP model served as a guide for implementation of the following EBP project. The JHNEBP model served as the framework for this EBP project. The model consists of three phases and 20 steps to promote practice improvements and improve patient outcomes (Melnyk & Fineout-Overholt, 2022). Phase one, including the creation of a practice question and

subsequent project planning, comprises steps one through seven which outlines the need for leadership and team building in order to address the need for clinical inquiry. As a team, combined professional knowledge and experience were key in successful planning and ultimate implementation of the following EBP project. Phase two (evidence phase) involved five steps in finding and appraising literature to develop the best evidence-based recommendations into a sustainable EBP project. The project leader conducted a thorough literature review with the assistance of the Health and Research Services Librarian at Valparaiso University to locate the most relevant and up-to-date evidence. Although this phase is laborious, it is crucial in identifying recommended EBP and sets a clear direction for the intended intervention. Lastly, the third phase (translation phase) involves identification of practice setting-specific recommendations and the creation of an action plan to ensure that the project promotes adoption of the recommended intervention into real-time practice. The last few steps of JHNEBP specifically address the need to reflect on the project as a whole before disseminating all of the findings and promoting future sustainability efforts. In this phase, the student project leader worked closely with clinic staff to discuss necessary steps leading to long-term sustainability of the Nourishly© application as well as continued diabetes education, support, and goal setting specific to lifestyle modifications including improved dietary intake. Dissemination of findings was achieved by providing a thorough review of the finalized data, with the help of statistician, Greg Gilbert, to key stakeholders. Despite the primary outcomes being statistically insignificant, the key stakeholders were aware that the project intervention stems from the most up to date clinical research and professional recommendations on how to best manage prediabetes and T2D in adolescents by means of lifestyle modifications alongside familial support, education, and digital technologies. Results of the data analysis aside, key stakeholders have identified ease of implementation of the project intervention, specifically the Nourishly© application, into clinic flow. Overall, the JHNEBP model has been proven extremely useful for the following EBP project

Recommendations for the Future

Research

The use of digital technology, more specifically smartphone applications, to assist with weight loss and dietary modification management is an area of growing interest in healthcare. The most up to date research was utilized to help guide the use of Nourishly© application for the purpose of the EBP project; however, there is still a need for more high-quality investigations within this sector of healthcare, specifically related to use of mobile technologies in youth with diabetes. One important area of necessary research is the effectiveness of smartphone applications in promoting weight loss and dietary modification. While previous research has demonstrated promising results, there is a great need for more rigorous systematic reviews composed of randomized controlled trials to further evaluate the effectiveness of different smartphone applications on the promotion of lifestyle modifications. In pediatrics, lifestyle modifications, including weight loss and dietary modification, are the cornerstone to the initial management of prediabetes as well as T2D. Therefore, in light of the digital era, research that demonstrates effectiveness of multimodal smartphone applications that can assist youth in successful implementation of lifestyle modifications is key to future aversion of the diabetes epidemic.

Another important area of research going forward is the factors that influence patient engagement and adherence to smartphone applications. Research has demonstrated that interventions involving the use of digital technologies have been associated with improved treatment adherence, monitoring, patient satisfaction, and overall clinical benefits in the setting of youth onset diabetes. It has also been shown that patients who use these applications regularly are more likely to achieve their weight loss and dietary modification goals. Other advantages of mobile technology in the healthcare setting include practicality, reliability, and easy access to health-related information as well as direct communication to providers which allows for efficient health management. This can also provide patients and their families with

better access to services in areas or populations who may require more support socioeconomically. With this information, it is essential to identify the factors that promote patient engagement and adherence to digital technology use in healthcare specifically within the realm of weight loss and dietary modification for diabetic youth. Additionally, more high-level research is needed to identify potential barriers to the use of smartphone applications. This is essential for successful implementation of smartphone related interventions to reduce and maintain weight while also promoting a well-rounded diet. Additionally, few research studies exist to describe the long-term benefits of lifestyle modifications via smartphone application usage. Maintaining adequate weight by means of a balanced diet is a lifelong commitment and should start as early in life as possible.

Interventions that lead to decreased adiposity and subsequent achievement of optimal weight in youth may contribute to reversal of insulin resistance and underlying diabetes if addressed early. By addressing the following research gaps, we can gain a better understanding of how to best utilize smartphone applications in diabetic youth to promote weight loss, dietary modification, and optimal diabetes control.

Education

This EBP project focused specifically on a dietary approach to reducing BMI and HbA1c in youth with prediabetes and T2D by maintaining food logs, via the Nourishly© application, which help raise awareness of food intake and assist in monitoring progress over time. Additionally, diet tracking can assist patients in calorie tracking; however, this was not utilized for the purpose of this EBP project as calorie counting is more so frowned upon when treating overweight and obese youth. There is a desire from medical providers and other healthcare staff to maintain a healthy relationship with food and weight which calorie counting can negatively affect. This is why the Nourishly© application was deemed appropriate by the project team for this EBP project as it simply captures a photo of food items being eaten and the quantity without recording quantitative caloric values.

Proper dietary intake in youth is essential to general health to properly fuel the growing mind and body, prevent disease and illness, avoid excess adiposity, and promote improved sleeping habits. The following topics of education were addressed with patients through weekly dietary tips provided via the Nourishly© application over the course of the 12-week project period alongside use of patient handouts that were provided to patients at the time of recruitment. It is important to note that the most up to date CPGs focus initial treatment of diabetic youth on concurrent modification of all known modifiable risk factors for diabetes including obesity, physical inactivity, unhealthy eating habits, and sedentary lifestyles all of which can be addressed through basic nursing interventions. Diet can be tied into the management of each of the following modifiable risk factors; however, diet by itself will likely not lead to successful long-term decrease in weight and subsequent HbA1c as demonstrated by the results of this EBP project. Therefore, a multimodal approach to improving weight and HbA1c in diabetic youth should be implemented. With tighter control of these risk factors, adolescents who are prediabetic or have T2D can improve their overall health and achieve better control of their HbA1c decreasing their risks of morbidity and premature mortality in the future. Research states that nursing implications for addressing obesity in diabetic youth also endorses a familial approach to providing education on healthy eating habits, promoting regular physical activity, and encouraging healthy sleeping habits.

The Nourishly© application has the ability to track each of the following modifiable risk factors discussed above. However, the EBP project team felt that asking each of the participants to track their dietary intake, weight, hours of sleep and physical activity would be asking too much from a population of patients who already historically fails to follow through on recommended interventions. This likely would have contributed to an even higher attrition rate. Therefore, if this EBP project were to be repeated, it would be recommended that all modifiable risk factors be targeted using the Nourishly© application following recommendations from current CPGs. If repeated using a larger sample size that is not only representative, but more

receptive to the intervention at hand, data analyses will likely show increased statistical significance with a stronger clinical effect. It is also recommended that future projects incorporate more frequent follow-ups throughout the implementation period to keep participants engaged. Although the Nourishly© application has a secure chat function that worked well throughout the entirety of the following EBP project, there is something to be said about verbally conversing with an individual versus communication through a digital screen. Additionally, allocating more time during the recruitment phase would have been helpful to engage in goal setting with patients alongside clinical staff. These recommendations are made based on the student project leader's experiences throughout the entirety of the following EBP project and should serve to assist future students and researchers in their pursuit of achieving desired outcomes in overweight and obese youth with prediabetes and T2D.

Conclusion

The presence of pediatric onset diabetes has reached an alarming level and is thought to be more disruptive than those with later onset disease contributing to premature morbidity and mortality. This is demonstrated by the NHANES survey which reported an alarming increase in the incidence of prediabetes among 12- to 19-year-old individuals from 11.5% in 1999–2002 to 28.2% between 2015–2018 (Perng et al., 2023). Obesity and the presence of excess adipose tissue also continues to be recognized as one of the most important risk factors in developing prediabetes and subsequent T2D in youth to date (Kaakinen et al., 2018; USPSTF, 2022; Wong et al., 2022). In the presence of the childhood obesity epidemic, incidence of T2D in adolescents is reported by Perng et al. (2023) as twice that of T1D in several non-White racial and ethnic groups. Furthermore, Perng et al. (2023), "project a fourfold increase in prevalence of youth-onset T2D in the U.S. by 2050" more notably among those who are overweight and obese as well as racial and ethnic minority youth, particularly those of Black or other indigenous populations (p 493). While Perng et al. (2023) consider the development of youth-onset T2D considered to be relatively rare, any occurrence or predisposition to this

condition in children and adolescents is concerning given its aggressive clinical course, association with risk of debilitating complications by young adulthood, and high all-cause mortality" (p. 490). Therefore, preventing and treating childhood obesity by means of intense lifestyle modification continues to remain a high priority in today's healthcare.

The goal of this EBP project was to determine if implementing an evidence-based meal tracking smartphone application alongside dietary feedback and education would result in reduction of BMI and HbA1c in overweight and obese adolescents with prediabetes and T2D. Despite the insignificant results of this EBP project, using an approach that combines improved dietary intake by means of digital technologies, including mobile phone applications, is likely to be effective in combating parallel rises in childhood obesity and diabetes related conditions according to the most up to date research.

Digital technologies are not an end in themselves, but have become essential tools in our advancing society especially in developing population to promote health. They have specifically been proven to meaningfully contribute to the fight against obesity in people of all ages by promoting healthy lifestyle modifications which in pediatrics continues to be recognized as cornerstones in the management of prediabetes and prevention of subsequent T2D. Early development of obesity and diabetes in life are said to be multifactorial in nature related to genetic predispositions, in utero exposures, heterogeneous pathophysiology of diabetes, and cultural practices alongside disparities in socioeconomic status and access to health care. Because of this and knowing research in youth is a continued challenge, this EBP project contributes to the already existing need for continued investigation into both short-term and long-term effects of multimodal smartphone applications to aid in lifestyle modifications in youth with prediabetes and T2D to reduce negative effects of the ongoing childhood obesity epidemic.

REFERENCES

Academy of Nutrition and Dietetics (2023). *What is kids eat right month?* Eatright.org. https://www.eatright.org/kids-eat-right-month/what-is-kids-eat-right-month

American Diabetes Association, (2019). Lifestyle management: *Standards of medical care in diabetes—2019. Diabetes Care, 42(*1), S46-S60. https://doi.org/10.2337/dc19-S005

American Diabetes Association (2022, July 28). *Statistics about diabetes.* https://diabetes.org/about-us/statistics/about-diabetes

Bacha, F., Cheng, P., Gal, R. L., Beaulieu, L., Kollman, C., Adolph, A., Shoemaker, A. H., Wolf, R., Klingensmith, G. J., & Tamborlane, W. V. (2021). Racial and ethnic disparities in comorbidities in youth with type 2 diabetes in the pediatric diabetes consortium (PDC). *Diabetes Care, 44*(10), 2245–2251. https://doi.org/10.2337/dc21-0143

Brouwers, M., Kho, M. E., Browman, G. P., Cluzeau, F., Feder, G., Hanna, S., & Makarski, J. (2013). AGREE II: Appraisal of guidelines for research & evaluation II. *Canadian Medical Association Journal*, *182*(18), e839-e842. https://doi.org/10.1503/cmaj.090449

Centers for Disease Control and Prevention (2021, August 24). *New research uncovers concerning increases in youth living with diabetes in the U.S*. https://www.cdc.gov/media/releases/2021/p0824-youth-diabetes.html

Centers for Disease Control and Prevention (2022, April 1a). *Childhood overweight & obesity.* https://www.cdc.gov/obesity/childhood/index.html

Centers for Disease Control and Prevention (2022, July 14b) *Why it matters.* https://www.cdc.gov/obesity/about-obesity/why-it-matters.html

Centers for Disease Control and Prevention (2022, September 1c). *BMI percentile calculator for child and teen.* https://www.cdc.gov/healthyweight/bmi/calculator.html

Centers for Disease Control and Prevention (21 March, 2023a). *Defining child BMI categories.* https://www.cdc.gov/obesity/basics/childhood-defining.html

Centers for Disease Control and Prevention (2023, April 24b) *What is diabetes?* https://www.cdc.gov/diabetes/basics/diabetes.html

Dang, D., Dearholt, S., Bissett, K., Ascenzi, J., & Whalen, M. (2022). Johns Hopkins evidence-based practice for nurses and healthcare professionals: Model and guidelines. 4th ed. Sigma Theta Tau International. https://www.hopkinsmedicine.org/evidence-based-practice/model-tools.html

El Sayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R., Brown, F. M., Bruemmer, D., Collins, B. S., Hilliard, M. E., Isaacs, D. Johnson, E. L., Kahan, S., Khunti, K., Leon, J., Lyons, S. K., Perry, M. L., Prahalad, P., Pratley, R. E., Seley, J. J., Stanton, R .C., & Gabbay, R. A. (2022). Children and adolescents: *Standards of care in diabetes—2023*. *Diabetes Care*, *46*(1), S230–S253. https://doi.org/10.2337/dc23-S014

El Sayed, N. A., Aleppo, G., Aroda, V. R., Bannuru, R. R, Brown, F. M., Bruemmer, D., Collins, B. S., Cusi, K., Das, S. R., Gibbons, C. H., Giurini, J. M., Hilliard, M. E., Isaacs, D., Johnson, E. L., Kahan, S., Khunti, K., Kosiborod, M, Leon, J., Lyons, S. K., Murdock, L., … & Gabbay, R. A. (2023). Summary of revisions: Standards of care in diabetes- 2023. *Diabetes Care, 46*(1), S5-S9. https://doi.org/10.2337/dc23-Srev

Hampl, S. E., Hassink, S. G., Skinner, A. C., Armstrong, S. C., Barlow, S. E., Bolling, C. F., Avila Edwards, K. C., Eneli, I., Hamre, R., Joseph, M. M., Lunsford, D., Mendonca, E., Michalsky, M. P., Mirza, N., Ochoa, E. R., Sharifi, M., Staiano, A. E., Weedn, A. E., Flinn, S. K., Lindros, J., & Okechukwu, K. (2023). Clinical practice guideline for the evaluation and treatment of children and adolescents with obesity. *Pediatrics, 151*(2), 1-100. https://doi.org/10.1542/peds.2022-060640

Kaakinen, P, Kyngäs H, & Kääriäinen M. (2018). Technology-based counselling in the management of weight and lifestyles of obese or overweight children and adolescents: A descriptive systematic literature review. *Informatics for Health & Social Care, 43*(2), 126–141. https://doi.org/10.1080/17538157.2017.1353997

Kenosha County Public Health (2023). *2022 Kenosha County community health assessment.* https://www.kenoshacounty.org/thrive

Liu, J., Li, Y., Zhang, D., Yi, S. S., & Liu, J. (2022). Trends in prediabetes among youths in the US from 1999 through 2018. *JAMA Pediatrics, 176*(6), 608-611. https://doi.org/10.1001/jamapediatrics.2022.0077

Magge, S. N., Silverstein, J., Elder, D., Nadeau, K. & Hannon, T. S. (2020). Evaluation and treatment of prediabetes in youth. *The Journal of Pediatrics, 219,*11-22. https://doi.org/10.1016/j.jpeds.2019.12.061

McGraw, K. O., & Wong, S. P. (1992). A common language effect size statistic. *Psychological Bulletin*, *111*(2), 361–365. https://doi.org/10.1037/0033-2909.111.2.361

Melnyck, B. M. & Fineout-Overholt, E. (2023). *Evidenced-based practice in nursing and healthcare: A guide to best practice* (5th ed). Wolters Kluwer.

Milwaukee Department of City Development (2019). *Milwaukee fresh food access report.* https://city.milwaukee.gov/home

Perng, W., Conway, R., Mayer-Davis, E., & Dabelea, D. (2023). Youth-onset Type 2 Diabetes: The epidemiology of an awakening epidemic. *Diabetes Care*, *46(*3), 490–499. https://doi.org/10.2337/dci22-0046

Qui, L. T., Gui-Xiang, S., Ling, L., Zhang, J. D., Wang, D., & Fan, B. Y. (2022). Effectiveness of multiple eHealth-delivered lifestyle strategies for preventing or intervening overweight/obesity among children and adolescents: A systematic review and meta-analysis. *Frontiers of Endocrinology, 13,* 1-12. https://doi.org/10.3389/fendo.2022.999702

Racine Kenosha Community Action Agency (2022). *Comprehensive community needs assessment.* *https://rkcaa.org/wp-content/uploads/2022/08/Needs-Assessment-Full.pdf*

Shah, A. S., Zeitler, P. S., Wong, P., Pena, A. S., Wicklow, B., Arslanian, S., Chang, N., Fu, J., Dabadghao, P., Pinhas-Hamiel, O., Urakami, T., & Craig M. E. (2022). ISPAD clinical practice

consensus guidelines 2022: Type 2 diabetes in children and adolescents. *Pediatric Diabetes, 23,* 872–902. https://doi.org/10.1111/pedi.13409

Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). *Biometrika*, *52*(3–4), 591–611. https://doi.org/10.1093/biomet/52.3-4.591

Smart, C. E., Annan, F., Higgins, L. A., Jelleryd, E., Lopez, M., & Acerini, C. L. (2018). ISPAD clinical practice consensus guidelines 2018: Nutritional management in children and adolescents with diabetes. *Pediatric Diabetes*, *19*, 136–154. https://doi.org/10.1111/pedi.12738

Sivapuram, M. S. (2021). *Diabetes management: considerations for adolescents* [Evidence summary]. Joanna Briggs Institute EBP Database. http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=jbi&NEWS=N&AN=JBI634

US Preventive Services Task Force (2022, September 9). *Screening for prediabetes and type 2 diabetes in children and adolescents: US Preventive Services Task Force recommendation statement.* https://www.uspreventiveservicestaskforce.org/uspstf/recommendation/prediabetes-type2-diabetes-children-adolescents-screening

Wang, Y., Min, J., Khuri, J., Xue, H., Xie, B., Kaminsky, L. A., & Cheskin, L. J. (2019). Effectiveness of mobile health interventions on diabetes and obesity treatment and management: Systematic review of systematic reviews. *JMIR Mhealth Uhealth, 8*(4), 1-12. https://doi.org/10.2196/15400

Wisconsin Department of Health Services (2022). *Wisconsin diabetes action plan.* https://www.dhs.wisconsin.gov/diabetes/action-plan.htm

World Health Organization (2020, October 19). *Noncommunicable diseases: Childhood overweight and obesity.* https://www.who.int/news-room/questions-and-answers/item/noncommunicable-diseases-childhood-overweight-and-obesity

World Health Organization (2021, June 9). *Obesity and overweight*. https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

Wong, J., Ross, G. P., Zoungas, S., Craig, M. E., Davis, E. A., Donaghue, K. C., Maple-Brown, L. J., McGill, M. J., Shaw, J. E., Speight, J., Wischer, N., & Stranks, S. (2022). Management of type 2

diabetes in young adults aged 18–30 years: ADS/ADEA/APEG consensus statement. *The Medical Journal of Australia, 216*(8). https://doi.org/10.5694/mja2.51482

BIOGRAPHICAL MATERIAL

Ms. Torhorst began her collegiate education and Division 1 soccer career at Valparaiso University in 2017. While in nursing school, she represented the women's soccer team as a member of the Student Athlete Advisory Committee and as team captain. She also engaged in various acts of community service as a member of the Pi Beta Phi Fraternity for Women and also participated in College Mentors for Kids. Upon completion of her junior year, she had the opportunity to work as a student nurse intern at Northwestern Memorial Hospital in Chicago, Illinois where she fine-tuned her skills and discovered her interest in pursuing an advanced practice degree. Considering these aspirations, Ms. Torhorst returned for her senior year at Valpo and later applied to their BSN-DNP program. Prior to graduation she was informed of her acceptance and went on to graduate from Valparaiso University Cum Laude with her Bachelor of Science in Nursing (BSN) in May of 2021. Shortly thereafter, she began coursework for the Doctor of Nursing Practice (DNP) program in her home state of Wisconsin while also jumpstarting her nursing career at one of Southeast Wisconsin's leading medical centers working on a medical-surgical and telemetry unit. The following year, she transitioned to an outpatient urology clinic in pursuit of her dream to work in the ambulatory setting as a future FNP. Ms. Torhorst continues to work as Urologic RN Specialist in Southeast Wisconsin providing care to mainly older adults with a wide variety of urologic specific conditions. Despite only working part time as a graduate student, she continues to be recognized by her fellow staff and team leader for her flexibility, confidence and utmost proficiency in the urologic setting. Ms. Torhorst has been a member of the Sigma Theta Tau National Honor Society, Zeta Epsilon chapter, since her undergraduate studies and has also become a student member of the American Association of Nurse Practitioners (AANP) as well as the Wisconsin Association of Nurse Practitioners (WANP) during her time as a graduate student. Given her background in specialty work, Ms. Torhorst hopes to pursue a career in a specialized, adult health outpatient clinic in her home state of Wisconsin after graduation.

ACRONYM LIST

AAH: Advocate Aurora Health

AH: Advocate Health

ADA: American Diabetes Association

ACL: Associated Clinical Laboratory

AH: Aurora Healthcare

BMI: Body Mass Index

CDC: Centers for Disease Control and Prevention

CPG: Clinical Practice Guideline

CITI: Collaborative Institutional Training Initiative

CLES: Common Language Effect Size

CINHAL: Cumulative Index of Nursing and Allied Health

EBP: Evidence-Based Practice

HbA1c: Glycosylated Hemoglobin A1c

IRB: Institutional Review Board

Johanna Briggs Institute: JBI

KCPH: Kenosha County Public Health

MA: Medical Assistant

MD: Medical Doctor

MDCD: Milwaukee Department of City Development

NHANES: National Health and Nutritional Examination Survey

NP: Nurse Practitioner

PHI: Personal Health Information

PCOS: Polycystic Ovarian Syndrome

RN: Registered Nurse

SES: Socioeconomic Status

SPSS: Statistical Package for Social Sciences

JHNEBP: The Johns Hopkins Nursing Evidence Based Practice Model

TRIP: Turning Research into Practice

T1D: Type 1 Diabetes

T2D: Type 2 Diabetes

USPSTF: United States Preventative Services Task Force

Wi-Fi: Wireless Fidelity

WI: Wisconsin

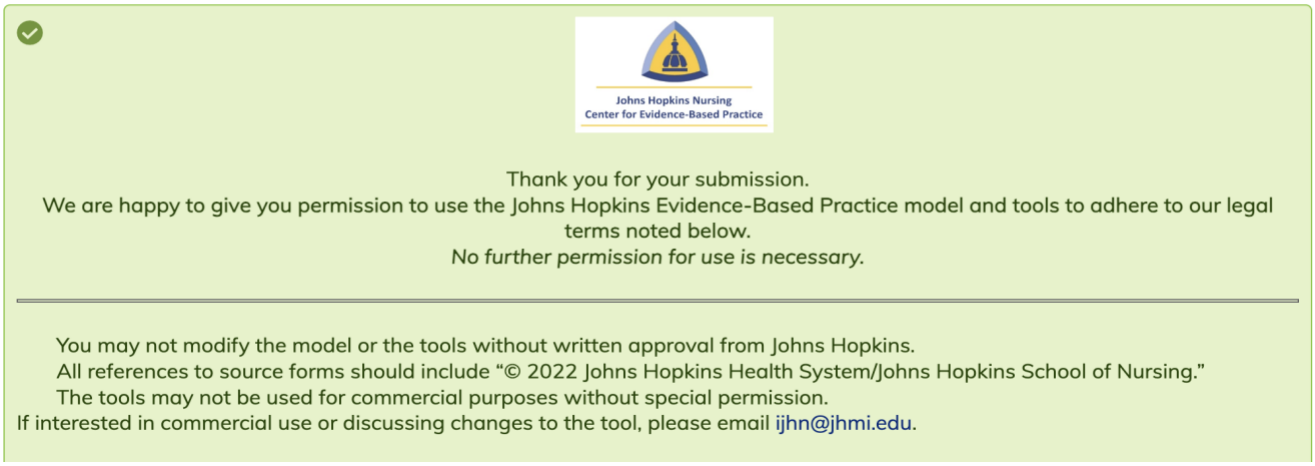
WDHS: Wisconsin Department of Health Services

WHO: World Health Organization

APPENDIX A

The John Hopkins Nursing Evidence- Based Practice Model Permission

JOHNS HOPKINS EBP MODEL AND TOOLS- PERMISSION



APPENDIX B

Literature Search

Database/Resource Searched	Keywords/Phrases Used	Limiters Used	Number of Results from Search	Number of Pieces of Evidence *Selected* for Use
Cochrane	Diabetes mellitus AND adolescent	January 2018- June 2023 and Cochrane Reviews	7	0
JBI	Adolescent OR youth AND diabetes	2018-2023	56	1
TRIP	title: diabet* AND (adolescen* OR child*) OR (obes* OR overweight)	Since 2018 and “Guidelines”	94	3
Medline	(MM “Diabetes Mellitus”) OR (MM “Prediabetic State”) AND (MM “Adolescent”) OR (MH “Adolescent”) AND weight OR “body mass index” OR BMI OR obes* OR overweight AND treat* OR manag*	2018-2023, English language, and scholarly peer reviewed articles	163	1
CINAHL	(MM "Diabetes Mellitus") OR (MM "Diabetes Mellitus, Type 2") OR (MM "Prediabetic State") AND (MH "Adolescence") AND weight OR “body	2018-2023, English language, and scholarly peer reviewed articles	221	1

	mass index" OR BMI OR obes* OR overweight AND treat* OR manag*			
	List the Title of the Article/Piece of Evidence where the References/Citations were Chased From		**Number of Pieces Searched for/Evaluated from that Evidence**	**Number of New Pieces of "Chased" Evidence *Selected* for Use**
List the Pieces of Evidence where Citations were "Chased" from. May include Systematic reviews, evidence summaries, clinical guidelines, journal articles, etc.	Gosak, L., Pajnkihar, M., & Stiglic, G. (2022). The impact of mobile health use on the self-care of patients with type 2 diabetes: Protocol for a randomized controlled trial. *JMIR Research Protocols, 11*(6), 1-19. https://doi.org/10.2196/31652	N/A	6	1
	Salama, M., Biggs, B. K., Creo, A., Prissel, R., Alaa, N. A, & Kumar, S. (2023). Adolescents with type 2 diabetes: Overcoming barriers to effective weight management. *Diabetes, Metabolic Syndrome & Obesity, 16*, 693-711. https://doi.org/10.2147/DMSO.S365829	N/A	6	1
		N/A		
		N/A		

		N/A		
	List the Title of each of the Journal(s) that were "Hand Searched"	**List the Years/Time Frame of each Journal that was Searched *(Should match all other searches)***	**Number of Pieces Selected/Evaluated from that Journal**	**Number of New Pieces from "Hand Searching" *Selected* for Use**
List the Journals that were "Hand Searched". When Hand Searching, review the table of contents of specific journals then "chase" down relevant articles not already obtained via databases or citation chasing.	JMIR mHealth and uHealth	2018-2023	5	1
	Frontiers in Endocrinology	2018-2023	7	1
			<u>Total</u> Number of pieces of Evidence Selected for Use:	10

APPENDIX C

Table 1.2

Evidence Table

Lead Author/ Year/Quality Purpose	Purpose/Design /Sample	Interventions	Measurement/ Outcomes	Results/Findings	Strengths/ Limitations
Level I Evidence					
El Sayed et al., 2022 High/AGREE II	**Purpose:** To provide the ADA's recommended components of diabetes care as well as general treatment goals, guidelines, and tools to evaluate quality of care for children and adolescents with type 1 diabetes, type 2 diabetes, and other forms of pediatric diabetes. **Design:** CPG **Sample:** CPGs, RCTs, systematic reviews, meta-analyses, and intervention studies	Clinical recommendations provided in the following domains: Diabetes self-management education and support, screening and diagnosis, diagnostic challenges, overall management, nutrition therapy, physical activity and exercise, school and childcare, psychosocial care, glycemic monitoring, insulin delivery, and their targets, autoimmune conditions, management of	A1C for diabetes screening in high-risk youth Lifestyle management as a key to diabetes care Meal planning approaches to achieve improved A1C Modest, sustained weight loss to delay progression from prediabetes to type 2 diabetes Familial involvement in diabetes management	**Recommendations:** A1C can be used to test for prediabetes or diabetes in children and adolescents. A reasonable A1C target for most children and adolescents with type 2 diabetes is <7%. Risk-based screening for prediabetes and/or type 2 diabetes should be considered after the onset of puberty or ≥10 years of age, whichever occurs earlier, in youth with overweight (BMI ≥85th percentile) or obesity (BMI ≥95th	**Strengths:** The guideline is written by a reputable organization and is very thorough. It covers many aspects of T2D in children and adolescents related to this project including screening, diagnosis, and successful lifestyle management techniques including weight management and nutritional therapies. It includes information obtained from several CPGs RCTs, systematic reviews, and intervention studies to guide age-specific care.

		cardiovascular risk factors, microvascular complications, and prevention and management of complications.		percentile) and who have one or more additional risk factors for diabetes. Glycemic status should be assessed every 3 months. Nutrition for youth with prediabetes and type 2 diabetes, like for all children and adolescents, should focus on healthy eating patterns that emphasize consumption of nutrient-dense, high-quality foods and decreased consumption of calorie-dense, nutrient-poor foods, particularly sugar-added beverages. Medical nutritional therapy can assist in decreasing HbA1c levels. Given the necessity of long-term weight management for youth with type 2 diabetes, lifestyle intervention should be based on a chronic care model and	**Limitations:** Includes information on T1D (Type 1 diabetes) and other diabetic conditions. The guideline itself is lengthy causing the read to take a significant amount of time to read, dissect and absorb appropriate information. It provides great emphasis in interventions not focused on within this literature review and further EBP project.

				offered in the context of diabetes care. Youth with overweight/obesity and type 2 diabetes and their families should be provided with developmentally and culturally appropriate comprehensive lifestyle programs that are integrated with diabetes management to achieve a 7–10% decrease in excess weight. All youth with type 2 diabetes and their families should receive comprehensive diabetes self-management education and support that is specific to youth with type 2 diabetes and is culturally appropriate.	
Magge et al., 2020 High/Johns Hopkins	**Purpose:** Describe and promote proper evaluation and treatment of prediabetes in youth. **Design:** Evidence summary with Expert opinion	Clinical recommendations provided in the following domains: Screening, treatment including specific lifestyle modifications, follow up care	Screening measures for high-risk youth Diabetes diagnostic criteria in youth Lifestyle interventions for appropriate management in youth	**Recommendations:** The Pediatric Endocrine Society with the Endocrine Society and European Society of Endocrinology, and the ADA endorse screening for prediabetes/T2DM in high-risk youth.	**Strengths:** Evidence based. Majority of studies included are RCTs which are considered to be high levels of evidence. Produced by the Johns Hopkins University school of medicine which consistently

	Sample: CPGs, RCTs, clinical trials, and other intervention studies.			The American Diabetes Association (ADA) defines diabetes as … a hemoglobin A1c (HbA1c) of 6.5% by a National Glycohemoglobin Standardization Program-certified device, standardized to the Diabetes Control and Complications Trial assay. With the updated diagnostic HbA1c criteria for diabetes in 2010, also came an HbA1c range associated with increased risk for diabetes: 5.7%-6.4%. The ADA states that the term “prediabetes” may be applied to this group and that those with HbA1c in the 6.0%-6.4% group are at particularly high risk for developing diabetes. Intensive lifestyle interventions focused on improved nutrition and increased exercise in diabetic youth should be stressed.	ranks among the United States’ top educational programs. Includes information backed by the American Diabetes Association, a well-known, reliable, and diabetes specific network of volunteers, families, caregivers, and medical professionals. **Weaknesses:** Expert opinions are the lowest ranking on the evidence hierarchy. Information contained within this paper is occasionally challenged by this evidence summary. Not all studies contained within this summary are RCTs.

Qui et al., 2022 High/Johns Hopkins	**Purpose:** To determine the efficacy of multiple eHealth-delivered lifestyle interventions for the prevention or treatment of overweight and or obese children and adolescents. **Design:** Systematic review and meta-analysis **Sample:** 40 Two-arm RCTs	Use of eHealth (e.g., internet, computers, tablets, telehealth, mobile applications, phone calls, text messages, and emails) for delivering lifestyle interventions (e.g., dietary changes, physical activity or behavioral therapy for weight management, such as self-monitoring, goal setting, or providing feedback).	BMI, BMI Z-score, waist circumference, body weight, and body fat percent.	**Recommendations:** eHealth-interventions are successful in decreasing BMI, body weight, body fat percentage, and waist circumference as described with statistically significant results. Parental and or school involvement with eHealth-delivered interventions is also recommended based on statistically significant results. Mobile-based interventions specially are recommended in overweight or obese children and adolescents to induce changes in wight and subsequent BMI.	**Strengths:** Included only RCTs. Focused on strictly overweight and obese children and adolescents. Utilized mobile applications as a main intervention of interest. Changes in lifestyle interventions such as dietary changes and weight management were targeted outcome measures. Adds to existing body of evidence related to mobile based lifestyle interventions in the setting of overweight and obese children and adolescents. **Weaknesses:** Interventions did not have to be solely delivered through eHealth measures. Interventions were not limited to just the use of mobile applications. Participants did not include those strictly diagnosed with prediabetes and or T2D. Blinding of participants

					nonexistent due to nature of interventions. Mild to high heterogeneity of studies included. Difference body weigh references among included studies affecting overall stability.
Shah et al., 2022 High/AGREE II	**Purpose:** To provide an updated guideline related to the risk factors, diagnosis and presentation of youth onset T2D, the initial and subsequent management of youth-onset T2D, and management of co-morbidities and complications. **Design:** CPG **Sample:** CPGs, RCTs, systematic reviews, meta-analyses, and other quantitative interventions studies.	Clinical recommendations provided in the following domains: Pathophysiology, risk factors, screening, and diagnosis of prediabetes and T2D. Education, recommendations and modification related on diet, exercise and sleep for the entire family. Information related to glycemic monitoring, targets, and pharmacotherapy. How social determinants of health relate to diabetes care. The transition of care from childhood to adulthood. Screenings	Diabetes screening measures Diagnostic pearls of T2D Diabetes specific education for T2D	**Recommendations:** Targeted screening to identify cases of T2D can be considered after onset of puberty or after 10 years of age in youth who have a body mass index (BMI) ≥85th percentile for age and sex and risk factors for T2D. Diabetes in youth should be diagnosed using the ADA or ISPAD criteria. HbA1c is universally available, can be performed any time of day, but should utilize a laboratory based, DCCT aligned, NGSP certified methodology and not a point-of-care method.	**Strengths:** Focuses specifically on children and adolescents with prediabetes and T2D. Includes information on lifestyle modifications including diet modification and maintenance of a healthy weight. Written by the International Society for Pediatric and Adolescent Diabetes (*ISPAD),* the only international society focusing on all types of diabetes in the worldwide population under 25. Uses updated information from ongoing clinical trials in the target population. Evidence-based and thorough in

		for comorbidities and complications.		Hemoglobin A1c (HbA1c) can be used to screen for T2D. HbA1c ≥ 6.5% (48 mmol/mol) by a NGSP-certified device, standardized to the DCCT assay is diagnostic of T2D. Education should be provided soon after diagnosis in a culturally sensitive and age-appropriate manner and should include diabetes self-management education that is specific for pediatric T2D. Education content should include the pathophysiology and treatment of T2D in youth, building skills of healthy eating, knowledge about macronutrients, portion sizes, and food label reading.	its recommendations. Includes information from evidence of high rank on the evidence hierarchy. **Weaknesses:** Utilization of international data. Includes information on young adults up to age 25 which is outside of the project age range. Includes information on glycemic monitoring and pharmacotherapy unrelated to EBP project.
Smart et al., 2018 High/AGREE II	**Purpose:** To provide information on international nutritional management guidelines	Clinical recommendations provided in the following domains	Nutritional management and an individualized approach to education	**Recommendations:** Most children with type 2 diabetes are overweight	**Strengths:** Focuses specifically on nutritional management of children and

	for children and adolescents in the setting of T1D and T2D. **Design:** CPG **Sample:** CPGs, RCTs, systematic reviews, meta-analyses, and other quantitative interventions studies.	related to both T1D and T2D: Aims of nutritional management, guidelines on energy balance, energy intake and food components, maintenance of a healthy body weight, guidelines for nutritional care, education and meal planning, education tools and methods, dietary recommendations for specific insulin regimes, age group specific advice, nutritional management of exercise and physical activity, and the management of co-morbidities.	Prevention and management of overweight/obesity Guidance on family food choices, appropriate portion sizes, energy density of foods, meal routines and physical activity Parents as positive role models Individualized dietary plans	or obese, therefore treatment should be centered on education and lifestyle interventions to prevent further weight gain or achieve weight loss with normal linear growth. The entire family should be included in the lifestyle intervention because parents and family members influence the child's food intake and physical activity, and they are often overweight or obese and have diabetes as well. There is evidence from ketogenic diets that low-carbohydrate diets can be nutritionally inadequate and result in growth failure; however, evidence also suggests that calorie controlled, lower carbohydrate diets may achieve greater reductions in lipid profiles and are therefore an effective strategy for the	adolescents with T2D. Includes information on how nutrition plays a role in weight management. Includes specific nutritional strategies for children and adolescents with T2D. Written by the International Society for Pediatric and Adolescent Diabetes (*ISPAD),* the only international society focusing on all types of diabetes in the worldwide population under 25. **Weaknesses:** There is information and furthermore recommendations included in this CPG derived from adult diabetic patients. Not specific to prediabetes and T2D patients. Includes international data. Focuses on insulin regimens and pharmacologic treatment measures which are not a part of this EBP project.

				optimization of type 2 management. Regular meals and snacks (at least three balanced meals per day) ensures that the range of nutrients are consumed to meet daily recommended requirements. Plot growth curve, BMI and if possible, waist circumference, every 3 months to monitor weight.	
Sivapuram, 2021 High/Johns Hopkins	**Purpose:** To answer the following clinical questions: What is the best available evidence related to non-pharmacological strategies for the management of diabetes in adolescents? **Design:** Evidence summary **Sample:** 3 CPGs & 3 RCTs	Provides clinical insight and further recommendations on the non-pharmacologic approach to care of young adults with T1D and T2D.	Non-pharmacological diabetic interventions aimed at improving clinical, behavioral and psychosocial outcomes Interventions involving digital technologies Multicomponent interventions Glycemic targets are necessary for metabolic control and should be aimed with	**Recommendations:** Structured educational resources (especially computer assisted education) designed specifically for adolescents are more likely to be effective in increasing their knowledge uptake, SMBG, and compliance with management strategies. Digital technology is associated with	**Strengths:** Includes high level of evidence. Evidence-based. Provides information from well-known and trusted professional healthcare organizations. Provides valuable insight on dietary strategies as well as the use of digital technologies in the setting of adolescent diabetes care and further management.

			clinical judgement with consideration of individual risk factors and therefore tailored to each child. Individualized nutritional therapy	improved treatment adherence, monitoring, patient satisfaction, and overall clinical benefits. Interventions that integrate medical, behavioral, and psychosocial components and involve parents have a beneficial effect on diabetes management outcomes. An individualized meal plan that ensures optimal growth and development without compromising glycemic control should be implemented and evaluated regularly. Individual nutritional therapy (sensitive to cultural, ethnic, and family traditions, as well as the cognitive and psychosocial needs of the individual child) and regular eating routines is beneficial for glycemic control, but the optimal macronutrient composition varies and	**Weaknesses:** Not specific to prediabetes and T2D. Includes a wide variety of digital interventions.

				should approximate 50–55% < 35%, and 15–20% of energy from carbohydrate, fat, The recommended A1C target of ≤7.5% should be aimed using tailored treatment strategies while minimizing severe or recurrent hypoglycemia.	
USPSTF, 2022 Good/Johns Hopkins	**Purpose:** To describe the current recommended screening measures for prediabetes and T2D in children and adolescents. **Design:** Evidence summary **Sample:** 3 RCTs	**Clinical recommendations are provided with information specific to: The importance behind screening, defining prediabetes and T2D, types of screening measures, treatment and preventive measures, suggestions for practice as well as potential harms of screening in the context of children and adolescents with prediabetes and T2D.**	Interventions of interest included screening measures that may prevent future potential burdens of prediabetes and T2D.	**Recommendations:** The definitions of prediabetes and diabetes in children and adolescents are the same as in adults… a HbA1c level of 5.7% to 6.4… is consistent with prediabetes… a HbA1c level of 6.5% or greater… is consistent with the diagnosis of T2D. Lifestyle interventions to achieve weight loss, improve diet, and increase physical activity are recommended for youth diagnosed with prediabetes and diabetes. The Centers for Disease Control and	**Strengths:** Includes strong levels of evidence. Written by a national trusted panel of experts who develop clinical recommendations. The review excluded studies limited to or predominately comprising adults or pregnant women. Population of interest focused on children and adolescents with prediabetes and T2D. **Weaknesses:** The USPSTF concludes that the evidence is insufficient to assess the balance of benefits and harms of screening for type 2 diabetes in

				Prevention recommends programs that increase exercise and improve nutrition; these programs include extensive education on promoting self-management skills and establishing individualized plans for self-monitoring of glycemic targets. Prediabetes and T2D can be detected accurately by measuring fasting plasma glucose or HbA1c level, or with an oral glucose tolerance test. Obesity and excess adipose tissue, especially when centrally distributed, are to be considered the most important risk factors for type 2 diabetes in younger persons. Family history of diabetes (including gestational diabetes) is also a strong risk factor.	children and adolescents.
Wong et al., 2022 High/Johns Hopkins	**Purpose:** To provide clinical recommendations on important aspects of	Clinical recommendations provided on the following: Screening,	Screening measures HbA1c	**Recommendations:** Screening for diabetes is recommended in young	**Strengths:** Specific to T2D. Developed by the Australian Diabetes Society Expert

	diabetes care in young adults with T2D **Design:** CPG/Expert consensus statement **Sample:** CPGs with a mixture of quantitative and qualitative studies.	diabetes type, psychological care, lifestyle, glycemic targets, pharmacological agents, cardiovascular disease risk management, comorbidity assessment, contraception and pregnancy planning, and patient-centered education.	Recommended dietary consumption Self-management strategies Diabetes specific education.	adults with overweight or obesity and additional risk factors. The HbA1c target should be ≤ 6.5 % if it can be achieved without undue hypoglycemia risk and self-management burden. Regular 3-monthly glycated hemoglobin monitoring is warranted. Diabetes self-management and diabetes education are cornerstones of diabetes care. Structured education, an assessment of the individual's learning needs, and follow-up education need to be integrated into every clinical consultation. Obesity is a key modifiable risk factor. A sustained weight loss of 7–10% in individuals with excess weight is expected to provide long term benefits.	Consensus Development Group, from which a working group of experts in the field was formed. The Australasian Pediatric Endocrine Group (APEG) and Australian Diabetes Educators Association (ADEA) have reviewed and endorsed the following guidelines. **Weaknesses:** The main studies available specific to type 2 diabetes in young adults were cross-sectional observational studies. Includes information on pregnancy, daily glucose monitoring and pharmacologic intervention snot relevant to the project at hand. Includes international data.

				Culturally appropriate programs promoting healthy diet and increased physical activity need to be provided, and family involvement needs to be individualized as developmentally appropriate. Maintaining a healthy relationship with food is paramount.	
Level 3 Evidence					
Kaakinen et al., 2018 High/Johns Hopkins	**Purpose:** To describe and evaluate technology-based counseling interventions in weight and lifestyle management for obese or overweight children and adolescents. **Design:** Descriptive systematic literature review **Sample:** 14 RCTs, 6 quasi-experimental, 1 comparison study, 1	Counseling programs delivered via the Internet and interactive multimedia games. CD ROMs, text messages, TV games, and emails. Group (family) and individually tailored counseling interventions conducted at summer camps, schools, and in participants homes.	Measured outcomes included body mass index (BMI), waist-to-hip ratio, blood pressure, heart rate, pedometer, and accelerometer readings, and energy expenditure from calorimeter measurements. Self-reported outcomes focused on changes in diet (mostly consumption of 100% fruit juice, fruits, and	**Recommendations:** Technology-based counseling interventions in weight and lifestyle management for obese or overweight children and adolescents can lead to a decrease in BMI and waist-to-hip ratio and increases in vegetable and fruit intake. Providing a tailored program that involves individual feedback and	**Strengths:** Majority of the evidence came from RCTs which are highly ranked in the evidence hierarchy. Included studies concerning obese or overweight children and adolescents (below 18 years of age). A specific protocol was used to perform the search with strict inclusion criteria. The search was performed in conjunction with an

	correlative study, & 2 intervention studies		vegetables, and physical activity. Participants knowledge of nutrition. Self-reported data concerning depressed moods, program adherence, and self-efficacy (e.g. healthy eating) and physical activity.	goal setting are crucial to success in this population related to management of obesity. Parental involvement in addressing childhood obesity leads to more successful lifestyle modifications and further weight control.	information specialist, i.e. a librarian. Several databases were used. The figures and outcomes of the literature search are described in Table 2, so readers can follow the study stages and decisions. At all stages, the study selection process was performed by three investigators independently and was clearly defined and is fully reproducible. **Limitations:** Studies were not specific to children and adolescents with prediabetes or T2D. Varying quality and heterogeneity of the selected studies, i.e. sample sizes, type of interventions, measures, and length of follow-up times differed between the studies.
Wang et al., 2019 Good/Johns Hopkins	**Purpose:** To evaluate the effectiveness of mHealth interventions for diabetes and obesity	Use of an mHealth intervention (eg, use of mobile devices, apps, and text message) for	Clinical biomarkers: HbA1c levels, weight/weight status, BMI, waist circumference, blood	**Recommendations:** mHealth interventions on diabetes and obesity management, especially	**Strengths:** Included newly published reviews that were not included in other studies. Includes

	treatment and management. **Design:** Systematic Review **Sample:** 18 meta-analyses reported in 6 systematic reviews	managing or treating obesity/diabetes while measuring clinical biomarkers, treatment adherence, or health-related behaviors (eg, healthy eating and exercise) to provide quantitative results examining the effectiveness of the intervention (or use of the mHealth devices/programs).	pressure, serum lipid/cholesterol levels, severe hypoglycemia/adverse effects, and C-reactive protein levels. For measuring treatment adherence: medication/treatment adherence and glycemic self-control/monitoring. Indicators of health-related behaviors: PA and diet.	in the areas of glycemic control and weight management, provide clinically significant results as demonstrated by this review. Each of the following systematic reviews concluded that mHealth was feasible and can improve health outcomes among patients suffering from diabetes and/or obesity.	patients with a previous diagnosis of diabetes. Included the intervention of interest (mobile application) as well outcomes of interest for this EBP project (HbA1c and BMI). **Weaknesses:** Not specific to adolescent patients with prediabetes or T2D. High level of heterogeneity in the characteristics and findings of the 17 reviews. the reviews included only a small number of RCTs.

APPENDIX D

Patient Handouts

Phrases that *HELP* and *HINDER*

As the caregiver, you play the biggest role in your child's eating behavior.
What you say has an impact on developing healthy eating habits.
Negative phrases can easily be changed into positive, helpful ones!

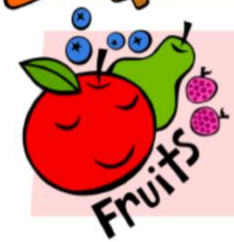
Phrases that *HINDER*	Phrases that *HELP*
INSTEAD OF ...	**TRY ...**
Eat that for me. *If you do not eat one more bite, I will be mad.* Phrases like these teach your child to eat for your approval and love. This can lead your child to have unhealthy behaviors, attitudes, and beliefs about food and about themselves.	***This is kiwi fruit; it's sweet like a strawberry.*** ***These radishes are very crunchy!*** Phrases like these help to point out the sensory qualities of food. They encourage your child to try new foods.
INSTEAD OF ...	**TRY ...**
You're such a big girl; you finished all your peas. ***Jenny, look at your sister. She ate all of her bananas.*** ***You have to take one more bite before you leave the table.*** Phrases like these teach your child to ignore fullness. It is better for kids to stop eating when full or satisfied than when all of the food has been eaten.	***Is your stomach telling you that you're full?*** ***Is your stomach still making its hungry growling noise?*** ***Has your tummy had enough?*** Phrases like these help your child to recognize when he or she is full. This can prevent overeating.
INSTEAD OF ...	**TRY ...**
See, that didn't taste so bad, did it? This implies to your child that he or she was wrong to refuse the food. This can lead to unhealthy attitudes about food or self.	***Do you like that?*** ***Which one is your favorite?*** ***Everybody likes different foods, don't they?*** Phrases like these make your child feel like he or she is making the choices. It also shifts the focus toward the taste of food rather than who was right.
INSTEAD OF ...	**TRY ...**
No dessert until you eat your vegetables. ***Stop crying and I will give you a cookie.*** Offering some foods, like dessert, in reward for finishing others, like vegetables, makes some foods seem better than others. Getting a food treat when upset teaches your child to eat to feel better. This can lead to overeating.	***We can try these vegetables again another time. Next time would you like to try them raw instead of cooked?*** ***I am sorry you are sad. Come here and let me give you a big hug.*** Reward your child with attention and kind words. Comfort him or her with hugs and talks. Show love by spending time and having fun together.

Adapted from "What You Say Really Matters?" in *Feeding Young Children in Group Settings*, Dr. Janice Fletcher and Dr. Laurel Branen, University of Idaho.

Along with filling half of our plate with colorful **vegetables** and **fruits** (and choosing them as snacks), split the other half between **whole grains** and **healthy protein**:

The more veggies – and the greater the variety – the better.

Potatoes and French fries don't count as vegetables because of their negative impact on blood sugar.



Eat plenty of fruits of all colors.

Choose whole fruits or sliced fruits (rather than fruit juices; limit fruit juice to one small glass per day).

Go for whole grains or foods made with minimally processed whole grains. The less processed the grains, the better.

Whole grains—whole wheat, brown rice, quinoa, and foods made with them, such as whole-grain pasta and 100% whole-wheat bread—have a gentler effect on blood sugar and insulin than white rice, bread, pizza crust, pasta, and other refined grains.

Choose beans and peas, nuts, seeds, and other plant-based healthy protein options, as well as fish, eggs, and poultry.

Limit red meat (beef, pork, lamb) and avoid processed meats (bacon, deli meats, hot dogs, sausages).

It's also important to remember that fat is a necessary part of our diet, and what matters most is the type of fat we eat. We should regularly choose foods with healthy unsaturated fats (such as fish, nuts, seeds, and **healthy oils** from plants), limit foods high in saturated fat (especially red meat), and avoid unhealthy trans fats (from partially hydrogenated oils):

Use healthy oils from plants like extra virgin olive, canola, corn, sunflower, and peanut oil in cooking, on salads and vegetables, and at the table.

Limit butter to occasional use.

Dairy foods are needed in smaller amounts than other foods on our plate:

Choose unflavored milk, plain yogurt, small amounts of cheese, and other unsweetened dairy foods.

Milk and other dairy products are a convenient source of calcium and vitamin D, but the optimal intake of dairy products has yet to be determined and the research is still developing. For children consuming little or no milk, ask a doctor about possible calcium and vitamin D supplementation.

Water should be the drink of choice with every meal and snack, as well as when we are active:

Water is the best choice for quenching our thirst. It's also sugar-free, and as easy to find as the nearest tap.

Limit juice—which can have as much sugar as soda—to one small glass per day, and avoid sugary drinks like sodas, fruit drinks, and sports drinks, which provide a lot of calories and virtually no other nutrients. Over time, drinking sugary drinks can lead to weight gain and increase the risk of type 2 diabetes, heart disease, and other problems.

Finally, just like choosing the right foods, incorporating physical activity into our day by **staying active** is part of the recipe for keeping healthy:

Trade inactive "sit-time" for "fit-time."

Children and adolescents should aim for at least one hour of physical activity per day, and they don't need fancy equipment or a gym—*The Physical Activity Guidelines for Americans* suggest choosing unstructured activities for children such as playing tug-of-war, or having fun using playground equipment.

Overall, the main message is to focus on diet quality:

The *type of carbohydrate* in the diet is more important than the *amount of carbohydrate* in the diet, because some sources of carbohydrate—like vegetables (other than potatoes), fruits, whole grains, and beans—are much healthier than sugar, potatoes, and foods made from white flour.

The Kid's Healthy Eating Plate does not include sugary drinks, sweets, and other junk foods. These are not everyday foods and should be eaten only rarely, if ever.

The Kid's Healthy Eating Plate encourages the use of healthy oils in place of other types of fat.

About the Kid's Healthy Eating Plate

The Kid's Healthy Eating Plate is a visual guide to help educate and encourage children to eat well and keep moving. At a glance, the graphic features examples of best-choice foods to inspire the selection of healthy meals and snacks, and it emphasizes physical activity as part of the equation for staying healthy.

The Kid's Healthy Eating Plate was created by nutrition experts at the Harvard T.H. Chan School of Public Health, based on the best available science, to enhance the visual guidance provided by the U.S. Department of Agriculture's MyPlate icon. The Kid's Healthy Eating Plate reflects the same important messages as the Harvard Healthy Eating Plate, with a primary focus on diet quality, but is designed to further facilitate the teaching of healthy eating behaviors to children.

For more information, visit *The Nutrition Source* (www.hsph.harvard.edu/nutritionsource/kids-healthy-eating-plate).

Academy of Nutrition and Dietetics

Eat Right

Food, Nutrition and Health Tips from the Academy of Nutrition and Dietetics

20 Ways to Enjoy More Fruits and Vegetables

Building a healthy plate is easy when you make half your plate fruits and vegetables. It's also a great way to add color, flavor and texture plus vitamins, minerals and fiber. All this is packed in fruits and vegetables that are low in calories and fat. Make 2 cups of fruit and 2 ½ cups of vegetables your daily goal. Try the following tips to enjoy more fruits and vegetables every day.

1. Variety abounds when using vegetables as pizza topping. Try broccoli, spinach, green peppers, tomatoes, mushrooms and zucchini.
2. Mix up a breakfast smoothie made with low-fat milk, frozen strawberries and a banana.
3. Make a veggie wrap with roasted vegetables and low-fat cheese rolled in a whole-wheat tortilla.
4. Try crunchy vegetables instead of chips with your favorite low-fat salad dressing for dipping.
5. Grill colorful vegetable kabobs packed with tomatoes, green and red peppers, mushrooms and onions.
6. Add color to salads with baby carrots, grape tomatoes, spinach leaves or mandarin oranges.*
7. Keep cut vegetables handy for mid-afternoon snacks, side dishes, lunch box additions or a quick nibble while waiting for dinner. Ready-to-eat favorites: red, green or yellow peppers, broccoli or cauliflower florets, carrots, celery sticks, cucumbers, snap peas or whole radishes.

8. Place colorful fruit where everyone can easily grab something for a snack-on-the-run. Keep a bowl of fresh, just ripe whole fruit in the center of your kitchen or dining table.

9. Get saucy with fruit. Puree apples, berries, peaches or pears in a blender for a thick, sweet sauce on grilled or broiled seafood or poultry, or on pancakes, French toast or waffles.

10. Stuff an omelet with vegetables. Turn any omelet into a hearty meal with broccoli, squash, carrots, peppers, tomatoes or onions with low-fat sharp cheddar cheese.

11. "Sandwich" in fruits and vegetables. Add pizzazz to sandwiches with sliced pineapple, apple, peppers, cucumber and tomato as fillings.

12. Wake up to fruit. Make a habit of adding fruit to your morning oatmeal, ready-to-eat cereal, yogurt or toaster waffle.

13. Top a baked potato with beans and salsa or broccoli and low-fat cheese.

14. Microwave a cup of vegetable soup as a snack or with a sandwich for lunch.

15. Add grated, shredded or chopped vegetables such as zucchini, spinach and carrots to lasagna, meat loaf, mashed potatoes, pasta sauce and rice dishes.

16. Make fruit your dessert: Slice a banana lengthwise and top with a scoop of low-fat frozen yogurt. Sprinkle with a tablespoon of chopped nuts.

17. Stock your freezer with frozen vegetables to steam or stir-fry for a quick side dish.

18. Make your main dish a salad of dark, leafy greens and other colorful vegetables. Add chickpeas or edamame (fresh soybeans). Top with low-fat dressing.*

19. Fruit on the grill: Make kabobs with pineapple, peaches and banana. Grill on low heat until fruit is hot and slightly golden.

20. Dip: Whole wheat pita wedges in hummus, baked tortilla chips in salsa, strawberries or apple slices in low-fat yogurt, or graham crackers in applesauce.

**See "Color Your Plate with Salad" at www.eatright.org/nutritiontipsheets for more tips on creating healthy salads*

For a referral to a registered dietitian nutritionist and for additional food and nutrition information visit www.eatright.org.

The Academy of Nutrition and Dietetics is the largest organization of food and nutrition professionals. The Academy is committed to improving the public's health and advancing the profession of dietetics through research, education and advocacy.

This tip sheet is provided by:

Authored by Academy of Nutrition and Dietetics staff registered dietitian nutritionists.

Academy of Nutrition and Dietetics

Eat Right

Food, Nutrition and Health Tips from the Academy of Nutrition and Dietetics

Eat Right with MyPlate

Find your healthy eating style using these recommendations from the *2015-2020 Dietary Guidelines*.

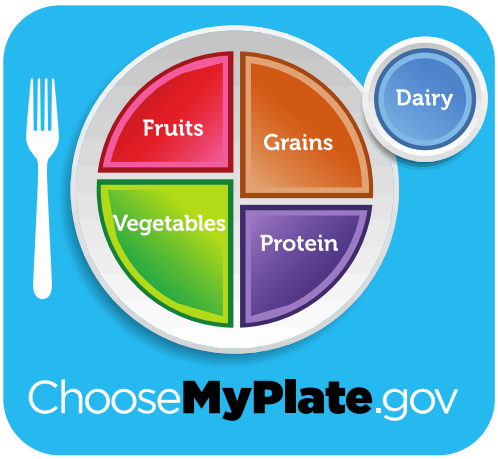
Simply start with small changes to make healthier choices you can enjoy.

Make half your plate fruits and vegetables: Focus on whole fruits.

- Choose whole fruits –fresh, frozen, dried or canned in 100% juice.
- Enjoy fruit with meals, as snacks or as a dessert

Make half your plate fruits and vegetables: Vary your veggies.

- Try adding fresh, frozen or canned vegetables to salads, sides and main dishes.



- Choose a variety of colorful veggies prepared in healthful ways: steamed, sautéed, roasted or raw

Make half your grains whole grains.

- Look for whole grains listed first or second on the ingredients list - try oatmeal, popcorn, whole-grain bread and brown rice.
- Limit grain desserts and snacks such as cakes, cookies and pastries.

Vary your protein routine.

- Mix up your protein foods to include seafood, beans and peas, unsalted nuts and seeds, soy products, eggs, and lean meats and poultry.
- Try main dishes made with beans and seafood, like tuna salad or bean chili.

Drink and eat less sodium, saturated fat and added sugars.

- Use the Nutrition Facts label and ingredients list to limit items high in sodium, saturated fat an added sugars.
- Choose vegetable oils instead of butter and oil-based sauces and dips instead of ones with butter, cream or cheese.
- Drink water instead of sugary drinks.

Move to low-fat or fat-free milk or yogurt.

- Choose fat-free milk, yogurt and fortified soy beverages (soy milk) to cut back on saturated fat.
- Replace sour cream, cream and regular cheese with low-fat yogurt, milk and cheese.

Find more healthy eating tips at:

- **www.eatright.org**
- **www.kidseatright.org**
- **www.ChooseMyPlate.gov**

For a referral to a registered dietitian nutritionist and for additional food and nutrition information visit www.eatright.org.

eat right.

The Academy of Nutrition and Dietetics is the largest organization of food and nutrition professionals. The Academy is committed to improving the public's health and advancing the profession of dietetics through research, education and advocacy.

This tip sheet is provided by:

Source: ChooseMyPlate.gov

Authored by Academy of Nutrition and Dietetics staff registered dietitian nutritionists.

Plan Your Portions

American Diabetes Association.
Connected for Life

What Can I Eat?®

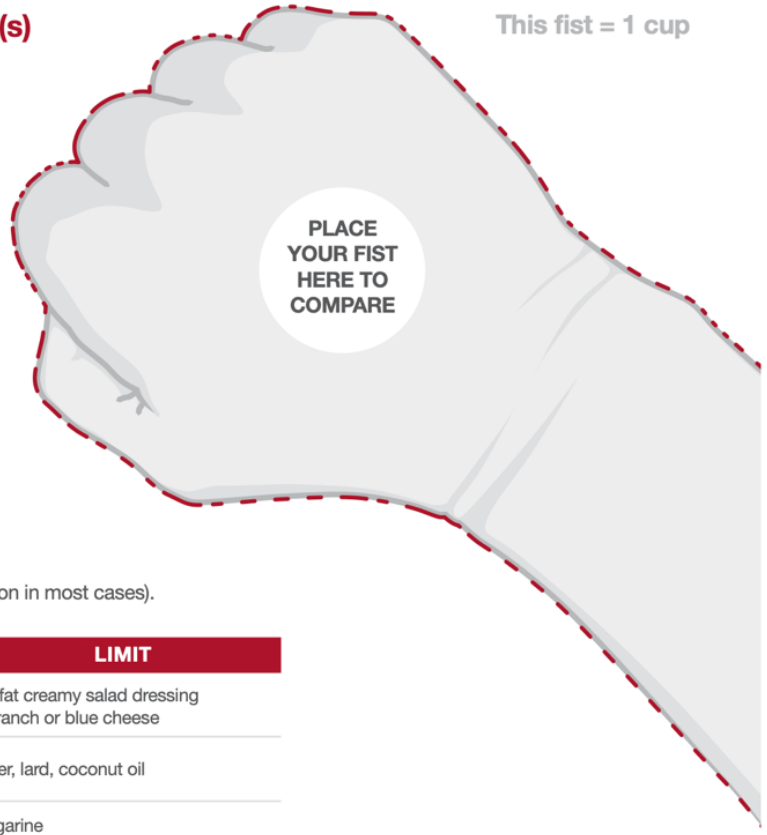
What Can I Eat? | 1-800-DIABETES (1-800-342-2383) | diabetes.org/whatcanieat

Plan Your Portions

American Diabetes Association. Connected for Life | What Can I Eat?®

Your fist is a handy tool that is always with you. Place your fist on the outline to the right to see how it compares to a measuring cup.

My fist = _____ cup(s)



Healthy Tip:

Choose low-cost recipes and meals. Recipes with fewer ingredients are often cheaper and quick to make. One place to look for recipes is **diabetesfoodhub.org**.

FATS: All fats are high in calories, so keep the portion size small (less than 1 tablespoon in most cases).

EAT OFTEN	SOMETIMES	LIMIT
Oil-based salad dressing: vinaigrette, oil and vinegar	Low-fat creamy salad dressing like light ranch	Full-fat creamy salad dressing like ranch or blue cheese
Oils: canola, olive, sunflower, peanut	Oils: corn, soybean, safflower, sesame	Butter, lard, coconut oil
Avocado, olives, seeds, peanut or almond butter	Mayonnaise	Margarine
		Cream

What Can I Eat? | 1-800-DIABETES (1-800-342-2383) | diabetes.org/whatcanieat

Cooking With Kids Resources

https://www.foodright.org/ FoodRight is a Milwaukee-based non-profit that empowers youth and families to eat foods that sustain life-long health through gardening and culinary lessons.

https://milwaukeepublicmarket.org/class/cooking-classes The Milwaukee Public Market hosts cooking classes for kids and adults. Check their website for schedules.

https://chopchopfamily.org Chop Chop is a quarterly cooking magazine for kids. Their website features recipes and teaches kitchen skills, available in both Spanish and English.

https://acfmilwaukee.com/chef-and-child-1 Offers culinary camps for kids in summer. Sometimes hosts events throughout the year.

https://foodhero.org/ Food Hero, an extension of Oregon State University, focuses on quick, healthy, affordable meals that families can prepare together. The site is available in English and Spanish and you can search for recipes easily by ingredients that you may already have at home.

https://cookingmatters.org/ Cooking Matters is a national program that conducts community nutrition education and cooking workshops focusing on affordable, nutritious food. This site features healthy recipes, nutrition information, and instructional videos.

https://www.americastestkitchen.com/kids/ From the PBS show "America's Test Kitchen", The Young Chef's Club includes recipes, videos kitchen skills, experiments, and design challenges. They are posting daily activities during the COVID-19 pandemic. This site does tend to favor sweet recipes.

https://www.choosemyplate.gov/myplatekitchen This is the official website for the USDA's My Plate program. The "My Plate Kitchen" section has a wide range of recipes by food group that you can select and print into your own custom cookbook.

https://www.jillcastle.com Jill Castle is a registered dietitian and expert in child nutrition. Check out the "Blog" section for healthy, family meals that are quick to prepare. This website is an excellent resource for many childhood nutrition topics such as feeding picky eaters and young athletes.

https://www.jamieoliver.com/features/category/get-kids-cooking/ British Chef, Jamie Oliver, has been at the forefront of making healthy cooking accessible to all in the UK. Some of the instructional videos on the website feature Jamie's 8 year-old son, Buddy, as the teacher. Note - You will need to convert recipes from metric to our standard recipe sizes using google.

https://www.commonbytes.org This program features videos on kitchen skills, nutrition, and gardening. This would be excellent for anyone interested in starting a garden at home this spring.

https://joyfoodsunshine.com/ - This website has a wide range of family friendly recipes with time-lapse videos for each recipe.

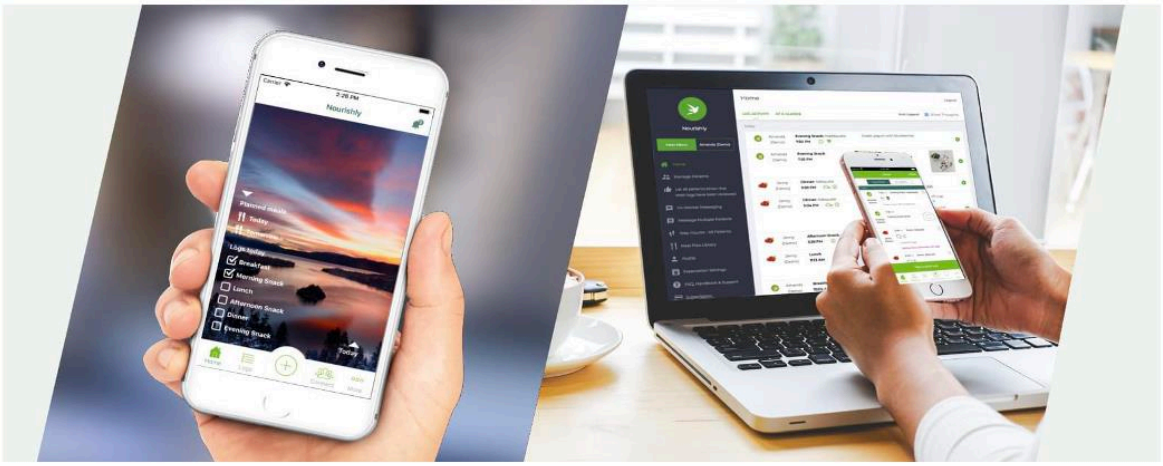
APPENDIX E

Guide for Creating Meal, Snack, & Drink Logs in Nourishly

Nourishly

Say "Hello" to the newest member of your treatment team.

Download on the App Store | Android App on Google Play



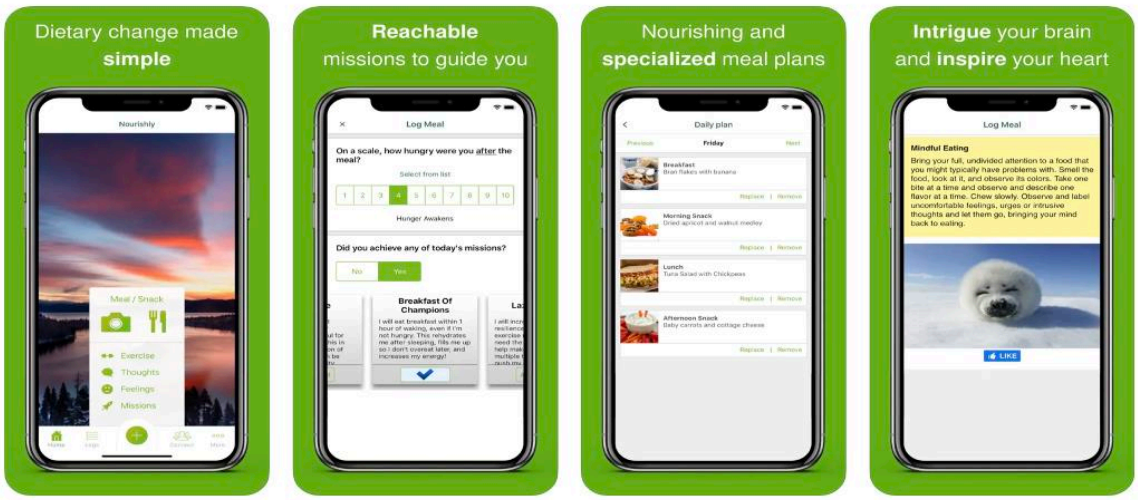
Nourishly provides a means for *nutrition management* from the privacy of your mobile device. Specialized content and tracking is available for those diagnosed with Prediabetes, Type 2 diabetes, and others.

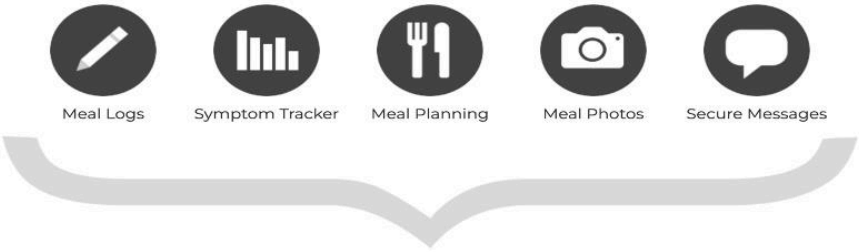
Nourishly features the ability to file meal logs, engage in a symptom tracker, conduct meal planning, take and save meal photos as well as engage with your treatment team by means of a secure messenging.

Replace paper meal monitoring and calorie-centric apps with Nourishly to see improvements in treatment engagement and the complete clinical picture.

- Easy to use — get started in minutes
- HIPAA compliant and reliable
- Evidence-based

Trusted by thousands of clinicians across multiple disciplines





Here's what Nourishly can do for you

⇒ **Track your meals**: find patterns and what is keeping you "stuck so that you can learn in the cotext of everyday life

⇒ **Link with your team**: connect with your healthcare team to keep them in the loop and receive feedback and support

⇒ **Teach you things**: Nourishly is packed with science-backed coping strategies to help you become stronger. It also promotes personal leaving and eventual internalization of new choices.

⇒ **Help you feel better**: Nourishly is committed to helping users build a healthy relationship with food and feel better their bodies

Download on the App Store

Google play

Ready to give it a go?

1 INSTALL

If you have an iPhone, Android or iPad go to the App Store and search for Nourishly Tap Install.

2 EXPLORE

Log some meals and check out the "More" section to find skills, goals and log questions that are just right for you.

3 LINK

Ready to power up? Ask your clinician for their Link Code and type it into the Clinician Connect section of your app for connected care that meets you where you are.

- HIPAA compliant to keep your information secure, even when shared with your treatment team.
- Not to be used to report emergencies. In the event of an emergency, please dial 911 or visit your nearest emergency room.
- Not a replacement for in-person communication. Your treatment team is not expected to be aware of, nor respond to, events reported in your app, except in session or as your clinician chooses.
- Here to provide information, not medical, legal or psychological advice, diagnoses, or treatment.

For questions or more information about Nourishly,please contact the Nourishly team at https://www.nourishly.com

APPENDIX F

Demographic Form

Nourishly: Improving BMI and HbA1c in overweight and obese adolescents with prediabetes and Type 2 Diabetes

Lauren Torhorst RN, BSN, DNP Student, Student Project Leader, Valparaiso University

Demographic Data Collection Form

Please fill in the blanks OR check the box that applies to you. Your answers will be recorded as anonymous.

How old are you? _____

Which gender do you most identify with? ❑Male ❑Female ❑non-Binary ❑Prefer not to answer ❑Prefer to self-describe: _____

Please select the category that best describes your race/ethnicity (check all that apply): ❑White/Caucasian ❑Black/African American ❑Asian ❑Native Hawaiian ❑Hispanic ❑American Indian ❑Alaskan Native ❑Other: _____ ❑Don't know ❑Prefer not to answer

Current diagnosis: ❑Prediabetes ❑Type 2 diabetes mellitus

Who do you consider to be your primary caregiver?
❑Mother ❑Father ❑Foster parent ❑Stepmother ❑Stepfather ❑Grandparent ❑Older sibling ❑Other: _____

APPENDIX G

Project Overview Form

Nourishly: Improving BMI and HbA1c in adolescents with prediabetes and Type 2 diabetes

Introduction: You are being invited to take part in an Evidence-Based Practice Project. The goal of an Evidence-Based Practice Project is to incorporate the best available research along with clinical experience and patient preferences, into clinical practice.

This project will study the effect of utilizing a smartphone application called Nourishly© in reducing Body Mass Index (BMI) and glycolate hemoglobin A1c (HbA1c) over a three-month time period.

What is the purpose of the project? The main reason for doing this project is to help answer the following clinical question: In adolescents aged 10-18 with a diagnosis of Prediabetes or Type 2 diabetes that are overweight or obese what is the effect of using a meal tracking smartphone application paired with individualized dietary feedback and education compared to prior non-use of any smartphone application and usual standard of care on glycolate hemoglobin A1c (HbA1C) and Body Mass Index (BMI) over a 3-month period?

What is Nourishly©? It is a meal tracking smartphone application that was created for a wide variety of patients with diverse needs including diabetes. This application utilizes picture taking capabilities to log your everyday dietary intake. Nourishly© goes beyond calorie-counting measures to enforce fundamental day-to-day behavior changes, induce personalized learning, and eventual internalization of new behaviors. The ultimate goal is for users to learn sustainable dietary habits and more.

Who can take part in the project? Participants eligible for this project must have a diagnosis of Prediabetes, Type 2 diabetes or Insulin Resistance, are between the age of 10-18 years, and have a BMI categorized as overweight or obese.

Student Project Leader: Lauren Torhorst BSN, RN
Student Project Leader Contact Information: Lauren.Torhorst@aah.org
Affiliated Academic Institution: Valparaiso University
Project Location: Aurora Pediatric Endocrinology
Project Advisor: Dr. Kristine Davis DNP, APRN, FNP-BC, FNP-C

APPENDIX H

Citi Training Certification

CITI PROGRAM

Completion Date 31-Mar-2023
Expiration Date N/A
Record ID 55133140

This is to certify that:

Lauren Torhorst

Not valid for renewal of certification through CME.

Has completed the following CITI Program course:

Social, Behavioral, and Education Sciences (RCR)
(Curriculum Group)
Social, Behavioral, and Education Sciences (RCR)
(Course Learner Group)
1 - RCR
(Stage)

Under requirements set by:

Valparaiso University

CITI
Collaborative Institutional Training Initiative

101 NE 3rd Avenue, Suite 320
Fort Lauderdale, FL 33301 US
www.citiprogram.org

Verify at www.citiprogram.org/verify/?w9e92c188-adb1-415c-b388-e9c073e0bb73-55133140

APPENDIX I

AAH HSR/IRB Determination Letter

AdvocateAuroraHealth

Research Subject
Protection Program
1020 N. 12th Street, #3120
PO Box 342, OHC #3120
Milwaukee, WI 53233-1308

T 414.219.7744
F 414.219.7477
IRBoffice@aah.org

www.aurora.org/irb

July 19, 2023

Lauren Torhorst BSN, RN for FNP, DNP

Dear Ms. Torhorst:

On July 19, 2023, the Advocate Aurora Health (AAH) RSPP received a Request for Determination of Human Subject Research (HSR) for your project entitled: *"Nourishly" - THE EFFECT OF USING A MEAL TRACKING SMARTPHONE APPLICATION IN OVERWEIGHT AND OBESE ADOLESCENTS WITH PREDIABETES OR TYPE 2 DIABETES TO IMPROVE BMI AND HbA1c.* Based on the information you provided, it is the IRB Chair's / RSPP team member's opinion that the proposed activity **does not** constitute Human Subject Research. As such, the proposed project does not require IRB oversight.

You have indicated that identifiable protected health information (PHI) is being used and/or disclosed as part of this project. Therefore, you must comply with HIPAA Privacy Rule requirements in this activity. Questions regarding HIPAA Privacy Rule requirements should be directed to the Site Privacy Officer of your location or Advocate Aurora Health's Chief Privacy Officer at 414.299.1713.

Note that IRB review is not administrative approval, and you should ensure that you have the approval of appropriate Advocate Aurora Health administrators before you conduct the project. **You should not refer to these activities as "human subject research" in any publication(s)/communication(s).**

Even if not determined to be human subject research, Advocate Aurora Research Institute (AARI) wishes to be notified of any project that is research. Some examples of this type of research are straightforward and easy to determine, e.g. analyzing de-identified tissue samples obtained from a commercial source or analyzing data from deceased individuals. It is your obligation to notify AARI of any research project conducted at AAH. For details contact AAH-Research-Authorization-and-Protocol-Review@aah.org.

Thank you for bringing your project to the attention of the Advocate Aurora Health Research Subject Protection Program. If the plan or intent of your proposal changes, you should contact the Research Subject Protection Program to determine if IRB review would be required at that time.

If you require further assistance, feel free to call the Research Subject Protection Program (414-219-7744 or 877-219-7744 toll-free outside of Milwaukee).

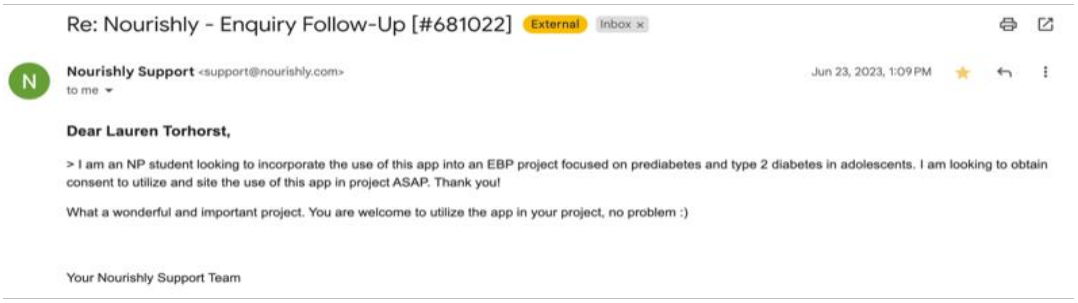
Sincerely,

Michelle Maternowski
Director, Research Subject Protection Program (RSPP)

v20220211

APPENDIX J

Nourishly© Application Permission



Re: Nourishly - Enquiry Follow-Up [#681022] External Inbox ×

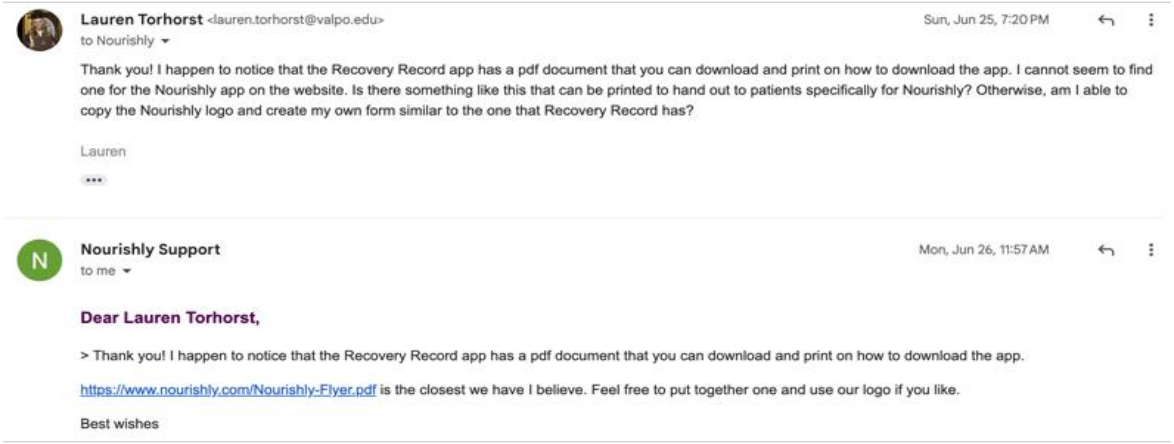
Nourishly Support <support@nourishly.com> Jun 23, 2023, 1:09 PM
to me

Dear Lauren Torhorst,

> I am an NP student looking to incorporate the use of this app into an EBP project focused on prediabetes and type 2 diabetes in adolescents. I am looking to obtain consent to utilize and site the use of this app in project ASAP. Thank you!

What a wonderful and important project. You are welcome to utilize the app in your project, no problem :)

Your Nourishly Support Team



Lauren Torhorst <lauren.torhorst@valpo.edu> Sun, Jun 25, 7:20 PM
to Nourishly

Thank you! I happen to notice that the Recovery Record app has a pdf document that you can download and print on how to download the app. I cannot seem to find one for the Nourishly app on the website. Is there something like this that can be printed to hand out to patients specifically for Nourishly? Otherwise, am I able to copy the Nourishly logo and create my own form similar to the one that Recovery Record has?

Lauren

Nourishly Support Mon, Jun 26, 11:57 AM
to me

Dear Lauren Torhorst,

> Thank you! I happen to notice that the Recovery Record app has a pdf document that you can download and print on how to download the app.

https://www.nourishly.com/Nourishly-Flyer.pdf is the closest we have I believe. Feel free to put together one and use our logo if you like.

Best wishes